M-2000C

USER MANUAL

M-2000C FLIGHT MANUAL

0 - INTRODUCTION

The following chapters describe the Mirage 2000C on-board systems and their employment.

The description sections cover the systems, control panels and indicators. The employment section describes systems procedures and settings for efficient use. Only the features implemented in DCS are covered.

You will find the check-lists at the end of the document. There will also be separate documents with larger version of the instrument layouts for your reference that you can print separately.

EFFECTIVITY

At the beginning of the flight manual you will find the list of effective changes. It points to the pages where changes in the document occurred since last release, permitting the virtual pilot to identify instantly where to look for new information without having to run through the whole document.

SOUND JUDGEMENT

These instructions provide you with a general knowledge of the aircraft, its characteristics, normal and emergency procedures. The instructions in this manual are for a crew inexperienced in this airplane and provide the best possible operating instructions under most circumstances. It is not a substitute for sound judgment. Multiple emergencies, adverse weather terrain, tactical environment etc... may require modifications to these procedures.

VERSION

The latest version of this manual is 2.0.0 (17/11/2021).

DEFINITIONS

The following definitions apply to warnings, cautions and notes found throughout the document.

WARNING	Operational procedures, techniques, etc., which may result in personal injury or loss of life if not carefully followed.
CAUTION	Operational procedures, techniques, etc., which may result in damage to equipment if not carefully followed.
NOTE	Important information to memorize.
NOT FUNCTIONAL	This feature has not been added to the module or is not yet functional.
INCORRECT	This feature is incorrectly implemented, or just not present in the real aircraft.
WORK IN PROGRESS	Indicate that this part of the manual is still being worked on.
NO FUNCTION	This command has no function in the real aircraft and is present in reserve or is a remnant of a removed functionality.
X SECTION	Interactive link to another part / chapter within the manual.

GLOSSARY

The first aircraft were destined to the French Air Force, and thus the associated documentation was written in French. Therefore, all systems designation and cockpit lettering are in French.

When an abbreviation is in French, the corresponding meaning is in italic, followed by the English translation. This is valid throughout the document. You will find the full list of abbreviations in ANNEXES SECTION.

INS: Inertial navigation system

UNI (*Unité de navigation inertielle*): Inertial navigation system.

PCA (*Poste de commande armement*): Weapon control panel.

PCR (*Poste de commande radar*): Radar control panel.

PPA (*Poste de préparation armement*): Weapons preparation panel.

PCN (*Poste de commande navigation*): Navigation control panel.

AOA: Angle-of-attack.

PSM: *Poste sélecteur de modes.* Mode selector panel.

ECM: Electronic countermeasures.

AP: Autopilot.

AAR: Air-to-air Refuelling.

QFE: Atmospheric pressure measured at the active runway threshold.

QNH: Calculated runway atmospheric pressure at medium sea level.

HOTAS: Hands on throttle and stick.

FBW: Fly-by-wire.

CDVE (*Commandes de vol electriques*): Fly-by-wire (FBW) flight controls.

RWR: Radar warning receiver.

DA (*Détecteur d'alerte*): Radar warning receiver.

AAM: Air-to-air Missile.

D^{2}M (*Détecteur de départ missile*): Missile launch warning system.

1013: Standard (STD) atmospheric pressure setting.

RDI (*Radar doppler à impulsions*): Pulse doppler radar.

Gal US: US gallons.

mph: Statute miles per Hour.

kt: Knots (Nautical miles per hour).

nm: Nautical miles.

km: Kilometers.

m: Meters.

mi: Miles.

ft/min: Feet per minute.

l: Liters.

AB: Afterburner.

PC: (*Post-Combustion*): Afterburner.

HUD: Head-up display.

VTH (*Visualisation tête haute*): Head-up display.

HDD: Head-down display.

VTB (*Visualisation tête basse*): Head-down display.

A (*Arrêt*): Off.

S.A. (*Semi-automatique*): Semi automatic.

SNA (*Systeme de navigation et d'armement*): Navigation and weapon system.

CNM (*Cannon neutre MAGIC*): Gun neutral MAGIC HOTAS command.

ACKNOWLEDGEMENTS

We would like to take a moment first to thank the following people involved on the project and who made possible the release of this aircraft.

RAZBAM TEAM

Ronald “Prowler” Zambrano – Team lead.

Tim Taylor, Metal2Mesh – 3d modeller and texturizer.

Larry “Zeus” Zambrano – Cockpit Coder.

CJ “CaptSmiley” Soques – Flight Model Coder.

KillHog – Systems rework coder.

EAGLE DYNAMICS

Alex O’kean, for all the help above and beyond.

Matt Wagner, for opening doors to us.

OTHERS

Joël L. – Data miner, beta tester and M-2000C enthusiast.

Rlaxoxo – Sound modder. For his help in getting this bird sound right.

Baltic Dragon - Campaign and training missions designer. Author of the updated manual.

Eric “Hadès” G. - author of several chapters and schematics used in the text.

C.B. (bzzz) - for proof reading the manual, pointing out (hundreds of) bugs and inconsistencies and adding a lot of really useful real - life background information.

Helljumper – Author of the update of the updated manual.

EFFECTIVE CHANGES

DATE	SECTION	VERSION	DESCRIPTION
27/01/2020	1-2	1.1.0	Updated cockpit layout photos and instrument descriptions
	1-3	1.1.0	Updated description of WSC and CNM switches in HOTAS part.
	9-2	1.1.0	Updated frequency ranges for V/UHF and UHF radios
	9-2	1.1.0	Completely re-written the part and instructions for V/UHF radio.
	10-2	1.1.0	Updated the HUD master modes part.
	10-3	1.1.0	Added triangle (magic + radar lock) to HUD symbology
	12-3	1.1.0	Changed PCN picture, updated text to remove the ENC button
	12-3	1.1.0	Changed PCN picture, updated text to remove the ENC button
	12-5	1.1.0	Added description of new waypoint increase / decrease buttons
	13-1	1.1.0	New contact symbols heading added
	13-1	1.1.0	Added information about RDI target identification capabilities
	13-1	1.1.0	Added information about HUD FLOOD combat mode
	13-2	1.1.0	Updated RWR codes
	13-2	1.1.0	Added Spirale Box description, table of programs and description of modes.
	14-2	1.1.0	Updated description of interior cockpit lighting knobs
	14-3	1.1.0	Added whole new section on NVGs
	15-2	1.1.0	Updates to Weapons Management section to include new functions
	15-3	1.1.0	Updates to section about the use of Magic 2 missiles
	15-3	1.1.0	Added Spiral Hud Scan description
	19-1	1.1.0	Added full list of French abbreviations and their English meanings.
	ALL	1.1.0	Fixed typos and updated text in almost all section
28/03/2020	10-3 15-3	1.1.1	Added MAV search patterns
17/11/2021	ALL	2.0.0	Total rework of the manual

1 - AIRCRAFT

1 – 1 - GENERAL INFORMATION

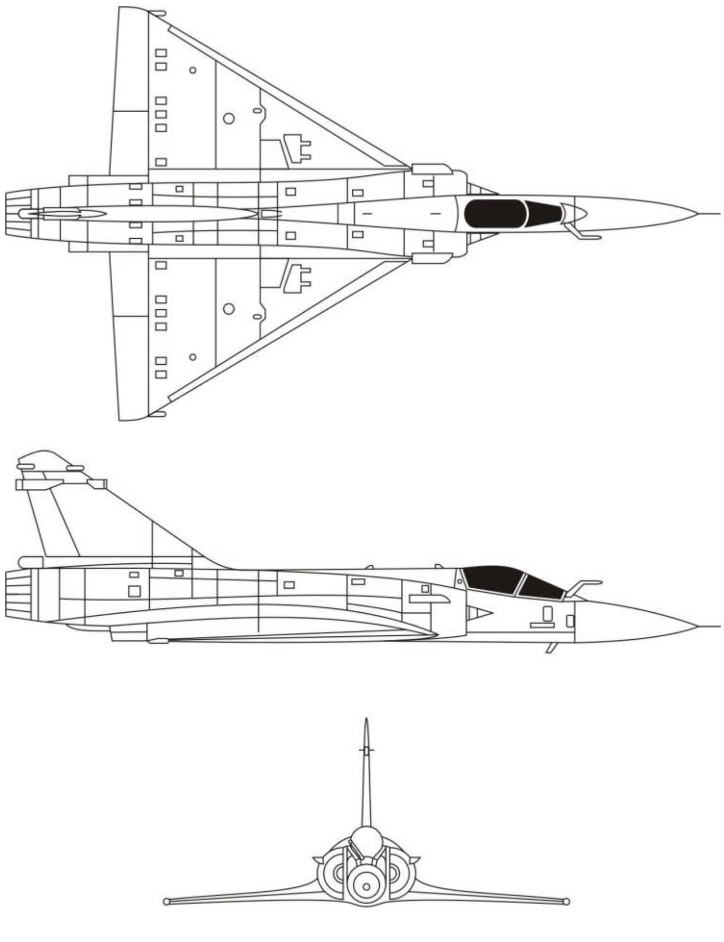
BASIC INFORMATION

The M-2000C is a fourth generation, single-seat, single-engine supersonic jet fighter aircraft. It is primarily a medium-range interceptor, but has limited secondary air-to-ground capability.

It has a delta-shaped wing, with 2-part leading edge slats and elevons on the trailing edge. These elevons act at the same time as elevators and ailerons.

Aircraft control is performed by means of a fly-by-wire system.

Air to air refueling capability is provided via a removable probe on the right side of the windshield. It is compatible with drogue type tankers such as the KC-130, KC-135 MPRS, S-3B and IL-78M.



M-2000C

POWER PLANT

Power is supplied by one SNECMA M53-P2 dual flow turbofan engine with afterburner on both flows.

THRUST Dry thrust: 64.3 kN (14,500 lbf).
Thrust with afterburner: 95.1 kN (21,400 lbf).

PERFORMANCES

SPEED Mach 2.2 (2,530+ km/h, 1,500+ mph) at high altitude.
Mach 1 (1,110 km/h, 690 mph) at low altitude.

RANGE 1,550 km (837 NM, 963 mi) with drop tanks.

CEILING 17,060 m (59,000 ft).

AIRCRAFT DIMENSIONS AND WEIGHT

WINGSPAN 9.13 m (29 ft).

LENGTH 14.36 m (47 ft 1 in) (14.66 m with air data probe on the nose)

HEIGHT 5.20 m (17 ft).

WEIGHT Empty weight: 7 600 kg (16,750 lb)
Loaded weight: 13 800 kg (30,420 lb)
Maximum takeoff weight: 16 500 kg (36,400 lb)

WEAPONS

PYLONS 4 wing pylons, 4 lateral fuselage pylons and 1 center fuselage pylon

ARMAMENT 2×30 mm (1.18 in) DEFA 554 revolver cannon, 125 rounds per gun

Matra R550 Magic-II infrared homing missiles

Matra Super 530D semi-active radar guided missiles.

Matra 68 mm unguided rocket pods, 18 rockets per pod.

Mk-82 general purpose 250 kg bombs

Mk-82Snakeye high drag 250 kg bombs

Mk-82Air high drag 250 kg bombs

BLG-66 "Beluga" cluster bombs

BAP-100 anti-runway bombs

GBU-12 250 kg (500 lb) laser guided bombs

GBU-16 500 kg (1,000 lb) laser guided bombs

GBU-24 1 000 kg (2,000 lb) laser guided bombs

OTHER Under-wing tanks, Fuselage centreline tank

Countermeasure suite with chaff, flares and radar jammer

HISTORY

The M-2000C is a French single engine fourth generation fighter. Designed in the late 1970s as a lightweight fighter for the French Air Force (Armée de l'Air). Later evolved into a multirole aircraft with several variants developed, with sales to a number of nations. Over 600 aircraft were built and it has been in service with nine nations.

The M-2000 was initially intended to replace the previous generation Mirage III for the export market, and was smaller and cheaper than the aircraft proposed to the French Air Force, called the Avion de Combat Futur ACF (Futur Combat Aircraft). The project was first known as the "Super Mirage III", then "Delta 1000", "Delta 2000", "Super Mirage 2000" to finally settle for "Mirage 2000".

Unlike the ACF, which was a strike aircraft with secondary capabilities as interceptor, the M-2000C was designed as an interceptor. When the ACF project was cancelled, the M-2000C was offered as a cheaper alternative to the French government and was approved on December 1978.

The M-2000C was also designed to compete with the General Dynamics F-16 in the lucrative European market, which was interested in small, but agile, lightweight fighters.

The M-2000C features a low-set thin delta wing with cambered section, 58 degrees leading-edge sweep and moderately blended root. The flight surfaces on the wings are composed of 4 elevons and 4 leading edge slats. Its center of lift is in front of its center of gravity, giving the fighter relaxed stability to enhance maneuverability. It incorporates fly-by-wire controls with 4 analog computers and a fifth, ultimate back-up one. Airbrakes are fitted above and below each wing in an arrangement very similar to that of the Mirage III and IV. A noticeably taller tailfin allows the pilot to retain control at higher angles of attack, assisted by the small strakes mounted along each air intake.

The aircraft uses retractable tricycle type landing gear. A runway tailhook or a fairing for a brake parachute can be fitted under the tail, which can operate in conjunction with the landing gear's carbon brakes to shorten landing distances. A removable refueling probe can be attached in front of the cockpit, offset slightly to the right of center.

COCKPIT

The Mirage 2000 is available as a single-seat or two-seat multi-role fighter. The pilot flies the aircraft by means of a center stick and left side throttle, with both incorporating hands-on-throttle-and-stick (HOTAS) controls. The pilot sits on a license-built version of the British Martin-Baker Mark 10 zero-zero ejection seat.

The instrument panel is dominated by the head-up display which presents data relating to flight control, navigation, target engagement and weapon firing, and the radar screen (or head - down display) located centrally below it. To the lower left is a stores management panel, above which are the flight instruments. The right half of the instrument panel accommodates the navigation, engine and systems displays. Located on the left side of the cockpit, just ahead of the throttle, are controls for the communications equipment.

ENGINE

The SNECMA M53 afterburning turbofan was developed for the ACF, and was available for the M-2000C project. The first 37 aircraft were equipped with the SNECMA M53-5 engine version; later aircraft were equipped with the more powerful SNECMA M53-P2 version. The M53-P2 provides 64.3 kilonewtons (14,500 lbf) of thrust dry and 95.1 kilonewtons (21,400 lbf) in afterburner. The air intakes are fitted with an adjustable half-inlet cone-shaped center body (named *souris* - mouse - in French), which provides an inclined shock of air pressure for highly efficient air intake. Total internal fuel capacity is 3,978 liters (1,051 US gal). There are also provisions for a jettisonable 1,300-litre (340 US gal) centerline fuselage fuel tank and for a 1,700-litre (450 US gal) or 2,000-litre (528 US gal) drop tank under each wing.

PAYLOAD AND ARMAMENTS

The M-2000C is equipped with built-in twin DEFA 554 30 mm revolver-type cannons with 125 rounds each. The cannons have selectable fire rates of 1,200 or 1,800 rounds per minute.

The aircraft can carry up to 6.3 tons (13,900 lb) of stores on 9 pylons, with 2 pylons on each wing and five under the fuselage. External stores can include Matra Super 530D medium-range semi-active radar-guided air-to-air missile on the inboard wing, and Matra Magic II short-range infrared-seeking AAM on either wing pylons.

SENSORS AND AVIONICS

Avionics for the M-2000C include the Sagem ULISS 52 inertial navigation system (INS), TRT radio altimeter, Dassault Electronique Type 2084 central digital computer, Digibus digital data bus and Sextant Avionique Type 90 air data computer. The communication equipment package includes the LMT NRAI-7C IFF transponder, IO-300-A marker beacon receiver, TRT ERA 7000 V/UHF com transceiver, TRT ERA 7200 UHF or EAS secure voice communications.

The aircraft has a redundant fly-by-wire automatic flight control system, providing a high degree of agility and easier handling, together with stability and precise control in all situations. The fighter's airframe is naturally unstable, and so it is coupled with FBW commands to obtain the best agility; however, in override mode it is still possible to exceed a 270 deg/sec roll rate and allows the aircraft to reach 11 g (within the 12 g structural limit), instead of 9 g when engaged.

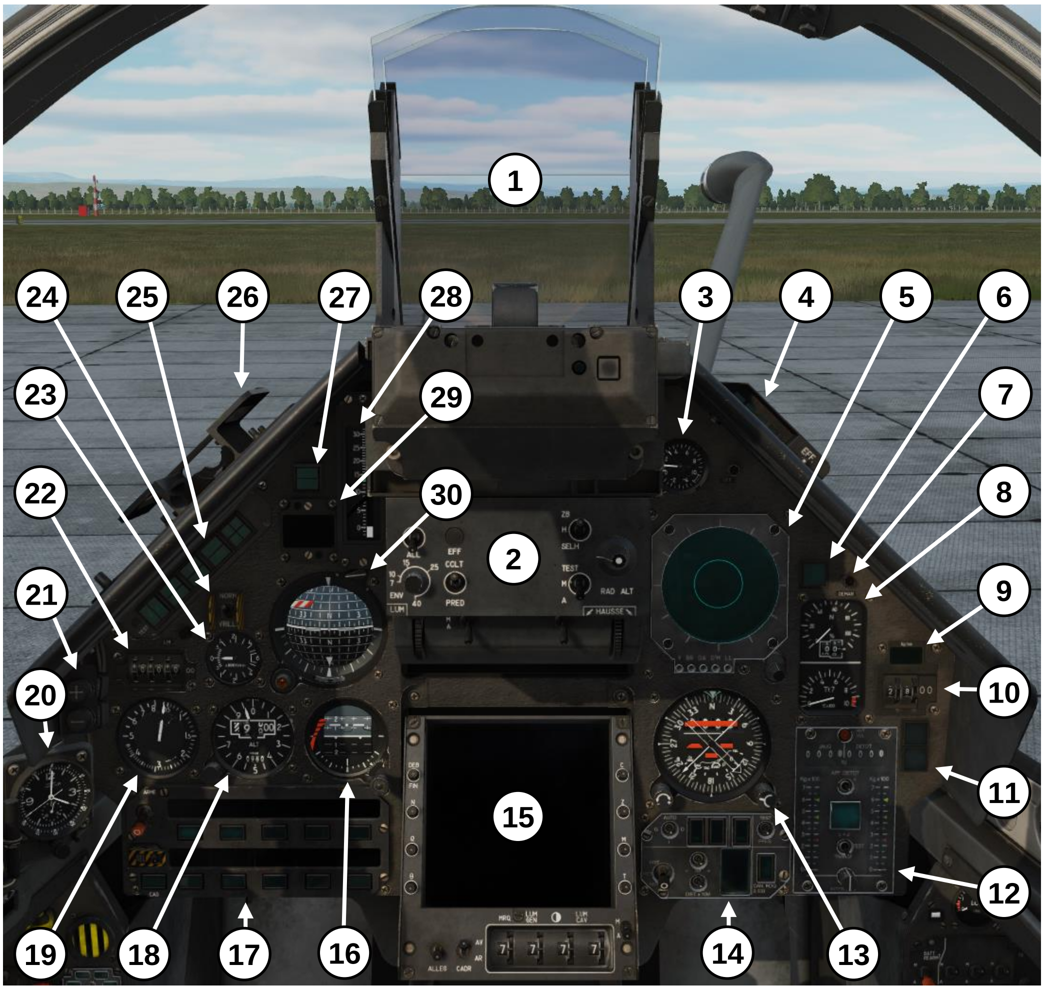
The aircraft uses the RDI pulse-Doppler radar with an operating range of 54 nm (100 km / 62 miles). This unit is a new development, the first French HFR radar, specialized for air-to-air duties and the first to provide serious look-down/shoot-down capabilities.

The M-2000C is equipped with SERVAL radar warning receiver (RWR) with antennas on the wingtips and on the rear of the top of the tail fin. It is also equipped with the SABRE radar jamming and deception system in a pod below the bottom of the tail fin, with the antenna in a fairing on the front of the tail fin. Countermeasures are provided by Spirale dispensers, each fitted on the extensions behind the rear of each wing root, giving a total capacity of 112 chaff cartridges, the flares dispensers are located under the wing roots with a total of 16 cartridges.

An additional ECLAIR pod can be mounted under the rear fuselage, providing a bigger countermeasure payload at the expense of the brake chute or hook.

1 – 2 - Cockpit layout

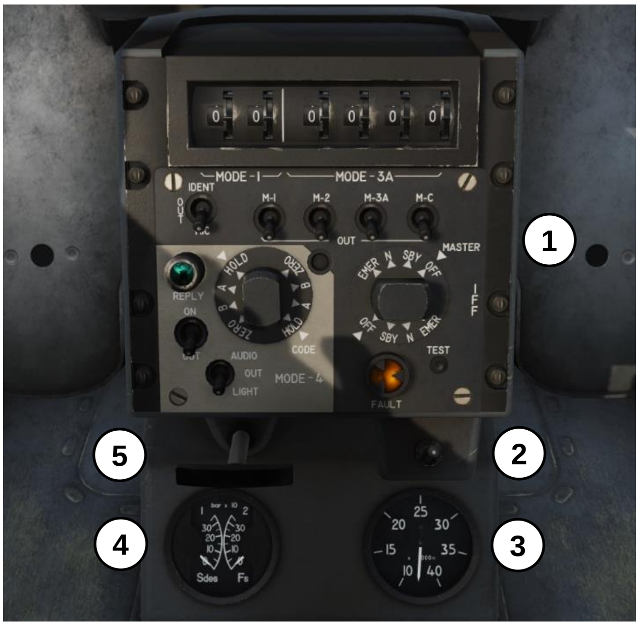
Front Dash



1. Head-up display (VTH – *Visualisation tête haute*): Reflective glass displaying navigation and weapon employment information.
2. VTH control panel (PCTH – *Poste de commande tête haute*): Sets VTH operation and parameters.
3. Accelerometer (*Accéléromètre*): Indicates current load factor.
4. Decoy launcher indicator panel (*Tableau de signalisation lance-leurre*): Indicates the status of the decoy launcher system.
5. Countermeasure display (VCM - *Visualisation contre-mesures*): Displays radar signals and countermeasure system status.
6. After burner light (*Voyant post-combustion*): Indicates that the engine after-burner is activated.
7. Engine start light (*Voyant démarrage*): Indicates that the engine is starting up.
8. Engine RPM and temperature indicator (*Indicateur N-Tt7*): Indicates the engine RPM and temperature.

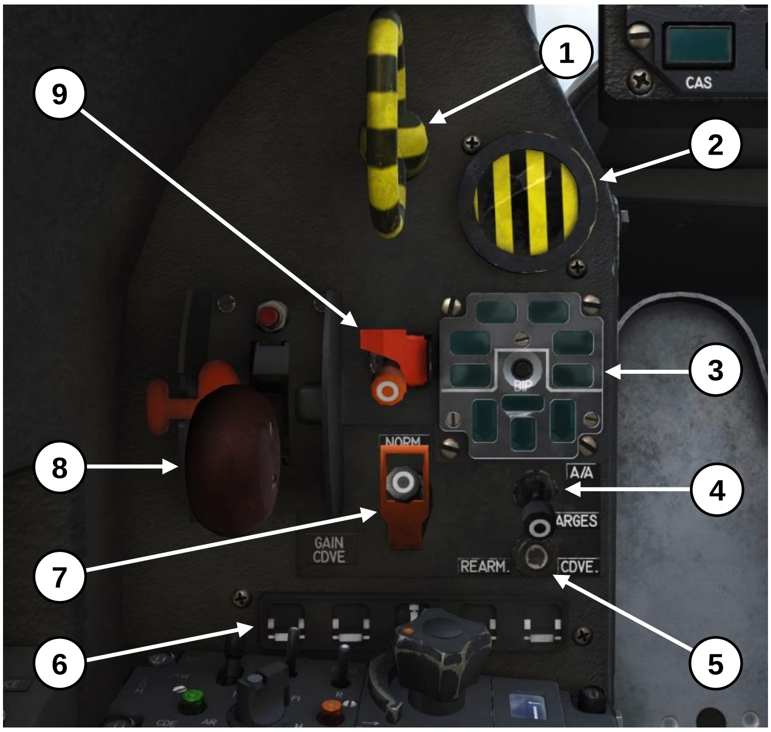
9. FUEL FLOW INDICATOR (*Indicateur de débit instantané*): Indicates the engine current fuel flow to the engine.
10. BINGO SELECTOR (*Afficheur BINGO*): Sets the aircraft BINGO.
11. ENGINE FIRE LIGHTS (*Voyant feu double*): Indicates an engine overtemp or fire.
12. FUEL CONTROL PANEL (*Tableau de contrôle carburant*): Displays and controls the aircraft fuel.
13. NAVIGATION INDICATOR (IDN – *Indicateur de navigation*): Main navigation instrument.
14. WEAPON PREPARATION PANEL (PPA – *Poste de préparation armement*): Allows weapon delivery configuration.
15. HEADS DOWN DISPLAY (VTB – *Visualisation tête basse*): Displays the radar and aircraft loadout.
16. BACKUP ATTITUDE INDICATOR (*Horizon de secours*): Backup attitude indicator.
17. WEAPON CONTROL PANEL (PCA – *Poste de commande armement*): Selects NAV modes, weapons, weapon modes and parameters.
18. ALTIMETER (*Altimètre*): Displays the current altitude in feet.
19. ANEMOMACHMETER (*Anémomachmètre*): Analogue instrument displaying the aircraft airspeed in knots and mach.
20. ONBOARD CHRONOGRAPH (*Chronographe de bord*): Analogue clock with chronometer.
21. DEST BUT INCREMENT/DECREMENT BUTTONS (boutons d'incrémentation/ décrémentation BUT de DEST): Increments or decrements the DEST BUT.
22. ALTITUDE SELECTOR (*Boitier d'affichage d'altitude*): Sets the auto-pilot selected altitude.
23. VERTICAL VELOCITY INDICATOR (*Variomètre*): Indicates the current vertical velocity in feet per minutes.
24. SPIN SWITCH (*Inverseur VRILLE*): Switches the aircraft's FBW in VRILLE mode to allow spin recovery.
25. AUTO-PILOT CONTROL PANEL (*Poste de commande pilote automatique*): Selects auto-pilot modes.
26. NIGHT VISION GOGGLES MOUNT (*Support repos JVN*): Holds the night vision goggles.
27. FAULT INDICATOR BUTTON (*Voyant-poussoir répétiteur de PANNE*): Lit-up to indicate a caution or a warning and allows their acknowledgment.
28. ANGLE OF ATTACK INDICATOR (*Indicateur d'incidence*): Indicates current angle of attack.
29. V/UHF FREQUENCY REPEATER (*Répétiteur de fréquence V/UHF*): Displays current V/UHF frequencies.
30. MAIN ATTITUDE INDICATOR (IS - *Indicateur sphérique*): Provides current attitude and bearing information as well as ILS guidance.

CENTER PYLON



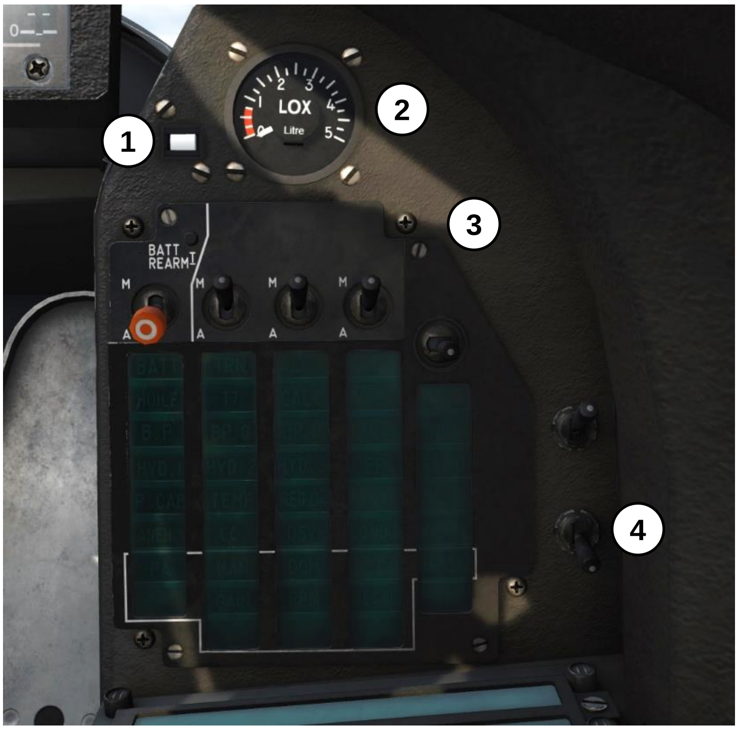
1. IFF TRANSPONDER (*Répondeur IFF*): IFF transponder configuration panel.
2. HYDRAULIC PRESSURE SELECTOR (*Inverseur sélection de pressions hydrauliques*): NOT FUNCTIONAL.
3. COCKPIT ALTIMETER (*Altimètre cabine*): Indicates the altitude equivalent to the atmospheric pressure inside the cockpit.
4. HYDRAULIC PRESSURE INDICATOR (*Indicateur double de pressions hydrauliques*): Indicates pressure of the different hydraulic systems.
5. RUDDER PEDALS ADJUSTMENT LEVER (*Commande réglage pédalier*): Used to adjust the rudder pedals position.

LEFT VERTICAL PANEL



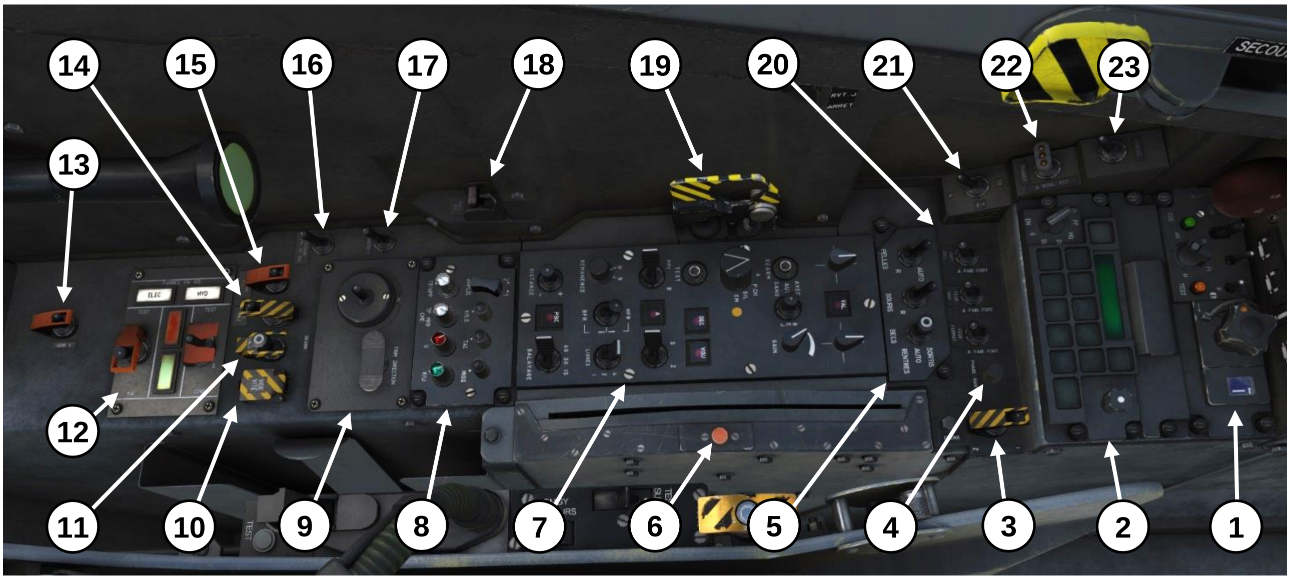
1. EMERGENCY GEAR HANDLE (*Poignée secours train*): Deploys the landing gear by the emergency system.
2. EMERGENCY JETTISON BUTTON (*Poussoir de largage détresse*): Triggers the emergency jettison procedure.
3. LANDING CONFIGURATION PANEL (*Tableau de configuration*): Displays the status of the landing related systems.
4. FBW MODE SWITCH (*Inverseur Air-Air/charges*): Selects the FBW mode.
5. FBW REARM BUTTON (*Poussoir de réarmement CDVE*): Rearms the FBW system.
6. CONTROL SURFACES POSITION INDICATOR (Indicateur de position gouvernes): Indicates the position of the elevons and rudder.
7. EMERGENCY FBW GAIN SWITCH (*Interrupteur GAIN CDVE*): Selects the emergency BFW gain mode.
8. GEAR HANDLE (*Commutateur de commande de train*): Sets the landing gear position.
9. GUN SAFETY SWITCH (*Interupteur sécurité canon*): Arms the guns.

RIGHT VERTICAL PANEL



1. O2 BLINKER (*Blinker O2*): Indicates oxygen mask flow.
2. O2 INDICATOR (*Indicateur O2*): Indicates O2 level.
3. ALARM PANEL (*Tableau d'alarmes*): Displays all the aircraft warning lights and hosts the electrical switches.
4. QRA SWITCH (*Inverseur réseau alerte*): Sets the aircraft in QRA mode.

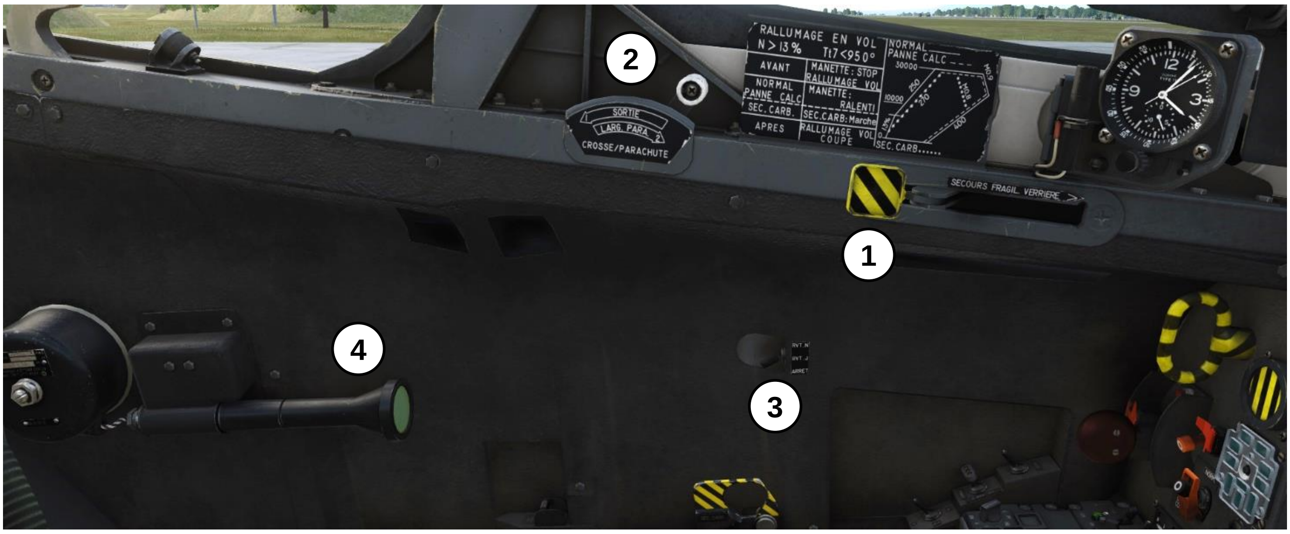
LEFT CONSOLE



1. UHF RADIO COMMAND PANEL (*Boite de commande UHF*): Configures the UHF (red) radio.
2. V/UHF RADIO COMMAND PANEL (*Boite de commande V/UHF HAVE QUICK*): Configures the V/UHF (green) radio.
3. BRAKE SYSTEM SWITCH (*Inverseur FREINS 1-2*): Selects which brake system to use.
4. REFUELING LIGHT LUMINOSITY ROTATOR (*Potentiomètre réglage luminositée phare ravitaillement*): Sets the refueling light luminosity. **NOT FUNCTIONAL**
5. SCOOPS/INLET CONES/SLATS CONTROL PANEL (*Poste de commande PELLES/SOURIS/ BECS*): Selects the operation mode for the scoops, inlet cones and slats aerodynamic devices.
6. ENGINE CUTOFF BUTTON (*Interupteur arrêt moteur*): Allows the throttle to go in the engine cutoff position.
7. RADAR CONTROL PANEL (PCR - *Poste de commande radar*): Controls de radar operation.
8. AIRCRAFT SOUND CONFIGURATION PANEL (*SIB – Système d'intercommunication de bord*): Sets the different aircraft sound levels.
9. EMERGENCY TRIM PANEL (*Boitier trims secours*): Sets the emergency trim.
10. EXTERNAL TANKS FUEL DUMP BUTTON (*Poussoir vide-vite réservoirs larguables*): Activates the external tank fuel dump.
11. ENGINE COMPUTER RE-ARMING AND EMERGENCY SWITCH (*Inverseur secours et réarmement calculateur*): Sets the engine computer in emergency mode.
12. FBW AND AP TEST PANEL (*Boitier de commande test CDVE et PA*): Starts and visualize the results of the FBW and AP tests.
13. FBW CHANNEL 5 SWITCH (*Interupteur chaine 5 CDVE*): **NOT FUNCTIONAL**.

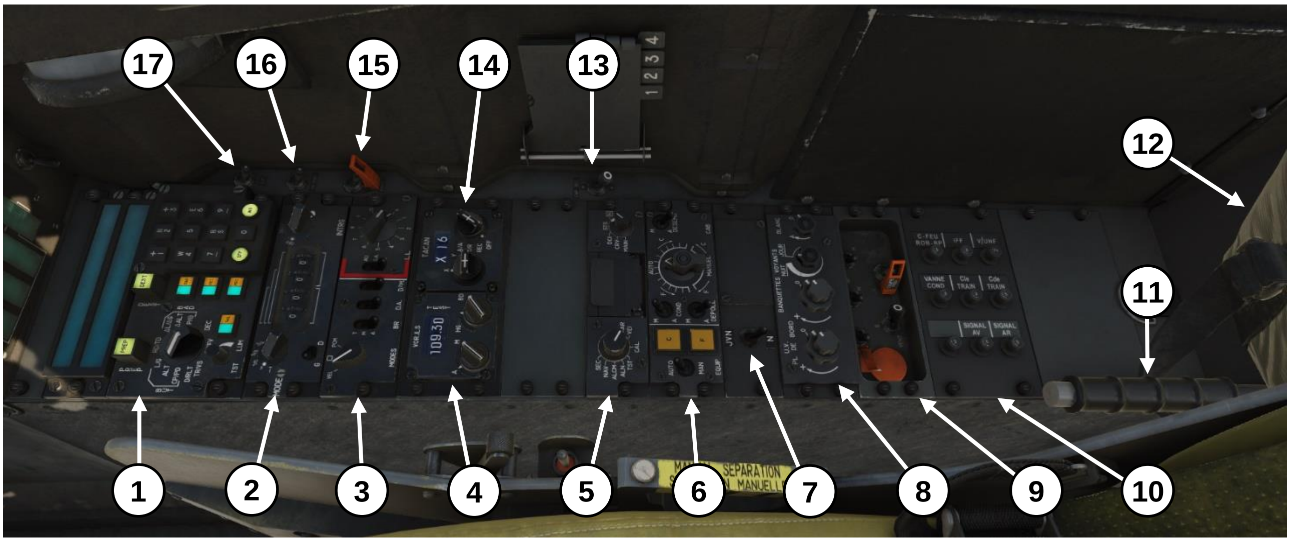
14. EMERGENCY OIL SWITCH (*Inverseur secours d'huile*): Activates the engine emergency oil.
15. EMERGENCY AFTERBURNER CUTOFF SWITCH (*Inverseur coupure secours PC*): Disables the afterburner.
16. RADAR GROUND EMISSION SWITCH (*Inverseur magnétique émission radar au sol*): Allows radar emission while the aircraft has weight on wheels.
17. TAPE RECORDER SWITCH (*Interupteur magnétophone*): **NO FUNCTION**
18. INFLIGHT RESTART MAGNETIC SWITCH (*Inverseur magnétique de rallumage en vol*): Starts the engine inflight restart procedure.
19. EMERGENCY FUEL THROTTLE AND SWITCH (*Inverseur et manipulateur secours carburant*): Turns on and uses the emergency fuel throttle system.
20. EXTERNAL LIGHTS SWITCHES (*Sélecteur feux externes*): Turns on or off the 3 aircraft external lights.
21. RECORDER SWITCH (*Inverseur AMM SERPAM*): Turns on and select the mode of the flight recorder. **NOT FUNCTIONAL**
22. LANDING AND TAXI LIGHT SWITCH (*Sélecteur phare d'atterissage et de roulage*): Toggles the landing light mode.
23. POLICE LIGHT SWITCH (*Interupteur phare de police*): Toggles the Police light activation.

LEFT WALL



1. CANOPY FRACTURE LEVER (*Commande fragilisation verrière*): Detonates the canopy fracture cords.
2. BRAKE CHUTE LEVER (*Commande parachute frein*): Deploys and jettison the brake chute.
3. INFLIGHT REFUELING SWITCH (*Inverseur commande ravitaillement en vol*): Sets the inflight refueling mode.
4. COCKPIT FLASHLIGHT (*Baladeuse*): Cockpit flash light, directly connected to the battery.

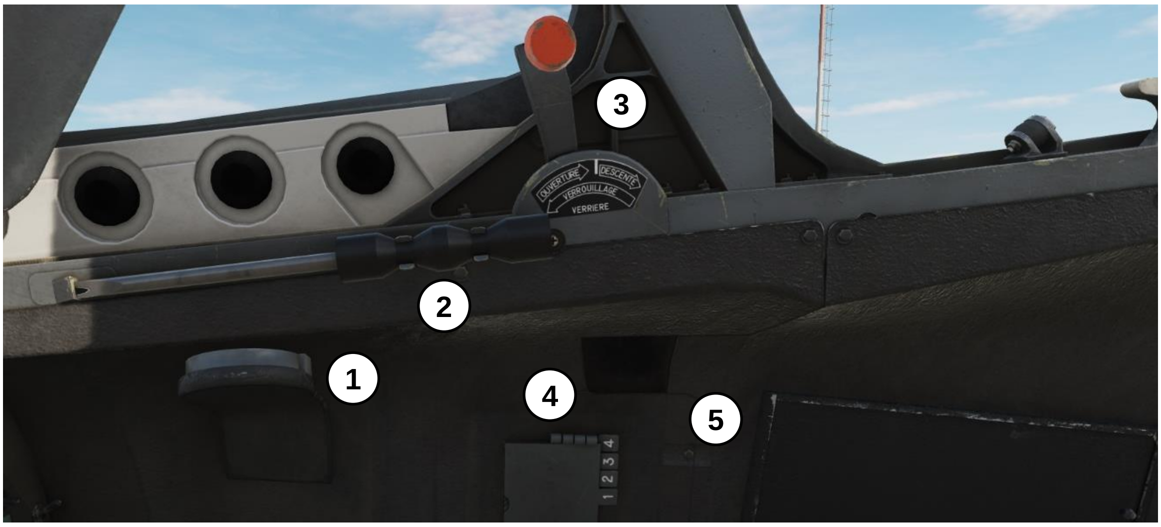
RIGHT CONSOLE



1. NAVIGATION CONTROL PANEL (PCN – *Poste commande navigation*): Displays and inputs information for the INS.
2. IFF INTERROGATOR PANEL (*Poste de commande interrogateur décodeur IFF*): Configures the radar IFF interrogator system.
3. COUNTERMEASURE PANEL (PCCM - *Poste de commande contre-mesure*): Configures the countermeasure system.
4. VOR/ILS CONFIGURATION PANEL (*Boite de commande VOR/ILS*): Configures the VOR and ILS system.
5. NAVIGATION CONFIGURATION PANEL (PSM – *Poste sélecteur de modes*): Sets the INS operational modes.
6. ENVIRONNENT CONTROL PANEL (*Boite de commande conditionnement*): Sets the cockpit environnemental conditions.
7. NVG SWITCH (*Inverseur JVN*): Sets the cockpit light to NVG compatible.
8. INTEROR LIGHTS PANEL (*Boite de commande éclairage*): Configures the cockpit lighting.
9. STARTUP PANEL (*Poste de commande démarrage*): Hosts the fuel pumps and startup switches and buttons.
10. FUSE PANEL (*Boitier disjoncteurs*): Hosts the aircraft fuses. NOT FUNCTIONAL
11. PARKING BRAKE HANDLE (*Manette de freinage parking*): Sets the parking brake.
12. NVG BAG (*Housse JVN*): Hosts the NVG goggles.
13. EMERGENCY ATTITUDE AND HEADING SWITCH (*Sélecteur cap-horizon secours*): Sets the emergency attitude and heading operational mode.
14. TACAN CONFIGURATION PANEL (*Boite de commande TACAN*): Configures the TACAN system.

15. PITOT HEAT SWITCH (*Interrupteur réchauffage anémo-indicence*): Enables the pitot heat system.
16. WARNING SOUND SWITCH (*Interrupteur avertisseur sonore*): Enables the audio warnings.
17. ELECTRIC PUMP SWITCH (*Inverseur commande éléctro-pompe*): Sets the emergency electric pump operation.

RIGHT WALL



1. EMERGENCY COMPAS (*Compas de secours escamotable*): Indicates the magnetic north.
2. LIFEBUOY PUNCHER (*Crève dinghy*): Tool that allow the puncture of the seat lifebuoy if it were to inflate inflight. **NOT FUNCTIONAL**
3. CANOPY LEVER (*Commande verrière*): Secures the canopy.
4. FREQUENCY BOOKLET (*Livret de fréquences*): Hosts important frequencies and corresponding presets for the radios. **NOT FUNCTIONAL**
5. MAP HOLDER (*Porte-cartes*): Holds mission related maps. **NOT FUNCTIONAL**

SEAT

1. OXYGEN CONTROL PANEL (*Poste de gestion oxygène*): Sets the pilots oxygen consumption.
2. EJECTION HANDLE (*Poignée d'éjection*): Starts the ejection sequence.
3. SEAT HEIGHT SWITCH (*Inverseur de hauteur du siège*): Sets the seat height.

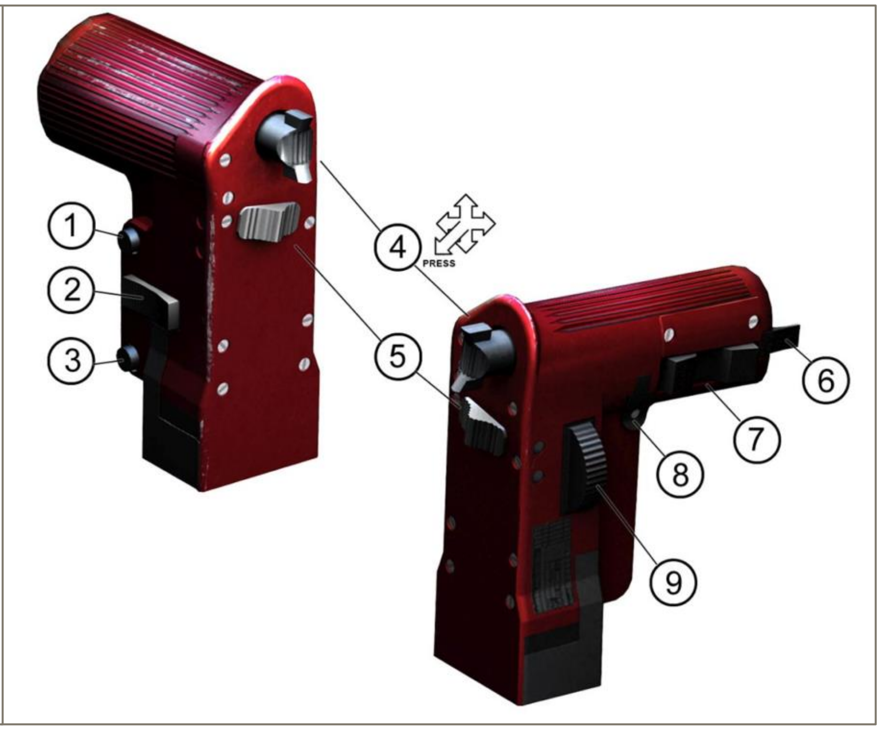
CANOPY

1. CANOPY HANDLES (*Poignées ouverture verrière*): Used to open and close the canopy.
2. HALF-OPENING HANDLE (*Poignée entrebailleur*): Used to keep the canopy half opened.
3. REAR VIEW MIRROR (*Rétroviseur de contrôle*): Mostly used to check for wingman position.

1 – 3 - HANDS ON THROTTLE AND STICK SYSTEM

The M-2000C has an integral HOTAS system that allows the pilot to control multiple functions without having to let go of the flight stick and/or throttle. Some controls will have multiple function depending on the SNA mode and weapon selection.

STICK AND THROTTLE CONTROLS



CONTROL STICK

No.	Control name	Description	Command name	Default key
1	TRIGGER SAFETY INDICATOR *Sécuritée détente*	When visible, the trigger is activated to fire weapons. Automatically set in accordance with the master arm switch.	Not applicable	Not applicable
2	MAGIC SEARCH / VERTICAL FIX *Recherche MAGIC / Recallage vertical*	Depending on the selected navigation or attack mode: • INS position update by overflying a ground reference point. • MAGIC unlock and return to search mode. • Switching between MAGIC scan modes.	Nav Update/Magic unlock	None
3	TRIM CONTROL *Manipulateur trim*	Trims the aircraft in roll and pitch. When the autopilot is engaged, it is used to control the commanded heading and pitch attitude. For more information please refer to AUTOPILOT section.	Trim DOWN Trim LEFT Trim RIGHT Trim UP	RCtrl + W RCtrl + A RCtrl + D RCtrl + S
4	COUNTERMEASURE SWITCH *Leurrage manuel*	Activates the selected countermeasure program on the PCCM. For more information see the COUNTERMEASURES section.	Decoy Program release	Delete
5	WEAPONS SYSTEM COMMAND *Commande temps reél SNA*	Depending on the selected weapon: • SNA in air-to-ground: Switches between the different sub-modes. • SNA in navigation or air-to-air: Selects the different radar auto-acquisition modes.	Weapons SystemCMD FWD Weapons SystemCMD Depress Weapons SystemCMD AFT	None None None
6	MICROB TRIGGER *Détente de tir MiCRoB*	2 stages trigger: • First stage: Activates the gun cam and the virtual tracers in air-to-air gun mode. • Second stage: Releases the selected weapon. MiCRoB means “missiles, guns, rockets, bombs” (*Missiles, canons, roquettes, bombes*)	MiCRoB/Trigger 1st Stage MiCRoB/Trigger 2nd Stage	None Space
7	AP STANDBY PADDLE *Palette débrayage PA*	Sets the autopilot in standby when engaged, allowing the pilot the control the aircraft. The autopilot will resume as soon as the paddle is released.	Autopilot Standby Mode	LAlt + A
8	PSIC TOGGLE *Fonction PSIC*	Toggles between PSIC and PSID locks.	STT/TWS Toggle	Enter

9	MWS / IFF INTERROGATOR *DIRAV-sol / IFF-vol*	Depending on the gear position: • Gear down: Toggles the NWS (DIRAV). • Gear up: Starts a radar IFF interrogation.	Nosewheel Steering/IFF Interrogate	S
10	AP DISCONNECT TRIGGER *Gâchette de déconnexion PA*	Depending on whether the autopilot is connected: • Connected: Disables all autopilot modes. • Disconnected: Allows the stick to exceed the elastic limit. The ability to exceed the elastic limit using this command is a DCS feature implemented as a way to simulate the elastic and mechanical stops for the stick.	Autopilot Disconnect/Exceed Elastic Limit	LShift + A

THROTTLE

No.	Control name	Description	Command name	Default key
1	JAMMER TOGGLE SWITCH *Inverseur PR/PCM*	Toggles the jammer emission.	Jammer ACTIVATE/Standby Toggle	E
2	RADIO SELECTION SWITCH *Sélecteur alternat radio*	2 “Push to talk” buttons for transmission both radios.	V/UHF GREEN Radio PTT UHF RED Radio PTT	None None
3	PANIC PUSH BUTTON *Leurrage semi-automatique*	Releases the emergency countermeasure program.	Decoy PANIC release	Insert
4	RADAR DESIGNATOR JOYSTICK *Manipulateur alidade / accrochage radar*	Controls the movements of the radar TDC as well as target designation.	TDC DOWN TDC LEFT TDC RIGHT TDC UP	. , / ;
5	AIRBRAKES CONTROL *Manipulateur aérofreins*	This 3 positions switch with the following functions: • Aft: Extends the A/B; spring-loaded position. • Middle: Retracts the A/B; stable position. • Forward: Extends the A/B; stable position.	Airbrake TOGGLE Airbrake ON Airbrake OFF	B LShift + B LCtrl + B
6	POLICE LIGHT SWITCH *Commande phare de police*	Toggles the police identification light.	Police Light Toggle	None
7	CNM SWITCH *Sélecteur armement CNM*	Allows MAGIC or air-to-air gun selection by overriding the PCA selection.	CNM AA Gun CNM Neutral (PCA select) CNM MAGIC	C None None

8	WEAPON SYSTEM PADDLE *Palette SNA*	Depending on the VTH mode and weapon selection: • APP: Hides the ILS symbology. • OBL: Designates the surface feature for the radar fix. • MAG or MAV selected: Slaves the MAGICs to the radar or the radar to the MAGICs.	Magic Slave/AG Designate/INS Position Update	None
9	ANTENNA ELEVATION CONTROL *Manipulateur calage antenne*	This 2 button wheel adjusts the radar antenna elevation.	Radar Antenna UP Radar antenna DOWN	None None

2 - ENGINE

2 – 1 - Engine Information

Introduction

The M-2000C uses the SNECMA M53-P2, afterburning turbofan engine. The M53 is single shaft driving both the turbofan and compressor. The M53 is relatively older in design in comparison to the newer engine design of the same generation, it retains very desirable traits for military use. This can cut maintenance and cost for service and reliability.

The single spool design of the turbofan engine has its draw backs. When one compressor section stalls on a single-spool fan, it directly effects the entire spool. With the two-spool engine, if the one compressor stalls, the remaining compressor and turbine continue to function independently, maintaining partial thrust, making it easier to get the stalled compressor working again, without having to rely on "wind milling" for engine to start.

The M53 is the only known single-spool turbofan extant as of 2013, while SNECMA transitioned to a more conventional two-spool design such as the M88.

General Characteristics

Type	Afterburning single-shaft turbofan
Length	5,070 mm (199.60 in)
Diameter	796 mm (31.33 in) inlet
Dry weight	1,515 kg (3,340 lb)
Compressor	8-stage axial compressor
Combustors	Annular
Turbine	2-stage axial turbine
Dry thrust	64.7 kN (6,600 kgp / 14,500 lbf)
Afterburning thrust	95.1 kN (9,700 kgp / 21,400 lbf)

2 – 2 - ENGINE CONTROLS

INTRODUCTION

The M53-P2 is controlled by a throttle, located on the left cockpit console, featuring a red lever in the center of the throttle quadrant. The throttle sends pilot's orders to an electronic regulation system (named CALC for *calculateur* - (engine) computer) providing a care-free handling of the engine for the crew.

The CALC manages engine RPMs (including high T7 temperature, low and high RPMs safeties), nozzle position and afterburner use.

The CALC also features an emergency mode, named SEC CALC which translates to "Emergency (engine) Computer", in case of failure of the main engine computer.

Switching engine control to SEC CALC may be automatically triggered when the main CALC built-in-test detects its own failure; it may also be triggered by the pilot through the CALC 3-position switch:

- Middle position (stable) = normal CALC use
- Forward position (momentary / spring-loaded) = reset normal CALC
- Backward position (stable & guarded) = forces SEC CALC mode.

In SEC CALC, the afterburner cannot be lit. It is however kept on if it was already engaged before the switch to SEC CALC.

Under SEC CALC, the nozzle rules change, and depend on a variety of factors, and the "flaps" regulating the bypass ratio of the engine remain fully open. Expect a lower thrust than in normal mode around MIL setting.

The engine RPM are still controlled by the throttle in SEC CALC. The pilot must act smoothly on the throttle, and pay close attention to the engine parameters, as some automatic protections may be lost.

A second emergency mode is SECOURS CARBURANT (SEC CARB) which translates to "Emergency Fuel", for more serious issues. SEC CARB mode is used in case of hydromechanical failure or serious regulation failure such as:

- Loss of efficiency of the main throttle
- Non-recoverable engine RPM drop
- Constant engine overspeed not recoverable via SEC CALC
- Mechanical failure of the normal driveline
- Inability to relight the engine inflight in normal or SEC CALC mode (after a commanded cut-off)
- Any inflight relight following an engine flame out

SEC CARB provides regulation of the engine RPM and nozzle independently of the main circuit.

The afterburner is not available in SEC CARB. The idle regime is higher than in normal mode, and the nozzle is forced open at higher RPM than usual.

This mode is triggered by lowering the yellow & black stripped plate - situated on the left of the main throttle, against the cockpit "wall" - towards the pilot.

The RPM are controlled through the tiny secondary throttle located behind the SEC CARB plate. Note that engine response is much slower than in normal mode (8 to 10 seconds from idle to full throttle), the pilot must anticipate his thrust needs. With the nozzle open at higher RPM and the afterburner not available, the max thrust is much lower than in normal mode. Consider jettisoning heavy payloads.

It is forbidden by SOPs to return to the normal regulation inflight, after having triggered the SEC CARB following one of the above-listed failures.

The engine may be relighted in SEC CARB mode. It cannot be cut-off in SEC CARB mode via the normal button & throttle (which are shunted). To cut-off the engine after landing, the pilot must either:

- return to normal regulation to use the normal method
- use the fuel shut-off valve to starve the engine

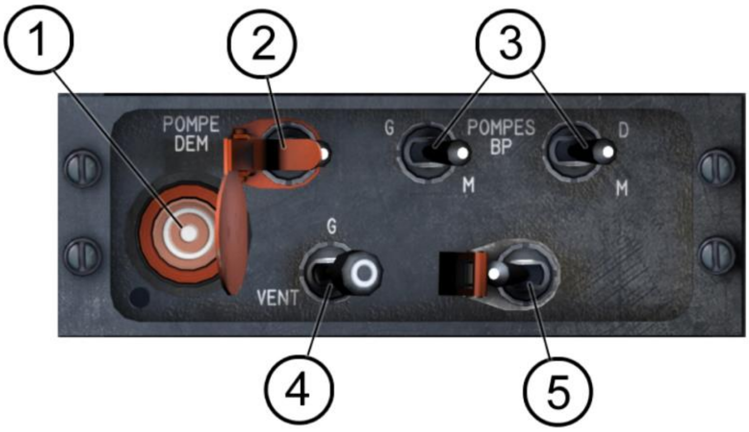
ENGINE STARTUP PANEL

The M-2000C does not have an Auxiliary Power Unit, instead it relies on a jet fuel starter (*MicroTurbo Noelle 180*) to start the SNECMA M53-P2 engine.

The Mirage jet fuel starter (JFS) is a gas turbine composed of an electric motor for its start, a compressor, combustion chamber and turbine assembly and a clutch. The JFS starts the engine via a drive shaft and an accessory drive. When the engine is stable at ground idle, the JFS is stopped.

The JFS can use the internal battery power, although a ground power is preferred to prevent draining the battery. The battery can sustain about 4 aborted starts.

The startup panel controls the feeder and starter pumps as well JFS startup sequence. It is located at the rear of the right console.



1. STARTER BUTTON (*Poussoir de démarrage*): Starts the JFS engine starter.
2. STARTER FUEL PUMP (*Interrupteur pompe démarrage*): Used to supply fuel to the engine during start sequence, even when only DC power (from battery) is available. It is automatically switched to the ON position when the starter button coveris opened.
3. BOOST FUEL PUMPS (*Interrupteurs pompes BP*): Turns on and off the low pressure fuel pumps.
4. IGNITION/VENTILATION SWITCH (*Sélecteur allumage ventilation*): 3 positions switch:
    - **Vent** (*Ventilation* - Crank): For dry runs of the engine
    - **G** (*Gauche* - Left): Select the left plug for ignition.
    - **D** (*Droit* - Right): Selects the right plug for ignition.
5. FUEL SHUT-OFF VALVE SWITCH (*Inverseur robinet BP*): Shut-off the engine fuel supply.

ENGINE'S AIRFLOW CONTROLS

In order to provide sufficient air flow to the engine, the Mirage uses 3 devices located on the intakes:

- INLET CONES (*Souris*): Mounted on the fuselage, at the start of both intakes, they slow down the intake air to subsonic speed when the aircraft is supersonic. They start to extend 1.2 Mach up to the aircraft max speed.

- SCOOPS (*Pelles*): Present just behind the bottom air inlet, the scoops extend to provide more air to the engine when at high AoA.
  The scoops extend in the following conditions:
  - Altitude above 25000ft.
  - Mach speed between 0,6 and 1,2.
  - CAS below 440kts.
  - AoA above 12°.

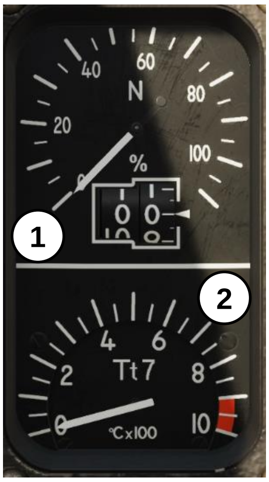
- AIR INLETS (*Tapettes d'entrées d'air*): Present on the top and bottom of the intakes, those inlets open by negative pressure inside the intake or are forced open aerodynamically by the scoops.


These devices are automatically operated and do not require pilot intervention except during emergencies. The inlet cones and scoops can be forced retracted on the scoops/inlet cones/slats control panel.

1. Scoops operation switch (*Inverseur pelles*): AUTO (Default) / R (Retracted - *Rentrés*).
2. Inlet cones operation switch (*Inverseur de commande souris*): AUTO (Default) / R (Retracted - *Rentrés*).

ENGINE RPM AND TEMPERATURE INDICATOR

The M-2000C engine gauges consist of 2 indicators that display engine RPM and temperature.



1. ENGINE RPM (*Indicateur N*): Indicates the percentage of engine power used.

   The RPM percentage is coming from the Engine Computer (FADEC), and is representing current engine RPM compared to the maximum available RPM in the current conditions. This means that this instrument does not reflect the raw engine power but the percentage of the available power is used.

2. ENGINE TT7 TEMPERATURE INDICATOR (*Indicateur Tt7*): Indicates the engine temperature in hundreds of degrees Celsius.

ENGINE STATUS AND WARNING LIGHTS

STARTUP LIGHT (*Voyant DEMAR*): The start-up light indicates a starter overspeed. It also flashes to indicates that the starter disengages from the engine, which happens at 45% RPM in normal conditions. INCORRECT

AFTER BURNER LIGHT (*Voyant post-combustion*): Located on the upper right area of the main panel (next to the Start Up Light). When the Afterburner is in use, the light will illuminate.

ENGINE FIRE LIGHTS (*Voyant feu double*): Illuminates when a fire or abnormal temperature is detected in the engine's secondary and/or in the afterburner chambers.

3 - ELECTRICAL SYSTEM

3 – 1 - ELECTRICAL POWER SUPPLY SYSTEM

The M-2000C power supply system consists of an alternating current (AC) and a direct current (DC) circuits.

- 2x 115/200 V, 20 KVA three-phase alternators (57 A per phase).
- 2x 150 A/28 V transformers-regulators (one for normal use, the other intended for emergencies).
- 1x 24 V, 40 A/h rechargeable battery.
- 1x 200 VA power converter.
- 1x 100 VA three-phase converter for the flight computer.

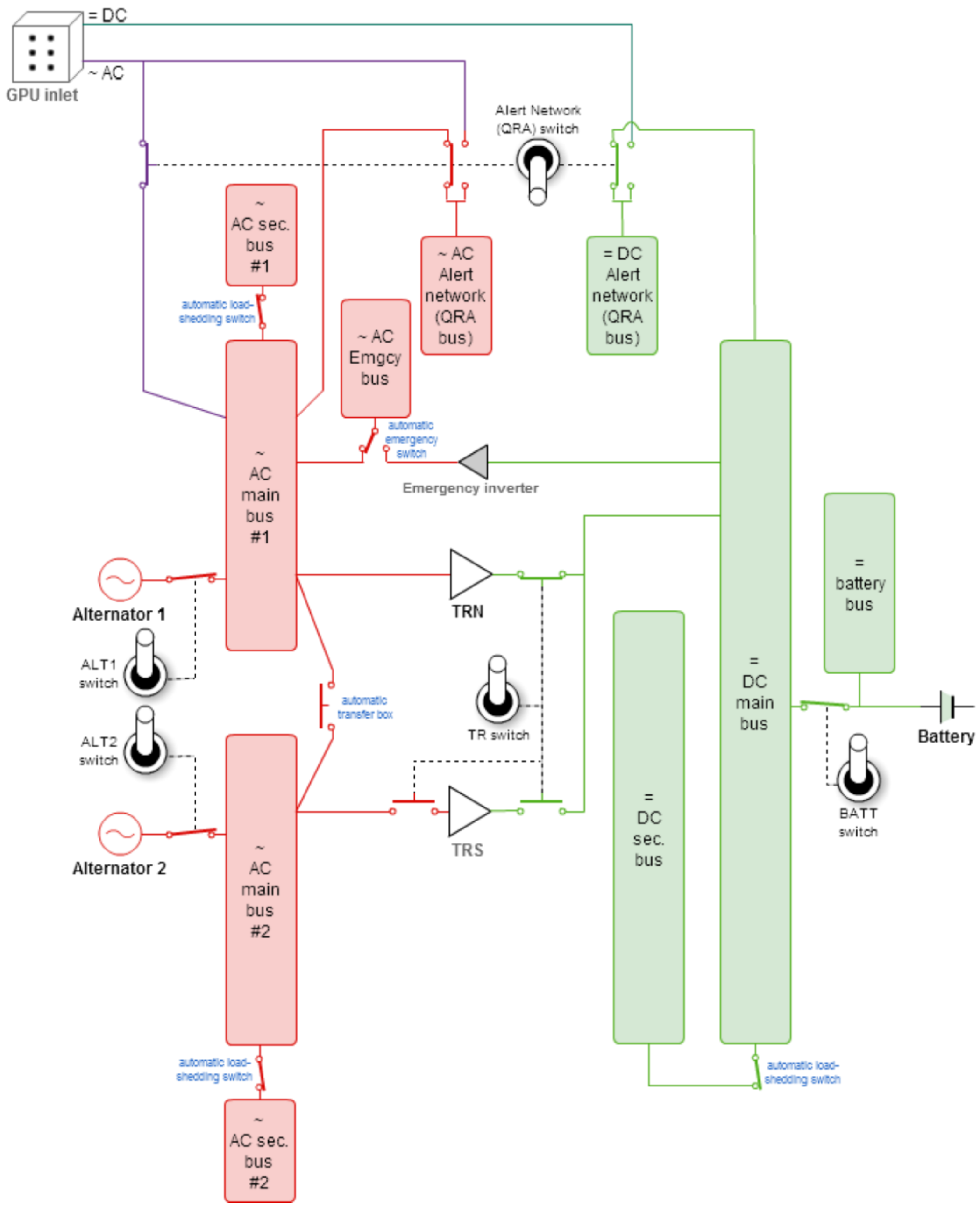
The aircraft also has connectors for external power supply that is used in most startup procedures.

POWER DISTRIBUTION SCHEMATICS

Both the AC and DC circuits are divided into the following buses:

1. 6x AC buses
   1.1. AC 1 Main bus
   1.2. AC “réseau d’alerte” (QRA) bus
   1.3. AC 1 Emergency bus
   1.4. AC 1 Secondary (load-sheddable) bus
   1.5. AC 2 Main bus
   1.6. AC 2 Secondary (load-sheddable) bus
2. 4x DC buses
   2.1. DC Main bus
   2.2. DC "réseau d'alerte" (QRA) bus
   2.3. DC Secondary (load-sheddable) bus
   2.4. Battery bus

NOTE	These are in fact part of the AC main 1 bus and the DC main bus, that can be powered separately, only when the aircraft is on the ground (with GPU) on QRA duties; those busses allow some devices to remain powered during alert so that start-up and take-off will be speeded up (most obvious example: the INS, which remain powered = aligned = ready to go). In the air, "Alert Network" switch being off, those buses are powered from the AC main 1 bus and the DC main bus.


= DC
~ AC
GPU inlet
Alert Network (QRA) switch
~ AC sec. bus #1
automatic load-shedding switch
~ AC Alert network (QRA bus)
= DC Alert network (QRA bus)
~ AC Emgcy bus
automatic emergency switch
Emergency inverter
~ AC main bus #1
Alternator 1
ALT1 switch
ALT2 switch
Alternator 2
TRN
TR switch
TRS
automatic transfer box
~ AC main bus #2
automatic load-shedding switch
~ AC sec. bus #2
= DC sec. bus
= DC main bus
= battery bus
Battery
BATT switch
automatic load-shedding switch

ELECTRICAL POWER EMERGENCY CONDITIONS

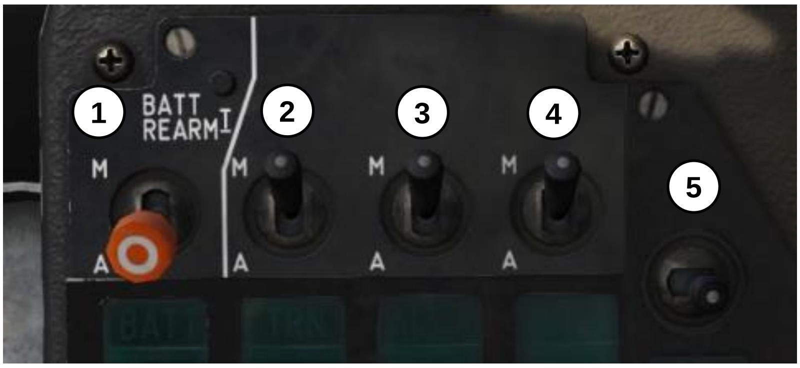
SITUATION	ALARM LIGHTS	AC BUSES	DC BUSES	REMARKS
GPU ON	ALT.1 ALT.2	All ON	All ON	The lights indicate that the alternators are offline due to the ground power.
GPU ON + BATT switch OFF	ALT.1 ALT.2 BATT	All ON	All ON	The battery powers its own bus but does not power the main DC buses and is not recharging.
GPU ON + QRA switch ON (up)	None	AC QRA ON All others OFF	DC QRA ON All others OFF	Normal situation when the QRA switch is on. NOT FUNCTIONAL
ALT failure or switched OFF	ALT.1 or ALT.2	AC sec. 1 OFF AC sec. 2 OFF All others OFF	All ON	The AC main bus connected to the failing or OFF alternator is powered by the other alternator through the automatic transfer box. Both AC sec. buses are disconnected by the automatic load shielding.
Double alternator failure or switched OFF	ALT.1 ALT.2 TR	AC emergency ON All others OFF	All ON	The AC emergency bus is powered by the battery via an emergency inverter. The DC buses are powered by the battery, this will lead to a quick CC failure due to battery discharge.
TRN failure and TR switch up	TR	All ON	All ON	The DC buses are powered by the TRS.
TRS failure and TR switch down or TRN + TRS failure	TR	All ON	All ON	The DC buses are powered by the battery, this will lead to a quick CC failure due to battery discharge.
Tension on DC buses < 26 V	TR CC	All ON	DC sec. OFF All others ON	Battery is discharging.
AC main 1 failure	ALT.1 TR	AC main 1 OFF AC sec. 1 OFF AC emergency ON AC QRA OFF AC main 2 ON AC sec. 2 OFF	All ON	The DC buses are powered through the TRS The AC emergency bus is powered by the battery though the emergency inverter
AC main 2 failure	ALT.2	AC main 1 ON AC sec. 1 OFF AC emergency ON AC QRA OFF AC main 2 OFF AC sec. 2 OFF	All ON	Both AC sec. buses are disconnected by the automatic load shielding.

Battery failure	**BATT**	All ON	Battery bus OFF All others ON	Only the battery bus is lost, the battery switch comes down automatically.
Battery isolated (switch down)	**BATT**	All ON	All ON	The battery is not recharged anymore.
Battery isolated (switch down) + TRN and TRS failure	None The alarm panel is not powered anymore	All ON	Battery bus ON All others OFF	Only the DC battery bus is powered and the battery is not recharged.
Battery failure + TRN and TRS failure	None The alarm panel is not powered anymore	All ON	All OFF	Total DC failure.

3 – 2 - Electrical Power Controls

Power control switches

The aircraft power supply is controlled by 4 switches located on the right vertical panel, at the top of the alarm panel.



1. Battery switch (*Interrupteur et réarmement batterie*): Turns on or rearms the battery.
2. Transformer-rectifier switch (*Inverseur transfo-redresseur*): Enables the main converter (up) or the emergency converter (down).
3. Alternator 1 switch (*Interrupteur alternateur 1*): Enables the first alternator to power the AC 1 main bus.
4. Alternator 2 switch (*Interrupteur alternateur 2*): Enables the second alternator to power the AC 2 main bus.

NOTE	The yellow warning lights beneath each Alternator switch will remain ON as long as ground power source is connected.

5. Lights Test Switch (*Inverseur tests voyant*): Used to test all the cockpit lights. Each of the 2 positions tests 1 of the lights for each alarm panel cell.

Circuit breaker panel

Circuit Breaker Panel: Located below the Engine Start Panel, it governs several systems and allows for quick disabling the electrical power for several systems. NOT FUNCTIONAL

4 - FUEL SYSTEM

4 – 1 - FUEL TANKS AND TRANSFER

FUEL TANKS

The M-2000C fuel system is divided into 2 groups:

- LEFT GROUP (*Group gauche*): Consists of the left feeder tank, left wing tanks and left fuselage tank.
- RIGHT GROUP (*Groupe droit*): Consists of the right feeder tank, right wing tanks and right fuselage tank.

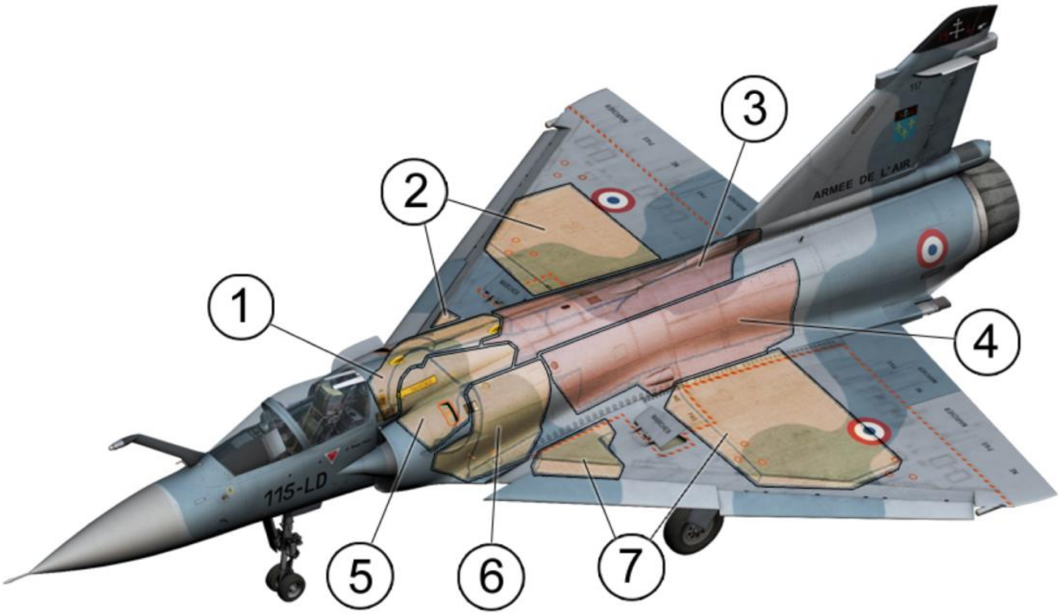
Additionally, a central tank just aft of the cockpit transfers into the 2 fuselage tanks.

The left and right fuselage tanks and central tank are also called forward group (*groupe avant*).

Also, 3 external tanks (RL – *réservoir larguable* or RP – *réservoir pendulaire*) can be loaded on the aircraft:

- 1 RP-522: On the centerline pylon.
- 2 RP-541: On the inboard pylon of each wings.

The aircraft has aerial refueling capability using a detachable probe on the starboard side forward of the cockpit.



No.	Description	Kg	Lbs.	US Gals	Liters
1	Right group forward tank	304.0	670.0	101.7	385.0
2	Right group wing tanks	523.0	1154.0	175.0	662.5
3	Right group feeder tank	592.5	1306.0	198.1	750.0
4	Left group feeder tank	592.5	1306.0	198.1	750.0
5	Center tank	320.0	705.0	107.0	405.0
6	Left group forward tank	304.0	670.0	101.7	385.0
7	Left group wing tanks	523.0	1154.0	175.0	662.5
	TOTAL INTERNAL FUEL	3160.0	6966.0	1056.6	4000.0
	RP-522 centerline tank	990.0	2182.6	343.4	1300.0
	TOTAL INTERNAL + RP-522	4150.0	9146.6	1400.0	5260.0
	RP-541/542 wing tank (each)	1580.0	3482.3	528.6	1700.0
	TOTAL INTERNAL + RP-522 + RP-541/542	7310.0	16111.2	2457.2	8660.0

FUEL TRANSFER

Fuel is supplied to the engine by 2 electrical pumps BP (*basse pression*) on the feeder tanks. These pumps are powered by the AC 1 main bus or, in case of failure, the AC 2 main bus.

The feeder tanks are filled in order by:

- The external tanks.
- The left and right groups and the center tank.

The above tanks are pressurized by engine bleed air, allowing the transfer to be done by pressure difference with the feeder tanks. A dynamic balancer ensures the balance of fuel between the fuselage and wing tanks to maintain weight centering.

If engine bleed air in not available only the fuel in the feeder tanks is usable.

4 – 2 - FUEL CONTROLS

FUEL CONTROL PANEL

1. REFUEL TRANSFER LIGHT (*Voyant ravitaillement en vol*): Indicates that the aircraft is receiving fuel from aerial refueling.
2. JAUG FUEL AMOUNT COUNTER (*Jaugeur reservoirs interne*): Displays the aircrafts internal fuel quantity in Kg.

   This number obtained by sensors inside the fuel tanks. The wing tanks don't have a sensor but their level is deduced from the forward tanks. This means that if there is a fuel transfer problem, the JAUG counter will be incorrect.
3. DETOT FUEL AMOUNT COUNTER (*Débimètre détotalisateur*): Displays the total fuel available to the aircraft including external tanks.

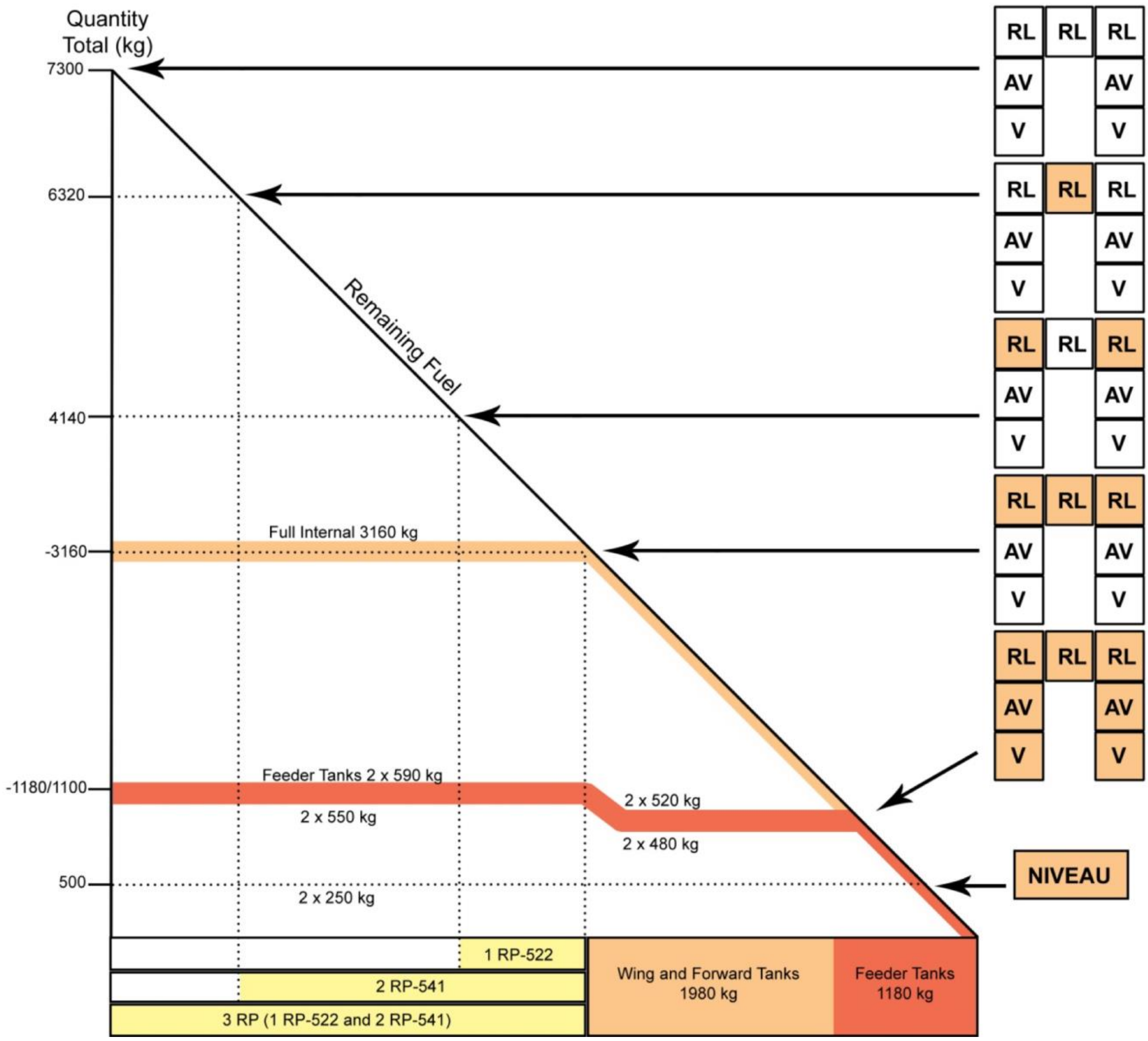
   The DETOT is manually set by the pilot or mechanic using the AFF DETOT switch. The engine fuel consumption is subtracted to the displayed value to obtain the updated fuel quantity. This means that this display can be inaccurate if it has been set incorrectly.

   CAUTION

   When spawning, the DETOT will be set to the total fuel quantity by the ground crew, but it won't be updated when refueling on the ground or in the air. The kneeboard "Pilot signout sheet" page contains a refueling section that is updated each time the aircraft is refueled.
4. AFF DETOT SWITCH (*Inverseur de réglage DETOT*): Sets the DETOT fuel quantity.

5. END OF TRANFER LIGHTS (*Indicateurs de fin de transfert*): Indicates that the corresponding fuel tank is not transferring fuel anymore. This can indicate that the tank is empty or that there is a transfer failure.
    - **RL** (*Réservoirs largables* - External tanks): 1 light for each external tank.
    - **AV** (*Groupe avant* - Forward group): 1 light for each fuselage tank. Since the central tank is connected to both fuselage tanks, both lights turning on indicate that the forward group is empty.
    - **V** (*Voilure* - Wing tanks): 1 light for each wing.
6. TRANSF TEST SWITCH: Test Fuel Transfer circuit. **NOT FUNCTIONAL**
7. LEFT AND RIGHT FEEDER TANKS LEVEL INDICATOR (*Bandeaux nourrices*): Indicates the fuel quantity in the feeder tanks. The level indicators also show 3 markers:
    - The top yellow mark indicates the maximum tank capacity, 600Kg for each tank. It is also the level at which the external tanks transfer fuel.
    - The middle yellow mark indicates the level (450kg for each tank) at which the left and right groups as well as the central tank starts to transfer fuel.
    - The bottom red mark indicates that there is only 250Kg in each feeder tank. Passing this level in either tank triggers the **NIVEAU** caution light on the alarm panel. This alarm indicates that the aircraft is low on fuel or a failure in fuel transfer.
8. FEEDER TANKS INTERCOM CONTROL (*Robinet INTERCOM*): Allows for fuel to transfer between the 2 feeder tanks to balance the weight in case of transfer failure. **NOT FUNCTIONAL**

FUEL CONSUMPTION AND TRANSFER DIAGRAM



FUEL FLOW INDICATOR AND BINGO SELECTOR

1. FUEL FLOW INDICATOR (*Indicateur de débit instantané*): Displays the engine fuel instantaneous consumption in kilograms per minute (Kg/min).
2. BINGO SELECTOR (*Afficheur BINGO*): The drums are used to set the JAUG fuel quantity at which the BINGO alarm will turn on.

   BINGO is used to indicate the minimum amount of fuel required for a safe return to base. It can also be used for other fuel states like JOKER (fuel quantity at which the pilot should end his mission).

EXTERNAL TANKS FUEL DUMP BUTTON

The M-2000C can only dump the fuel in the external tanks. The fuel dump is triggered by the external tanks fuel dump button and cannot be stopped once started. The button is guarded with a yellow/black stripped cover.

FUEL DUMP TIMES: RP-522 = 2 minutes 30 seconds

RP-541 = 4 minutes

5 - HYDRAULIC SYSTEM

INTRODUCTION

The aircraft's hydraulic system includes 2 independent systems with the same power. Each system has a 110 liter/min self-regulating pump with 280 bars of pressure. Additionally, there is a back-up electrical pump (EP – *Eléctro-pompe*) which is connected to system 2 and that automatically starts when the pressure in system 2 falls below 160 bars. This pump provides only 190 bars of pressure.

Each hydraulic system also features a hydro-alternator; those provide electric power, independently of the main electric system, to the #1 and #2 FBW channels computers respectively, so that even in case of total failure of the main electric system, the FBW remains operational as long as there is hydraulic power.

HYDRAULIC SYSTEMS DESCRIPTION

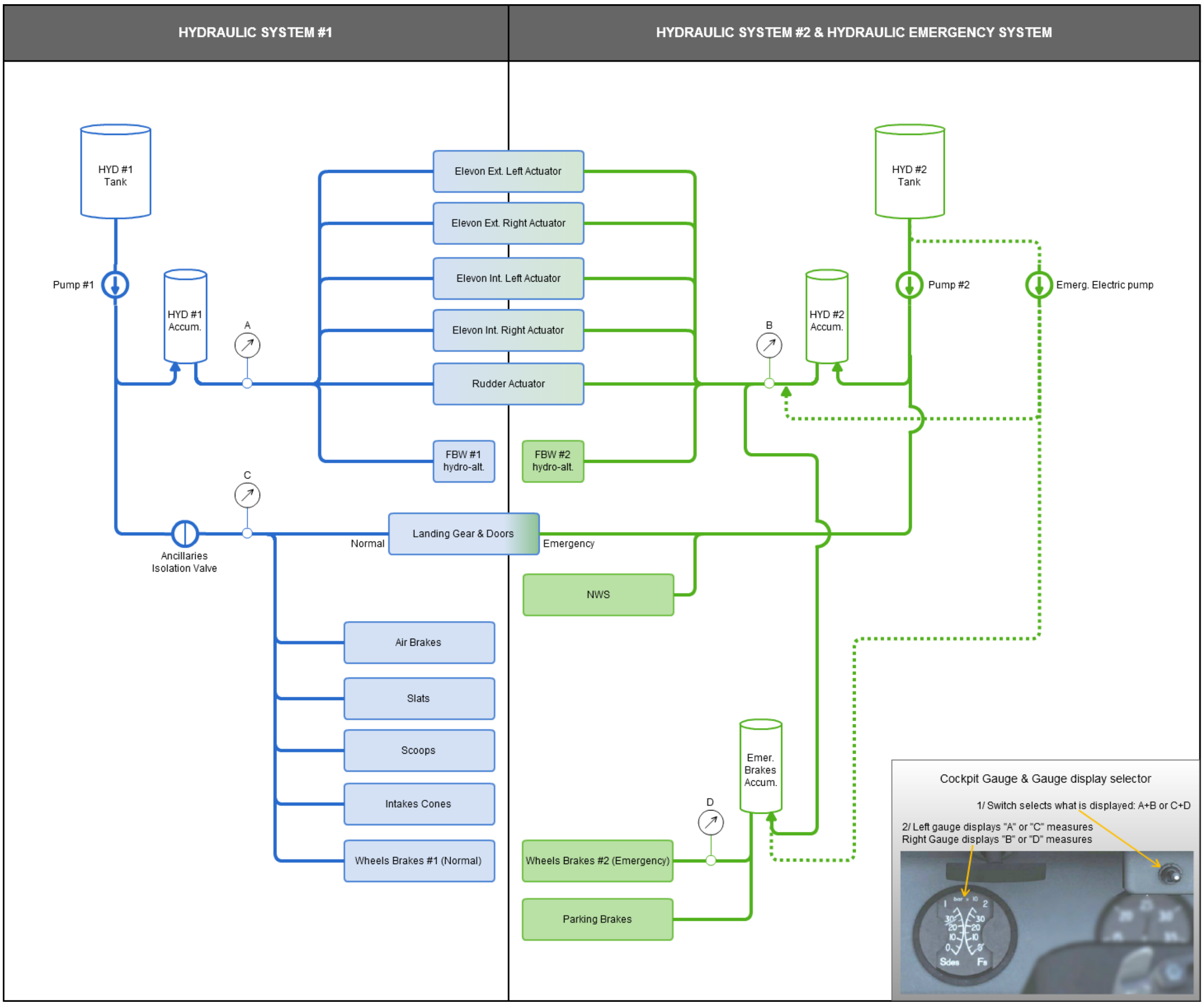
SYSTEM 1

- Air brakes
- Slats (*Becs*)
- Inlet cones (*Souris*)
- Scoops (*Pelles*)
- Landing gear
- Wheel brakes

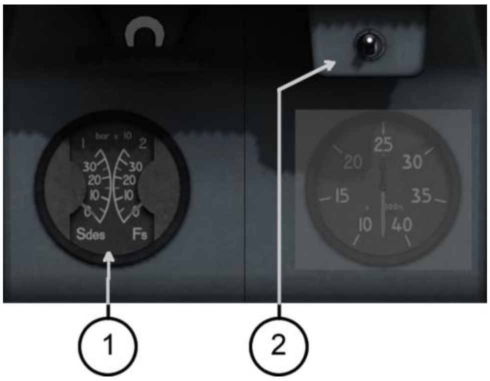
SYSTEM 2

- Emergency landing gear actuator.
- NWS
- Emergency brakes
- Parking brake

HYDRAULIC SYSTEM SCHEMATICS



HYDRAULIC PRESSURE INDICATOR AND SELECTOR



1. HYDRAULIC PRESSURE INDICATOR (*Indicateur double de pressions hydrauliques*): Displays hydraulic pressure for both systems.
2. HYDRAULIC PRESSURE SELECTOR (*Inverseur selection de pressions hydrauliques*): Used to select which system to display in the hydraulic pressure gauge. NOT FUNCTIONAL

6 - FLIGHT CONTROLS

6 – 1 - MOBILE SURFACES

INTRODUCTION

The M-2000C flights controls include the following mobile surfaces:

- 4 elevons for pitch and roll control.
- 1 rudder.
- 2 pairs of automatic slats (*becs*).

The elevons and the rudder are controlled by an electro-hydraulic servo connected to the 2 hydraulic circuits (HYD1 and HYD2, see the HYDRAULIC SYSTEM SECTION). The servos are connected to 2 motor-servos (NORMAL and EMERGENCY).

The slats are controlled by a pair of motors that are actuated by HYD1 and move depending on the flight conditions.

NORMAL OPERATION

ELEVATORS

Stick displacement:

UP	Elastic stop at 43.2 mm
	Mechanical stop at 54 mm
DOWN	Mechanical stop at 30 mm

The elastic stop provides a restraint that limits the load factor or AOA while allowing override during hard maneuvers.

NOTE	In DCS, the ability to exceed the elastic stop is provided by the AP Disconnect/Exceed Elastic Limit command, as flight sim joysticks don't include an elastic stop on the pitch axis.

The stick movement is filtered and reduced so that the total displacement + trim does not exceed the elastic stop unless that is the pilot's will.

AILERONS

Stick displacement: ±12º

The stick movement is filtered and reduced to maintain the roll speed limit, as a function of elevator command and load factor in order to reduce the roll speed and acceleration during high AOA and wing loads.

The aileron trim is added to the stick movement.

Aircraft stabilization is achieved as a function of roll angular speed.

RUDDER

Pedals displacement: ± 28.5 mm

Rudder authority is limited by stick pull-up command.

A transverse accelerometer provides static stabilization.

A yaw gyro provides with dynamic dampening.

SLATS

The automatic slats (*becs*) are actuated in function of the AoA. They begin to operate at 4º of AoA and are fully extended at 10º of AoA. The slats are automatically retracted when the landing gear is down.

The use of leading-edge slats also increases the aspect ratio during combat maneuvers.

SCOOPS/INLET CONES/SLATS CONTROL PANEL

The slats can be manually extended or retracted using the BECS switch on the scoops/inlet cones/slats control panel.

1. SLATS POSITION SWITCH (*Sélécteur de commande becs*): SORTIS (Extended) / AUTO (Default) / RENTRES (Retracted).

6 – 2 - FLY BY WIRE

INTRODUCTION

A fly-by-wire system replaces the conventional flight controls with an electronic interface that execute the commands sent by the pilot using the stick and rudder. The stick and rudder position as well as attitude, AoA, altitude, speed and acceleration in all directions is sent to a computer that will command flight surfaces to achieve the desired result. This means that the pilot is never in direct control, but rather he commands the computer to fly the aircraft.

The Mirage 2000 is naturally unstable aircraft that would be too complicated to control by conventional means. This unstable design allows for better performances and reduces de delta-wing configuration drawbacks. The FBW system allows great control over the aircraft nose and load factor, removes most of the parasitic behaviors and provide a more "care-free" control as it prevents exceeding the aircraft operational limits.

The FBW will limit load factor, AoA and roll rate to prevent stalls and maintain structural integrity. The limits are:

- 11±0.5 g longitudinal load factor
- 29° of angle of attack
- 270°/s of roll rate.

The control scheme for the pitch is different depending on the corrected airspeed.

At speeds above 300 knots, the stick commands a longitudinal load factor, this means that in straight level flight, trimming is not necessary. But when climbing or descending, the aircraft will tend to bring the nose up to maintain the longitudinal 1G neutral trim.

At speeds below 300 knots, the stick commands angle of attack (AoA). Trimming is then very necessary due to the high AoA amplitude at slow speeds.

There is short transition between the 2 control types at 300 kts.

Rudder is not necessary during turns as the FBW provides yaw stabilization that maintains zero lateral acceleration during steady flight. If active, rudder trim is redundant since both devices tend to cancel each other out.

NOTE	The rudder has a limited role in steering the aircraft. It is unnecessary except in certain regiments as during air-to-ground targeting or crosswind landing. To cover the latter case, the authority of the rudder is increased when the landing gear is down.

FBW modes Switch

The FBW mode switch (*Inverseur Air-Air/Charges*) is used by the pilot to adapt the FBW system to the stores loaded into the aircraft. 2 modes are available: Air/Air and Charges (Load).

Air-to-air Mode

- 9±0.5 g of longitudinal load factor at the elastic stop.
- 11±0.5 g of longitudinal load factor at the mechanical stop.
- 29° of AoA or 27º under 100 knots.
- 270º/s of roll rate and angular acceleration.
- Audio warning when AoA is above or equal to 29º, stick at full aft position or indicated air speed is below 100 knots.

This mode is allowed when the aircraft is clean (no load), or with a load limited to air-to-air missiles (Magic and/or 530D) and/or an empty centerline fuel tank.

Charges Mode

- 6±0.5 g of longitudinal load factor at the elastic stop.
- 9±0.5 g of longitudinal load factor at the mechanical stop.
- 29° of AoA or 27º under 100 knots.
- 150º/s of roll rate and angular acceleration.
- Audio warning when AoA is above or equal to 20º.

This mode must be used when the aircraft carries any of the following load: non-empty centerline droppable fuel tank, any wing droppable fuel tank, any bomb or rockets pod. This mode can also be used for air-to-air refueling as is provides finer controls on the aircraft.

CAUTION	Using air-to-air mode while the aircraft should be in the charge mode can lead to structure and load-out damage.

NOTE	Both modes have been covered to greater extent in the stock campaign available with the module.

DEGRADED AND EMERGENCY MODE OPERATION

One thing to know about the Mirage FBW system is that there is no way to disengage or turn it off as there is not mechanical connection between the stick and the control surfaces.

The aircraft will handle the activation of FBW emergency modes by itself most of the times as it has a lot of redundancies. However, it is possible to activate some emergency modes if needed.

SPIN SWITCH:

The SPIN switch (*Inverseur VRILLE*) is located at the top of the left front dash. Placing it in the *VRILLE* position gives full yaw and roll authority to the pilot. This mode primary use is to allow the pilot to recover from a flat spin.

WARNING

Using this mode while in normal flight can lead to stalls, spins and even structural damage at high speed as yaw stability is no longer guaranteed by the FBW system.

EMERGENCY FBW GAIN SWITCH:

The emergency FBW gain switch (*Interrupteur GAIN CDVE)* is located on the left vertical panel. Placing it in the emergency position will isolate the FBW computer from the air data computer. This means that the FBW system will no longer take speed, altitude, attitude, AoA and slip into account. This mode is primarily used when some component of the air data computer is damaged and normal FBW operation are resulting in unstable flight.

WARNING

Switching to this mode is irreversible and should only be done in case of emergency as the aircraft stability is then dependent on the pilot.

7 - AUTOPILOT AND TRIM

7 – 1 - AUTOPILOT

INTRODUCTION

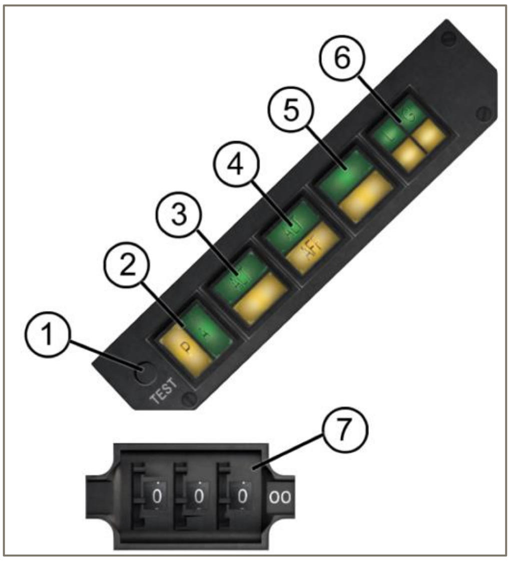
The autopilot (AP) provides automatic flight path control through basic and advanced modes. Its capabilities are:

- Hold pitch and roll angles.
- Hold barometric altitude.
- Fly a selected bearing.
- Level off at a selected barometric altitude.
- Fly an ILS approach.
- Trim the aircraft for the current speed, AoA and attitude.

OPERATIONAL LIMITS

MAX ALTITUDE	50,000 feet
MAX PITCH ANGLE	±40º
MAX AOA	18º
MAX ROLL	65º (will return to 60º when engaged)
MAX SPEED	50 kt IAS less than the operational limit for current configuration
MINIMUM SPEED	200 kt IAS (unless in approach, limit is 18º AoA)
MINIMUM ALTITUDE	Normal mode: 500 feet
	Localizer and Glideslope hold: 200 feet
	Selected altitude hold: 1,000 feet

AUTOPILOT CONTROL PANEL AND ALTITUDE SELECTOR



1. TEST PUSHBUTTON (*Bouton test PA*): Tests the panel lights and the autopilot "gong" audio warning.
2. AP ENGAGEMENT PUSHBUTTON (*Bouton mise en service PA*): Activates the autopilot in the attitude hold mode.
3. ALTITUDE HOLD MODE PUSHBUTTON (*Bouton tenue d'altitude*): Activates the altitude hold mode.
4. DISPLAYED ALTITUDE MODE PUSHBUTTON (*Bouton tenue d'altitude affichée*): Activates the displayed altitude hold mode.
5. Not used
6. AUTOMATIC APPROACH MODE PUSHBUTTON (*Bouton approche automatique*): Activates the automatic approach mode.
7. ALTITUDE SELECTOR (Boitier d'*affichage d'altitude*): Used to set a target altitude for the AP displayed altitude mode. The altitude is dependent on the altimeter pressure setting.

AUTOPILOT OPERATION

The attitude hold mode is the basic mode for the autopilot, it is engaged by using the AP engagement pushbutton. All the other autopilot modes are advanced modes that require the attitude mode to be engaged first. All advanced modes are exclusive except the automatic approach mode and the altitude hold mode that can be engaged simultaneously.

Once an advanced mode in engaged, selecting another advanced mode or pressing the mode pushbutton again will disengage it. Pressing the AP engagement pushbutton or the AP disconnect trigger while in attitude hold or any advanced mode will disengage all autopilot modes.

The Mirage 2000C autopilot is designed to be used in most phases of flight thanks the AP standby command; It is a long vertical paddle behind the stick that puts the autopilot in standby, memorizing the current modes, allowing the pilot to easily change the aircraft attitude and re-engage the auto-pilot by releasing the paddle. The paddle is naturally pressed when the pilot holds the stick.

When engaged the pilot can also command the pitch and bearing followed by the autopilot using the trim command on the stick. The selected pitch is set by moving an asterisk up and down on the VTH which represent where the autopilot will aim to place the FPM. The selected bearing is set by moving the AP bearing index on the IDN or the AP commanded bearing on the VTH.

AUTOPILOT MODES

ATTITUDE MODE

The attitude hold mode is the only basic mode of the autopilot, it needs to be engaged before any advanced mode can be selected. It is engaged using the AP engagement pushbutton.

The green half with an **A** marking will light up indicating that the mode is engaged. When the autopilot is in standby the green half will turn off and the amber half with a **P** marking will turn on.

PITCH

The aircraft will hold the FPM position on the pitch ladder. The pitch can be adjusted by moving the asterisk using the trim hat, the autopilot will adjust the pitch of the aircraft to place the FPM on the new asterisk position.

ROLL

2 sub-modes:

- ROLL HOLD: This sub-mode is selected if the aircraft has a bank angle over 10° when engaged or re-engaged. The autopilot will hold the aircraft bank angle up to 60°. If a bearing has been selected using the trim, the aircraft will switch to bearing hold once it has been reached.
- BEARING HOLD: This sub-mode is selected if the aircraft has an angle of bank under 10° when engaged or re-engaged. The auto will hold the bearing of the aircraft or follow the selected bearing set by the pilot using the trim hat.

ALTITUDE HOLD MODE

The altitude hold mode is the first advanced mode of the autopilot, the attitude mode needs to be engaged first before it can be selected. It is engaged using the altitude mode hold pushbutton.

The green half with an **ALT** marking will light up indicating that the mode is engaged. When the autopilot is in standby the green half will turn off and the amber half with no marking will turn on.

PITCH

The aircraft will adjust it to fly the barometric altitude the aircraft had at the time it was engaged. This means that when climbing or descending the aircraft will first adjust the pitch to reach the altitude and then hold it.

The held barometric altitude does not take the altimeter barometric setting into account, the barometric altitude reference is for a 1013 hPa setting. Changing the altimeter barometric setting has no effect on the autopilot.

ROLL

The aircraft will follow the attitude mode behavior.

DISPLAYED ALTITUDE MODE

The altitude hold mode is an advanced mode of the autopilot, the attitude mode needs to be engaged first before it can be selected. It is engaged using the displayed altitude mode pushbutton.

The green half with an **ALT** marking will light up indicating that the mode is currently capturing the displayed altitude. The amber half with an **AFF** marking will light up indicating that the mode is in standby or waiting to reach the displayed altitude.

This mode first requires setting an altitude on the altitude selector, it is this altitude that will be captured by the autopilot. This altitude is relative to the barometric altimeter taking into account the pressure setting.

When the altitude is captured, the displayed altitude mode will disengage and the altitude hold mode will engage.

PITCH

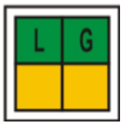
2 sub-modes:

- PITCH HOLD: The aircraft will hold the FPM position on the pitch ladder. The pitch can be adjusted by moving the asterisk using the trim hat.
- ALTITUDE CAPTURE: The aircraft will adjust the pitch to level off at the displayed altitude. In this sub-mode, the trim hat has no action in pitch.

ROLL

The aircraft will follow the attitude mode behavior.

AUTOMATIC APPROACH MODE



The automatic approach mode is an advanced mode of the autopilot, the attitude mode needs to be engaged first before it can be selected. It is engaged using the automatic approach mode pushbutton.

For this autopilot mode to work, the aircraft needs to receive the ILS signal from an airport as well as having the runway heading (CP - *cap vrai piste*) and glideslope (PD – *pente désirée*) set in the current DEST BUT.

WARNING

Having a wrong CP or PD will result in degraded performance for the autopilot and can lead to missed approaches and even a crash. Be sure to set them correctly and cross check the autopilot action with the ILS needles on the IS.

The button lights are divided into 2 sides, the localizer side (left) and the glide side (right). They function in the same manner.

The green quarter with an **L** or **G** marking will light up to indicate that the aircraft is following the ILS localizer or glide. The amber quarter with no markings will light up to indicate that the aircraft is not following the ILS localizer or glide. Both the green and amber quarters lighting up indicate that the deviation from the ILS localizer or glide is excessive.

PITCH

The aircraft will follow the attitude or altitude if it is engaged modes behavior until it receives the ILS glideslope signal. It will then disengage the altitude mode and fly the ILS glideslope. At this point, any pitch trim will disengage the autopilot in glide, to reengage it, the pilot needs to deselect and reselect the automatic approach mode. The autopilot can’t follow the glideslope until it receives the localizer signal.

ROLL

The aircraft will follow the attitude mode behavior until it receives the ILS localizer signal. It will then fly the ILS glideslope. At this point, any roll trim will disengage the autopilot in localizer, to reengage it, the pilot needs to deselect and reselect the automatic approach mode. The autopilot can follow the localizer when not receiving the glideslope signal.

WARNING

The automatic approach autopilot will guide the aircraft on the ILS until the decision height that is at 200ft most of the time. It will not land the aircraft, the pilot needs to take control as soon as he has the runway in sight or at the decision height to continue or fly a missed approach.

ABNORMAL OPERATION

AUTOPILOT FAILURE

If the AP fails, the master warning lights up, a chime is heard and on the warning light panel the red AP light comes on.

The AP is automatically disengaged and manual control reverted to the pilot.

7 – 2 - TRIM SYSTEM

TRIMMING THE AIRCRAFT

Due to the FBW command laws, pitch trim is not needed in strait level flight above 300 kts, but bellow that trim is needed to set the AoA the FBW will maintain with the stick neutral in pitch. This is particularly useful in approach to maintain 14° of AoA. When climbing or descending, trim is needed in order to keep the nose at the same pitch angle as the aircraft will maintain longitudinal load factor.

Roll trim is needed in case of internal fuel imbalance when external ordinance is not symmetrical in weight or drag.

Trimming is done by using the trim hat on the stick or using the autopilot. The autopilot will trim the aircraft for the current speed, attitude and altitude.

TRIMMING WITH THE AUTOPILOT

With the autopilot engaged, the trim hat will command pitch attitude and bearing to the autopilot. The pitch attitude is set by moving the asterisk on the VTH along the pitch ladder, the autopilot will then place the FPM over that asterisk. The bearing is set with the AP bearing index on the IDN or the AP commanded bearing on the VTH.

8 - LANDING GEAR

INTRODUCTION

The M-2000C has a tricycle landing gear. The nose wheel composed of 2 small tires with steering assembly and the main gear have a single large tire each and are equipped with carbon disk brakes. The aircraft is equipped with the SPAD anti-skid system and a parking brake.

The nose wheel steering is performed by the DIRAV (*Dirigeabilité Roue Avant*) system. It is linked to the rudder pedals and assures a proportional steering that reduce the risks of understeering up to 40 kts. Above that speed, the system is disabled.

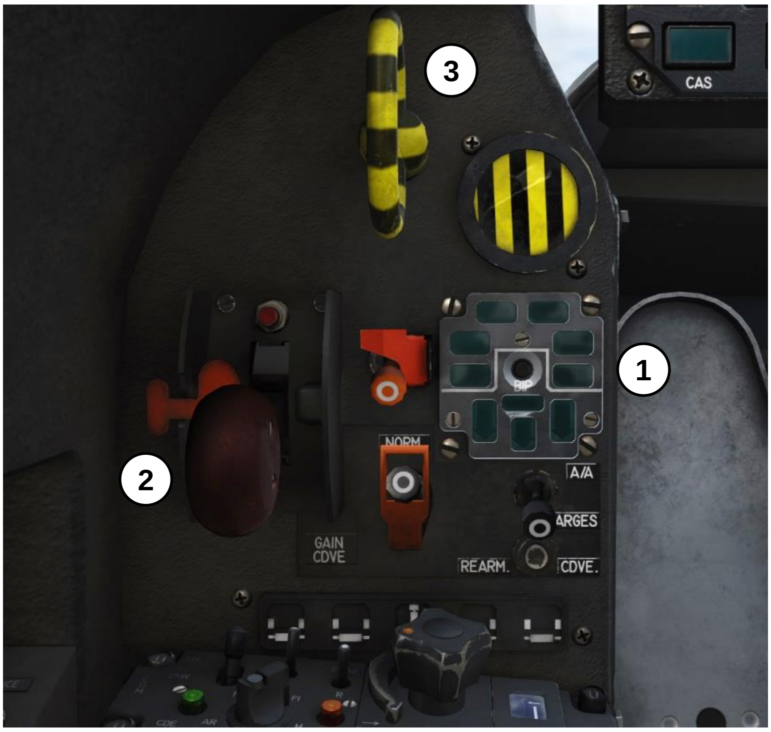
The normal braking pressure provided by the primary hydraulic system is 100 bars. It goes up to 280 bars with weight on wheels and RPM above 80%, it is called holding point pressure (*pression de point fixe*) and allows the aircraft to hold position with 100% RPM in dry ground conditions.

The emergency braking pressure provided by the secondary hydraulic system is 65 bars.

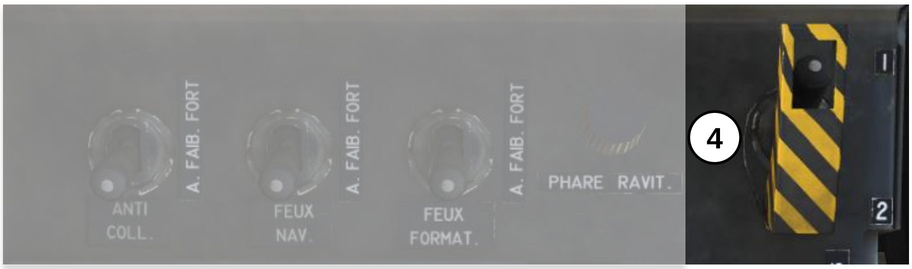
The parking brake pressure is provided by the secondary hydraulic system at 85 bars

The SPAD (*système perfectionné anti-dérapant*) system prevents tire lockup when braking that could lead to loss of control on the ground or tire damage. The system works by comparing the main landing gear wheel speed with the front landing gear wheel speed. As the front wheels are not braked, if there is a difference it means that the rear tires are locking up. The system will then reduce the braking force until the nose gear and main gear wheel speed is equivalent.

LANDING GEAR CONTROLS



1. LANDING CONFIGURATION PANEL (*Tableau de configuration*): Displays the status of the landing gear, airbrakes and emergency tail hook. More details below.
2. GEAR HANDLE (*Commutateur de commande de train*): Raises and lower the landing gear, also serves as landing gear warning light and blinks red whenever the gear is being lowered or raised and when the landing gear is up and then speed drops below 230 kts.
3. EMERGENCY GEAR HANDLE (*Poignée secours train*): Lowers the landing gear using the secondary hydraulic system in case of primary system failure.

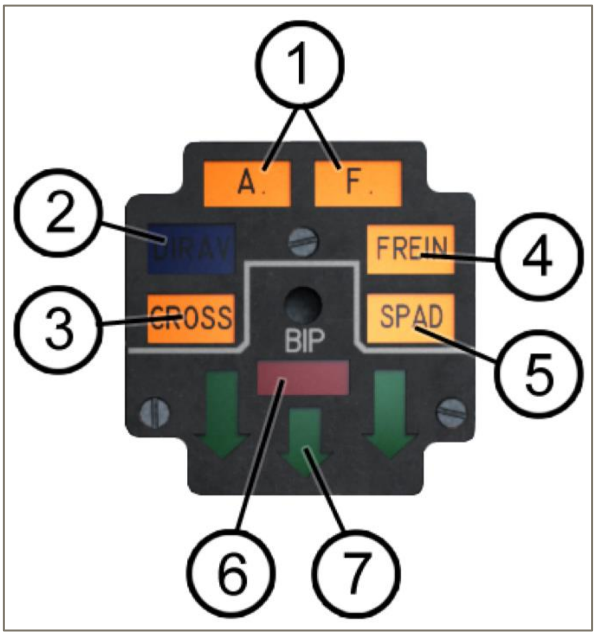


4. BRAKES SYSTEM SWITCH: Selects which hydraulic system the brakes will use. If pressure is lost in the primary hydraulic circuit, the change should be automatic. The most common use for the emergency position is SPAD failure.
   - In the default (forward) position, the brakes will use the primary hydraulic system and will use the SPAD anti-skid system.
   - In emergency (rearward) position, the brakes will use the primary hydraulic system and will not use the SPAD anti-skid system.

CAUTION	After landing AVOID applying brakes until your speed is below 100 knots. At these speeds, aero-braking and air-brakes are more efficient.
WARNING	SPAD is very inefficient while the front gear wheels are in the air, avoid applying brakes until the front landing gear is down and the wheels have caught up the ground speed.

LANDING CONFIGURATION PANEL

Located on the left vertical panel, the landing configuration panel (*tableau de configuration*) indicates the status of the landing systems and airbrakes.



1. AIRBRAKES ADVISORY LIGHT (*Voyant aéro-freins*): Indicates that the airbrakes are not in the retracted position.
2. NOSE WHEEL STEERING ADVISORY LIGHT (*Voyant Dirigeabilité roue avant*): Indicates that the nose wheel steering is engaged. Be aware that the NWS automatically disconnects when ground speed reaches 40 knots.
3. TAIL HOOK ADVISORY LIGHT (*Voyant crosse*): Indicates that the emergency tail hook is down or that the parachute has been deployed. **NOT FUNCTIONAL**
4. BRAKES ADVISORY LIGHT (*Voyant freins*): Indicates that there is more than 25 bars of pressure in the normal brake system.
5. ANTI-SKID WARNING LIGHT (*Voyant système perfectionné anti-dérapant*): Indicates that the Anti-Skid system is disconnected or that the anti-skid test failed. Flashes when the landing gear is in transition.
6. GEAR DOORS UNLOCKED ADVISORY LIGHTS (*Voyant trapes non verrouillé*): Indicates that the landing gear doors are not in the locked-up positions.
7. LOCKED LANDING GEAR ADVISORY LIGHTS (*Indicateur de train verrouillé*): Indicates that each landing gear is down and locked.

9 - AVIONICS

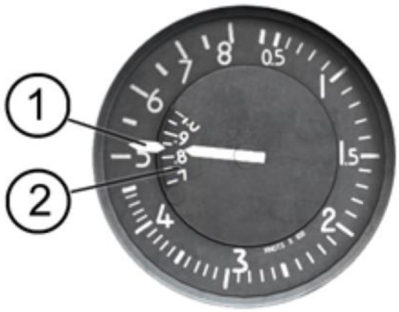
9 – 1 - FLIGHT INSTRUMENTS

ALTIMETER

The altimeter (*altimètre*) displays the aircraft's barometric altitude in feet. The readings are taken from the PS2 static port, part of the air data probe on the nose of the aircraft.

1. Hundreds of feet indicator.
2. Thousands of feet indicators.
3. Barometric setting adjustment knob.
4. Barometric setting display (in millibars).

ANEMOMACHMETER



The anemomachmeter (*anémomachmètre)* displays the aircraft's speed in knots and mach. The needle rotates around the indicator while the Mach wheel rotates underneath, correlating to the knots' needle position to display the mach speed.

1. Speed indicator in hundreds of knots.
2. Speed indicator in Mach.

VERTICAL VELOCITY INDICATOR

The vertical velocity indicator (VVI - *Variomètre*) displays the aircraft vertical velocity in thousands of feet per minute.

MAIN ATTITUDE INDICATOR

The main attitude indicator (IS - *Indicateur sphérique*) provides aircraft attitude, heading, marker overfly indication as well as ILS localizer and glideslope deviation. The instrument gets its attitude and heading from the INS.

On the sphere each pitch markings indicate 10° and each heading markings indicate 10°. The Bank markings indicate 10° with bigger markings at each 30°.

The pole command locks the instrument in the south pole position to prevent the display of incorrect information to the pilot in case of malfunction of the instrument or the INS.

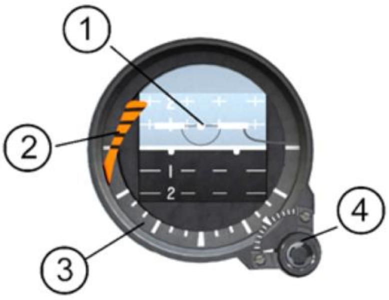
1. Roll angle indicator.
2. Malfunction flag.
3. Aircraft symbol (fixed).
4. Marker light.
5. Turn slip ball.
6. Course deviation needle.
7. Glideslope deviation needle.
8. Pole command.

ANGLE OF ATTACK INDICATOR

The angle of attack indicator (AoA - *indicateur d'incidence*) displays the vertical angle between the aircraft's waterline and its flight path. The instrument displays AoA values from -2º to 32º, with a green mark between 13° and 15° for the optimal approach AoA.

An off flag appears when the instrument is not powered or the AoA value is outside of the display.

STANDBY ATTITUDE INDICATOR



The backup attitude indicator (*Horizon de secours*) provides pitch and roll information. It is a self-contained system with its own gyros. It is powered by the emergency attitude and heading switch.

1. Aircraft symbol (adjustable).
2. OFF flag.
3. Roll angle indicator.
4. Cage/Aircraft symbol adjustment knob.

ACCELEROMETER

The Accelerometer (*Accéléromètre*) displays the aircraft longitudinal load factor in g.

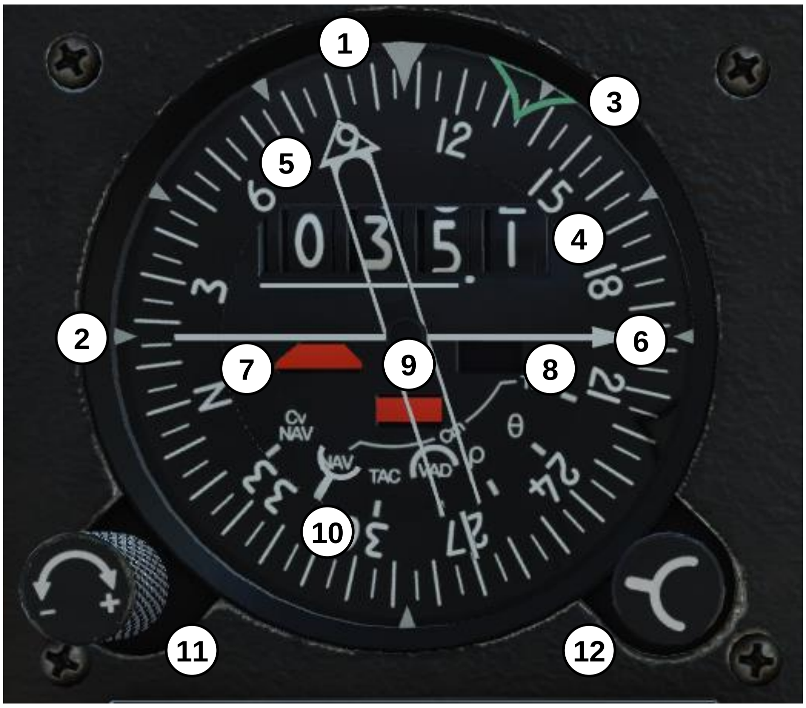
9 – 2 - NAVIGATION INDICATOR

INTRODUCTION

The navigation indicator (IDN - *indicateur de navigation*) is the Mirage main navigation and radio-navigation instrument. It displays the aircraft heading, distance and heading to the DEST BUT, TACAN or VAD, heading to the VOR station, and autopilot bearing index.

The IDN hosts a mode selector that controls the type of data that is displayed on the instrument. It also controls what north reference is used by all the aircraft navigation systems: true or magnetic. The PCN is the only instrument where the headings are always in true north.

NAVIGATION INDICATOR



1. HEADING INDICATOR (*Indicateur de cap*): The heading indicator Indicates the aircraft current heading relative to the mobile compass rose.
2. COMPASS ROSE (*Rose de cap*): Rotates relative to the heading indicator to indicate current aircraft heading. The compass is graduated each 5°, with a longer mark each 10°. The azimuth is present every 30° in tens of degrees except for the 000° where it is replaced with the N letter.
3. AUTOPILOT BEARING INDEX (*Index d'écart de route*): Indicates the selected bearing for the autopilot. See the **AUTOPILOT SUB-SECTION** for more information.
4. DISTANCE WINDOW (*Compteur de distance*): Indicates the distance to the DEST BUT, TACAN or VAD and the VAD azimuth in **θ** mode. A malfunction flag is present over the numbers if there is no distance information available.

5. LARGE NEEDLE (Aiguille large): Indicates the direction to the DEST BUT, TACAN or VAD relative to the compass rose.
6. THIN NEEDLE (Aiguille fine): Indicates the direction of the VOR beacon.
7. THIN NEEDLE FLAG (*Drapeau panne aiguille fine*): Indicates that the thin needle is malfunctioning or not indicating anything.
8. LARGE NEEDLE FLAG (*Drapeau panne aiguille large*): Indicates that the large needle is malfunctioning or not indicating anything.
9. HEADING FLAG (*Drapeau panne CAP*): Indicates that the compass rose is malfunctioning or that the INS does not provide heading information to the instrument. If heading information is available on the VTH, IS, or VTB, crosscheck it with the emergency compass.
10. MODE SELECTOR (Sélécteur de mode): Moves the selected mode indicator.
11. VAD KNOB (Affichage vecteur additionnel): Sets the VAD parameters.
12. SELECTED MODE INDICATOR (Indicateur de mode): Indicates the IDN operation mode, more information in the next section.

IDN MODES

The source of the information displayed on the IDN depends on the selected mode indicator position. The indicator position also sets the north used by the IDN, IS, VTH and VTB: true or magnetic.

IDN INDICATION TABLE

MODE SELECTOR POSITION	CV NAV	CM NAV	TAC	VAD	P	Θ	TEL
COMPASS ROSE	True heading	Magnetic heading					
HEADING FLAG	Indicates a heading malfunction on the instrument or that the INS does not provide heading information.						
WIDE NEEDLE	DEST BUT bearing		TACAN bearing	VAD bearing	VAD heading from TACAN	VAD heading from TACAN	TAF target bearing
WIDE NEEDLE FLAG	Indicates that the wide needle is malfunctioning or that the TAF is not providing target information. The wide needle will place itself 135° relative to the heading indicator.						
THIN NEEDLE	VOR bearing						TAF commanded bearing
THIN NEEDLE FLAG	Indicates that the thin needle is malfunctioning, that no VOR signal is received or that the TAF is not providing target information. The wide needle will place itself 225° relative to the heading indicator.						
DISTANCE WINDOW	DEST BUT distance		TACAN distance	VAD distance	VAD distance from TACAN	VAD bearing from TACAN	TAF target distance
DISTANCE WINDOW FLAG	Indicates that the distance window is malfunctioning, that no TACAN signal is received or that the TAF is not providing target information.						

9 – 3 - ONBOARD RADIOS

INTRODUCTION

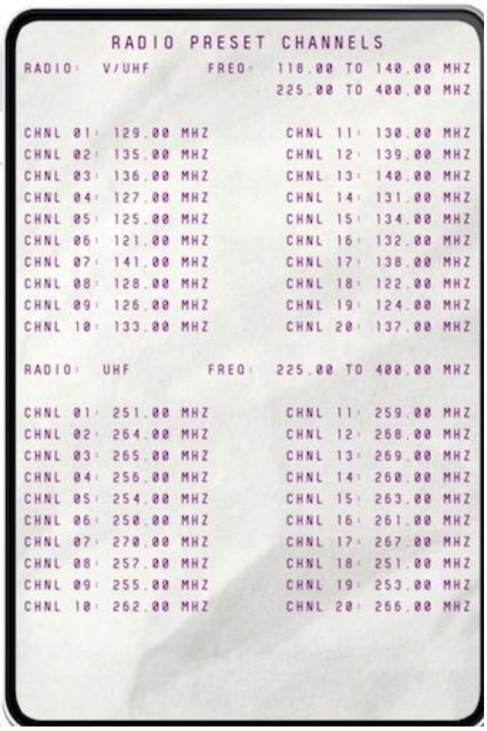
The Mirage 2000C is equipped with 2 onboard radios for communication with other aircrafts and ground stations. The pilot can listen to both radios at the same time but can only transmit on one at a time.

The transmission is controlled by a momentary 3 way switch on the throttle called the radio selection switch (*sélecteur alternat radio*).

RADIO PRESET CHANNELS

The preset channels for both radios are set up by the ground crew before each mission at the pilot request, this allows the pilot to only remember presets in place of frequencies. Preset channels require careful planning from the pilot as they are not editable in flight.

Preset channel can be checked on the "Radio preset channels" kneeboard page and in the data-card kneeboard page in the campaign missions.



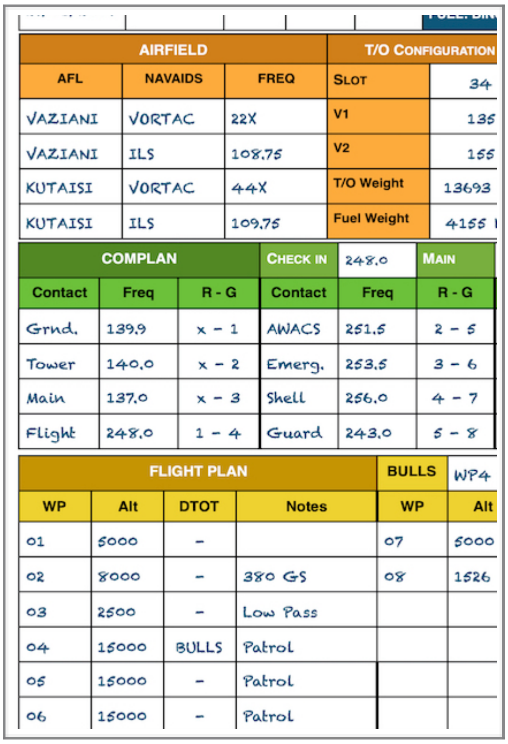
RADIO PRESET CHANNELS

RADIO: V/UHF FREQ: 118.00 TO 140.00 MHZ
225.00 TO 400.00 MHZ

CHNL 01: 129.00 MHZ	CHNL 11: 130.00 MHZ
CHNL 02: 135.00 MHZ	CHNL 12: 139.00 MHZ
CHNL 03: 136.00 MHZ	CHNL 13: 140.00 MHZ
CHNL 04: 127.00 MHZ	CHNL 14: 131.00 MHZ
CHNL 05: 125.00 MHZ	CHNL 15: 134.00 MHZ
CHNL 06: 121.00 MHZ	CHNL 16: 132.00 MHZ
CHNL 07: 141.00 MHZ	CHNL 17: 138.00 MHZ
CHNL 08: 128.00 MHZ	CHNL 18: 122.00 MHZ
CHNL 09: 126.00 MHZ	CHNL 19: 124.00 MHZ
CHNL 10: 133.00 MHZ	CHNL 20: 137.00 MHZ

RADIO: UHF FREQ: 225.00 TO 400.00 MHZ

CHNL 01: 251.00 MHZ	CHNL 11: 259.00 MHZ
CHNL 02: 264.00 MHZ	CHNL 12: 268.00 MHZ
CHNL 03: 265.00 MHZ	CHNL 13: 269.00 MHZ
CHNL 04: 256.00 MHZ	CHNL 14: 260.00 MHZ
CHNL 05: 254.00 MHZ	CHNL 15: 263.00 MHZ
CHNL 06: 250.00 MHZ	CHNL 16: 261.00 MHZ
CHNL 07: 270.00 MHZ	CHNL 17: 267.00 MHZ
CHNL 08: 257.00 MHZ	CHNL 18: 251.00 MHZ
CHNL 09: 255.00 MHZ	CHNL 19: 253.00 MHZ
CHNL 10: 262.00 MHZ	CHNL 20: 266.00 MHZ



AIRFIELD			T/O CONFIGURATION	
AFL	NAVAIDS	FREQ	SLOT	34
VAZIANI	VORTAC	22X	V1	135
VAZIANI	ILS	108.75	V2	155
KUTAISI	VORTAC	44X	T/O Weight	13693
KUTAISI	ILS	109.75	Fuel Weight	4155

COMPLAN			CHECK IN	248.0	MAIN
Contact	Freq	R - G	Contact	Freq	R - G
Grnd.	139.9	x - 1	AWACS	251.5	2 - 5
Tower	140.0	x - 2	Emerg.	253.5	3 - 6
Main	137.0	x - 3	Shell	256.0	4 - 7
Flight	248.0	1 - 4	Guard	243.0	5 - 8

FLIGHT PLAN				BULLS	WP4
WP	Alt	DTOT	Notes	WP	Alt
01	5000	-		07	5000
02	8000	-	380 GS	08	1526
03	2500	-	Low Pass		
04	15000	BULLS	Patrol		
05	15000	-	Patrol		
06	15000	-	Patrol		

V/UHF RADIO COMMAND PANEL

The V/UHF radio provides two-way voice communication on VHF and UHF frequency range. Frequencies can be set manually or selected via a preset memory rotator. The radio also features a buffer memory that stores the last selected radio frequency so it can be quickly selected.

The V/UHF radio frequency range is:

- VHF: 118.000 to 155.975 MHz
- UHF: 225.000 to 339.975 MHz

The V/UHF radio is referenced as the "**green**" radio, as the associated volume control knob on the aircraft sound configuration panel is colored green. It can also be called the **main** radio.

The V/UHF radio frequency displaye is repeated on the bottom row of the V/UHF frequency repeater.

1. RADIO FREQUENCY DISPLAY (*Afficheur de fréquence*): Displays the operation mode, the currently selected preset channel (indicated by a P followed by the preset number) or frequency.
2. MEM/CLR BUTTON (*Boutton MEM/CLR*):
   - **MEM** (Memory): Displays the value recorded in the radio's buffer memory (can be a channel or frequency) on the V/UHF radio display.
   - **CLR** (Clear): Deletes the previous input.
3. XFR/VAL BUTTON (*Boutton XFR/VAL*):
   - **XFR** (Transfer): Selects the buffer memory frequency as the active frequency.
   - **VAL** (Validate): Validates the input displayed on the V/UHF radio display.

4. OPERATION MODE SWITCH (*Sélécteur de mode d'opération*): Selects the radio operation mode:
   - **0** (Off): No power is applied, the display remains blank.
   - **FF (**Fixed frequency): Normal operating mode.
   - **HQ** (Have quick): NOT FUNCTIONAL
   - **SV** (Secure voice): NO FUNCTION
   - **DL** (Data link): NO FUNCTION
   - **G** (Guard): Sets the radio frequency to 243.000 MHz.
   - **EN** (Settings): NOT FUNCTIONAL
5. RADIO KEYPAD (*Clavier de configuration radio*): Selects the preset radio channel or sets the manual frequency. The keys can also display a green dot indicating that the key CONF option is active. Can also set radio option when in configuration mode.
6. CONF BUTTON (*Boutton CONF*): **CONF** (configuration), switches the radio keypad between configuration and normal mode.
7. PRESET CHANNEL SELECTOR (*Sélecteur canal radio*): Selects the V/UHF radio preset channel. If the radio frequency was set manually, it will switch back to preset channels.

SELECT A RADIO PRESET CHANNEL

The V/UHF radio preset channel can be set by 2 ways:

- Using the preset channel selector, the pilot needs to rotate the selector clockwise to increase or counterclockwise to decrease the selected preset channel. The new preset channel will be displayed on the radio frequency display.
- Using the keypad, the pilot needs to input the 2 digits of the preset channel number and press **VAL**. If the preset channel number is not valid, the radio will stay on the current preset channel.

SET A MANUAL FREQUENCY

On the V/UHF radio, the frequency can be set manually using the keypad. The pilot needs to input the 5 digits of the frequency using the keypad. The radio frequency display will show the manual frequency input and when the **VAL** button is pressed the new frequency will be saved as the active frequency. If the inserted frequency input is not valid, the radio will stay on the current preset channel or manual frequency.

RADIO KEYPAD CONFIGURATION MODE

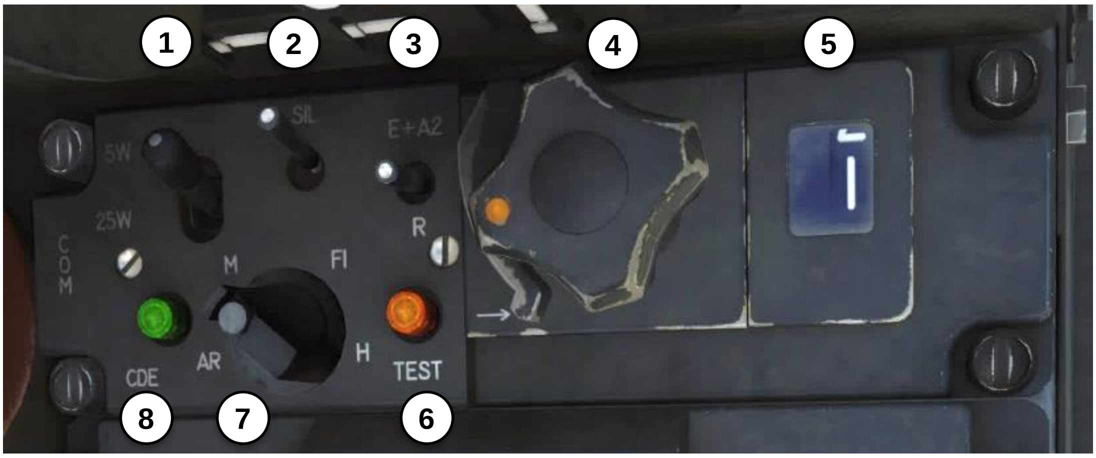
1. **READ**: Displays the frequency of the selected preset channel.
2. **SQL** (Squelch). Toggles squelch on and off.
3. **GR**: (Guard). Enables the background monitoring of the guard frequency (243.000 MHz).
4. **5/20**: Selects the transmission power for the radio. **NOT FUNCTIONAL**
5. **TONE**: **NOT FUNCTIONAL**
6. **TOD** (Time of day): **NOT FUNCTIONAL**

UHF Radio command panel

The UHF radio provides two-way voice communication on the UHF frequency range. Frequencies are memorized in 20 preset channels.

The UHF radio frequency range is 225.000 to 399.975 MHz.

The UHF radio is referenced as the "red" radio, as the associated volume control knob on the aircraft sound configuration panel is colored red. It can also be called the **auxiliary** or **secondary** radio.



1. Transmit power selector (*Inverseur de puissance d'émission*): Selects the radio transmission power. NO FUNCTION
2. SIL Switch (*Inverseur SIL*): Switches ON or OFF the automatic noise suppression feature.
3. Test switch (*Sélecteur de test*): NOT FUNCTIONAL
4. Preset channel selector (*Sélecteur canal radio*): Selects the UHF radio preset channel.
5. Preset channel indicator (*Indicateur canal radio*): Displays the currently selected preset channel.
6. Test button (*Bouton de test*): Tests the radio function, static should be heard.
7. Operation mode switch (*Sélecteur de mode d'opération*): Selects the radio operation mode:
   - **AR** (*Arrêt*): Off, no power is applied.
   - **M** (*Marche*): On, power is applied and the radio is set to the preset channel displayed on the preset channel indicator.
   - **F1** (Reception F1): Sets the radio for communication with the CDC trough the EVF panel.
   - **H** (*Homing*): NO FUNCTION
8. Secure encryption light (*Voyant d'encryption*): NO FUNCTION

V/UHF FREQUENCY REPEATER

The V/HUF frequency repeater repeats the V/UHF radio frequency display.

1. UHF RADIO REPEATER (*Répétition radio UHF*): Would indicate current UHF radio frequency in MHz.

   As the Mirage's UHF radio is not compatible with the frequency repeater, only asterisks are displayed.

2. V/UHF RADIO REPEATER (*Répétition radio V/UHF*): Mirrors the V/UHF radio frequency display. Flashes to indicate that the radio is transmitting.

3. UHF RADIO RECEIVE LIGHT (*Voyant de réception UHF*): Would lights up to indicate that the aircraft is receiving on the V/UHF radio.

   As the Mirage's UHF radio is not compatible with the frequency repeater, this light has no function.

4. V/UHF RADIO RECEIVE LIGHT (*Voyant de réception V/UHF*): Lights up to indicate that the aircraft is receiving on the V/UHF radio.

EDITING RADIO PRESET CHANNELS

Both radios preset channels can be edited in Mission Editor under the frequency tab for player and client aircrafts.

9 – 4 - AIRCRAFT SOUND CONFIGURATION PANEL

The aircraft sound configuration panel (SIB - *Système d'intercommunication de bord)* is located on the left console, aft of the radar control panel and throttle. Its main function is to adjust the aircraft sounds.

For each knob, rotating clockwise increases and counter-clockwise decreases the audio level.

1. AMPLIFIER SELECTOR SWITCH (*Sélecteur d'amplis*): Selects which amplification chain is used.
2. VOR/ILS VOLUME CONTROL KNOB (*Potentiomètre VOR/ILS*): Sets the volume for the VOR/ILS Morse code.
3. TACAN VOLUME CONTROL KNOB (*Potentiomètre TACAN*): Sets the volume for TACAN beacon identification Morse code.
4. MISSILE VOLUME CONTROL KNOB (*Potentiomètre missiles*): Sets the volume of the missile tones.
5. INTERCOM/CALL VOLUME CONTROL KNOB (*Touche potentiomètrique téléphone de bord et appel*): The intercom is only used in the Mirage 2000B two-seater aircraft. The call pushbutton is unused. This knob is unused in the Mirage 2000C. **NO FUNCTION**
6. GROUND COMMUNICATIONS/MARKER/ELECTRONIC COUNTERMEASURES VOLUME CONTROL KNOB (*Touche potentiomètrique téléphone de piste, marker et contre-mesures électroniques):* Sets the audio volume of the ground communications, marker beacon and electronic countermeasure. When pressed with the ground communication cord connected, the throttle radio selection switch is inhibited.
7. UHF RADIO VOLUME CONTROL KNOB (*Potentiomètre d'écoute UHF*): Sets the volume of the **red** (UHF - auxiliary) radio. The radio gets its name from the color of the knob.
8. V/UHF RADIO VOLUME CONTROL KNOB (*Potentiomètre d'écoute V/UHF*): Sets the volume of the **green** (V/UHF - main) radio. The radio gets its name from the color of the knob.

10 - NAVIGATION AND WEAPON SYSTEM

SECTION 10

SNA

INTRODUCTION

The navigation and weapon system (SNA – *système de navigation et d'armement*) represents the operating system that is in charge of the interface between the pilot and the different systems of the aircraft. The SNA is organized in modes with options that the pilot can select through PCA and HOTAS commands.

There are 4 SNA modes:

- Navigation mode
- Air-to-air mode
- Air-to-ground mode
- Jettison mode

These modes can be selected by 3 ways:

- Priority selection
- PCA selection
- Selective jettison

Additionally, the air-to-ground mode has 3 sub-modes:

- Pre-selected
- Selected
- Memorized

The HOTAS commands that interact with the SNA are:

- Weapon system command
- Weapon system paddle
- MAGIC search/Vertical fix command
- CNM switch

The SNA also controls the MAGIC background search (MAV – *MAGIC veille*) and selected search sector.

10 – 1 - SNA MODES SELECTION

PRIORITY SELECTION

The priority selection overrides any other previously selected normal or jettison mode. They are selected when the CNM HOTAS command is in the C (*cannon air-air* – air-to-air gun) or M (MAGIC) position.

The previously selected mode and options are memorized while a priority mode is active, they are restored once the CNM HOTAS command is returned to the N (*neutre* – neutral) position.

AIR-TO-AIR GUN

Selected when the CNM HOTAS command is in the C (*cannon air-air* – air-to-air gun) position, it sets the SNA in air-to-air mode.

MAGIC

Selected when the CNM HOTAS command is in the M (MAGIC) position, it sets the SNA in air-to-air mode

PCA SELECTION

The PCA selection is only possible if the HOTAS CNM command is in the N (*neutre* – neutral) position and the selective jettison switch is in the N position.

Navigation options selected on the PCA are kept when switching between navigation and air-to-ground mode.

NAV

Active when no weapon is selected on the PCA, it sets the SNA in navigation mode.

BL

Active when any BLx or BLF is selected on the PCA bottom row, it sets the the SNA in air-to-ground mode.

BF

Active when any BFx or BFF is selected on the PCA bottom row, it sets the SNA in air-to-ground mode.

CAS OR RK

Active when RK, RKF or CAS is selected on the PCA bottom row, it sets the SNA in air-to-ground mode.

POLICE

Active when the POL option is selected on the PCA top row, it sets the SNA is in air-to-air mode.

530

Active when 530 is selected on the PCA bottom row, it sets the SNA in air-to-air mode.

SELECTIVE JETTISON

The selective jettison mode is selected by placing the selective jettison switch in the SEL position. This mode can only be selected if the HOTAS CNM command is in the N (*neutre* – neutral) position.

The previously selected mode and options are memorized while this mode is active. They are restored once the selective jettison switch is returned to the N position.

AIR-TO-GROUND SUB-MODES

The air-to-ground sub-modes are select through the HOTAS weapon system command (WSC).

PRE-SELECTED

Default mode when the SNA is set to air-to-ground mode, in this mode, the VTH stays in NAV mode and the PCA displays the weapon options on the top row.

SELECTED

Active when the SNA is in air-to-ground mode and the WSC forward has been pressed. In this mode, the VTH displays weapon employment symbology and the PCA displays the weapon options on the top row. The radar is forced into emission in TAS mode if the TAS option is selected on the PCA.

MEMORIZED

Active when the SNA is in air-to-ground mode and the WSC aft has been pressed. In this mode, the VTH stays in NAV mode and the PCA displays navigation options on the top row.

10 – 2 - HOTAS SNA COMMANDS

WEAPON SYSTEM COMMAND

The weapon system command (*commande temps réel SNA* – WSC) has different functions depending on the SNA mode.

SNA IN AIR-TO-GROUND MODE

With the SNA in air-to-ground mode, 3 sub-mode can be selected:

- SELECTED (*Sélectionné*): The PCA top row displays weapon options and the VTH displays the weapon employment symbology.
- PRE-SELECTED (*Pré-sélectionné*): The PCA top row displays weapon options and the VTH is in NAV mode.
- MEMORIZED (*Mémorisé*): The PCA top row displays NAV options and the VTH is in NAV mode.

The SNA defaults to the pre-selected mode when an AG weapon is selected on the PCA. The mode can be changed using the weapon system command forward and aft. The weapon system command will follow the following logic:

- **Forward**: Sets the SNA in air-to-ground selected mode.
- **Depress**: No function.
- **Aft**: Each press will switch between the SNA pre-selected and memorized mode.

This logic results in the following behavior:

- While in selected:
    - **Forward**: No action.
    - **Aft**: The SNA is set to air-to-ground memorized mode.
- While in pre-selected:
    - **Forward**: The SNA is set to air-to-ground selected mode.
    - **Aft**: The SNA is set to air-to-ground memorized mode.
- While in memorized:
    - **Forward**: The SNA is set to air-to-ground selected mode.
    - **Aft**: The SNA is set to air-to-ground pre-selected mode.

SNA IN NAV OR AIR-TO-AIR MODE

With no weapon or an air-to-air weapon selected, WSC forward and aft select close combat modes while WSC depress returns the radar to line search. For more information, see the RADAR HOTAS CONTROLS SUB-SECTION.

WEAPON SYSTEM PADDLE

The weapon system paddle (*palette SNA*) has different functions depending on the SNA mode.

In any other SNA modes, the paddle has no function.

NAVIGATION

- **Radar fix**: Execute a navigation fix at the position of the designation diamond on the VTH.
- **Approach**: Toggle the declutter of the VTH ILS symbology.

AIR-TO-GROUND SELECTED

- **CCPL**: Designate the intended impact point for the bombs to the position of the designation diamond on the VTH.
- **CCPL PI**: Execute a navigation fix at the position of the designation diamond on the VTH.

If the weapon delivery mode is not CCPL or CCPL PI, the paddle has no function.

MAGIC SUB-MODE OR MAV SELECTED

- **Radar locked**: Slave the MAGIC missiles to the radar line of sight in an attempt lock the radar target.
- **MAGIC locked**: Slave the radar to the MAGIC missiles line of sight in an attempt lock the MAGIC target.

If the radar and MAGIC are locked on different target or none of them are locked, the paddle has no function.

MAGIC SEARCH/VERTICAL FIX COMMAND

The MAGIC search/vertical fix command (*recherche MAGIC/recalage vertical*) has different functions depending on the SNA mode.

NAVIGATION

Initiates a vertical navigation fix, same function as the REC key on the PCN.

MAGIC SUB-MODE OR MAV SELECTED

Switches between the available MAGIC search sectors.

This function has priority over the other, if MAV is selected while the SNA is in MAV mode, the MAGIC search/vertical fix command can’t be used to initiate a vertical navigation fix.

CNM SWITCH

The CNM switch (*sélecteur armement CNM*) function is the same irrelevant of the SNA mode.

- **C** (*Canons air-air* – Air-to-air guns): Rightmost position, selects the air-to-air gun and sets the SNA in air-to-air mode.
- **N** (*Neutre* – Neutral): Center position, returns to the previously selected SNA mode and weapon.
- **M** (MAGIC): Leftmost position, selects the MAGICs and sets the SNA in air-to-air mode.

There is a 0,5 second delay before the CNM switch neutral position is registered to allow the SNA to be switched between air-to-air gun and MAGIC modes without returning to the previous selection.

10 – 3 - MAGIC SEARCH

On the Mirage 2000C, the MAGIC missiles can search and track aircraft independently of the radar. This search function is automatically executed when the MAGICs or air-to-air guns are selected but can also be manually selected in most modes by selecting MAV (*MAGIC veille* – MAGIC background search) mode.

SEARCH SECTORS

When the MAGICs, air-to-air guns or MAV are selected, the MAGIC missile will perform a target acquisition search following a specific pattern. Multiple search pattern exists and are defined by the sector they scan:

- VERTICAL WIDE (*Vertical large*): A 18° wide and 37° tall rectangle shaped search sector with its bottom located 6,5° bellow the gun cross position.

  This search sector is selected by default when the MAGICs or air-to-air guns are selected.

  It is represented on the VTH by the MAGIC search sector symbology, a vertical double arrow right of the selected sub-mode.
- VERTICAL NARROW (*Vertical étroit*): A 7° box shaped search sector centered on the gun cross position.

  This search sector is selected pressing the MAGIC search/vertical fix HOTAS command while in vertical wide mode.

  While in vertical narrow, another MAGIC search/vertical fix HOTAS command press will return the search sector to vertical wide.

  It is represented on the VTH by the MAGIC search sector symbology, a vertical double arrow right of the selected sub-mode and the MAGIC narrow search symbology, the corners of a square located around the gun cross position.

  The MAGIC narrow search symbology represents the limits of the search sector.
- HORIZONTAL WIDE (*Horizontal large*): With a missile on each side, a 68° wide, 14° tall rectangle shaped search sector with its bottom located 2° above the gun cross position.

  With only 1 missile, a 35° wide, 14° tall rectangle shaped search sector with its bottom located 2° above the gun cross position.

  This search sector is selected by default when in MAV mode.

  It is represented on the VTH by the MAGIC search sector symbology, a horizontal double arrow right of the selected sub-mode.
- HORIZONTAL NARROW (*Horizontal étroit*): A 7° box shaped search sector centered on the gun cross position.

  This search sector is selected pressing the MAGIC search/vertical fix HOTAS command while in horizontal wide.

  While in horizontal narrow, another MAGIC search/vertical fix HOTAS command press will return the search sector to horizontal wide.

It is represented on the VTH by the MAGIC search sector symbology, a horizontal double arrow right of the selected sub-mode and the MAGIC narrow search symbology, the corners of a square located around the gun cross position.

The MAGIC narrow search symbology represents the limits of the search sector.

MAGIC BACKGROUND SEARCH

MAGIC background search (*MAV – MAGIC Veille*) allows the MAGIC missile to perform a contact acquisition search pattern when the MAGICs or air-to-air guns are not selected. It is selected by pressing the PCA weapon selection button under the MAG window. The MAG window will read MAV to indicate that MAGIC background search is active. The vertical search sectors are not available when MAV is selected.

MAV can be selected in any SNA mode and sub-mode but will be inactive in air-to-ground selected. MAV selection will be memorized between SNA modes and sub-modes.

MAV can also be selected while the MAGICs or air-to-air guns are selected to access the horizontal search sectors.

When the SNA is in NAV mode and MAV is selected, the MAGIC search/vertical fix HOTAS command won't initiate a vertical navigation fix, it will toggle between the horizontal wide and narrow search sectors.

11 - WEAPONS CONTROL PANEL

11 – 1 - WEAPON CONTROL PANEL

The weapon control panel (PCA – *poste de commande armement*) is located to the left of the VTB. It consists of 2 rows of five LCD displays with buttons below them, the master arm switch, the selective jettison guarded switch and an additional button for the air-to-ground gun mode.

The PCA controls the SNA modes and is used to select weapons for employment or jettison. The options displayed in the top row change based on the SNA mode while the bottom row displays the aircraft underwing ordinance.

1. MASTER ARM SWITCH (*Sécurité armement*): Allows weapon release.
2. SELECTIVE JETTISON SWITCH (*Inverseur sélectif*): Sets the SNA into selective jettison mode.
3. AIR-TO-GROUND GUNS SELECTION BUTTON (CAS - *Touche de sélection canons air-sol*): Selects the air-to-ground gun mode.
4. SNA OPTION DISPLAY (*Affichage des options du mode SNA*): Displays the curent SNA mode and sub-mode options. The display is divided into 5 sections, each containing a 3 letters segment display. Different options are displayed depending on the SNA mode, sub-mode and selected weapon.
5. SNA OPTION SELECTION BUTTONS (*Touches de sélection des options SNA*): Selects the option displayed in the SNA mode option display section on top of it. A yellow S is lit up on the button to indicate that the SNA option is selected.
6. LOADED STORES DISPLAY (*Affichage des emports présents*): Displays the aircraft's loaded stores as set by the ground crew at rearming. Can also display fictive weapon for training and stores configuration errors.
7. STORE SELECTION BUTTONS (*Touches de sélection des emports sous voilure*): Selects the store displayed in the loaded store display on top of the button. A yellow **S** is lit up on the button to indicate that the store is selected and a yellow **P** to indicate that the store is ready to be fired or released.

11 – 2 - SNA OPTIONS

INTRODUCTION

The PCA top row displays the options for the current SNA mode. The listed options depend on the SNA mode, sub-mode and selected weapon.

The SNA options are selected using the corresponding SNA option selection button, a yellow S is lit up on the button to indicate that the SNA option is selected.

SNA IN NAVIGATION MODE

With the SNA in navigation mode, the PCA top row will display navigation options and police mode selection.

- **TOP** (Go): Displays the speed guidance symbology on the VTH and start the speed guidance according to the TD (temps désiré – time to target) set for the current DEST BUT.
- **POL** (Police): Selects the police mode and set the SNA in air-to-air mode.
- **APP** (*Approche* – Approach): Selects the approadche sub-mode for the VTH.
- **RD** (*Route désirée* – Desired heading): Displays the desired heading symbology on the VTH.
- **OBL** (*Recallage oblique* – Radar navigation fix): Displays the radar navigation fix symbology on the VTH.

SNA IN AIR-TO-AIR MODE

With the SNA in air-to-air mode, the PCA top row will display weapon and radar options depending on the selected weapon.

POLICE

530

MAGIC

AIR-TO-AIR GUNS

- **RDO** (*Raliement désignation d'objectif* – Radar target designation): Selects or deselects the radar target designation generation. Selected by default when an air-to-air weapon is selected.
- **POL** (Police): Selects or deselects the police mode.
- **TAF** (*Télé-affichage* – Remote target designation): Toggles the display of the remote target designation on the VTB.
- **ARR** (*Arrière* – Rear): Changes the interception director behavior to guide the aircraft to the rear of the locked target.
- **LEN** (*Lent* – Low): Selects the low (1200 rounds/min) rate of fire for the guns.
- **RAP** (*Rapide* – High): Selects the high (1800 rounds/min) rate of fire for the guns. Selected by default.

SNA IN AIR-TO-GROUND MODE

With the SNA in air-to-ground mode, the PCA top row depends on the selected sub-mode. In memory mode, the top row will display the same options as in NAV mode, while in selected and pre-selected mode, the PCA top row will display weapon options and ranging selection depending on the selected weapon.

LOW AND HIGH DRAG BOMBS

LOW AND HIGH DRAG BOMBS WITH PI SELECTED

ROCKETS

AIR-TO-GROUND GUNS

- **TAS** (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- **RS** (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.
- **ZBI** (*Altitude barométrique* – Baro-altimetric ranging): The altitude difference between the aircraft and the impact point altitude is used to know the aircraft's altitude over the impact point. This information coupled with the aircraft attitude is then used to determine the range to the impact point.
- **PI** (*Point initial* – Initial point): Selects the PI mode for the current bomb mode.
- **EXT** (*Extérieur* – Outboard): The outboard pylons are selected for rocket firing. Only displayed if rockets pods are loaded on both the external and internal wing hardpoints.
- **INT** (*Intérieur* – Inboard): The inboard pylons are selected for rocket firing. Only displayed if rockets pods are loaded on both the external and internal wing hardpoints.
- **LEN** (*Lent* – Low): Selects the low (1200 round/min) rate of fire for the guns.
- **RAP** (*Rapide* – High): Selects the high (1800 round/min) rate of fire for the guns. Selected by default.

11 – 3 - LOADED STORES

The PCA bottom row displays and allow the selection of the stores loaded on the aircraft. The stores are displayed in the following order:

- MAGICs
- Super 530D
- External tanks
- Low drag bombs
- High drag bombs
- Rockets
- Fictive weapons in the same order as real weapons.

The stores are represented by a 2 or 3 digit code, for more information see the WEAPONS LOADOUT CHART SUB-SECTION.

The stores displayed on the bottom row correspond to the stores loaded on the aircraft after rearming. The display does not update itself when a store is no longer present on the aircraft.

The leftmost window is reserved for the MAGICs, if the missiles are not loaded on the aircraft, the window is blank.

The stores are selected using corresponding store selection button, a yellow S is lit up on the button to indicate that the store is selected. A yellow P indicates that the store is ready to be fired or released.

The store selection button under the MAGIC window will not select the MAGICs but select and deselect the MAV (*magic veille* – magic background search) mode, for more information see the NAVIGATION AND WEAPON SYSTEM MAGIC SEARCH SUB-SECTION.

External fuel tanks cannot be selected.

11 – 4 - SELECTIVE JETTISON

In selective jettison mode, the PCA top row is blank while the bottom row displays the stores that can be jettisoned from the aircraft. Only the stores that are still present and can be jettisoned from the aircraft are displayed.

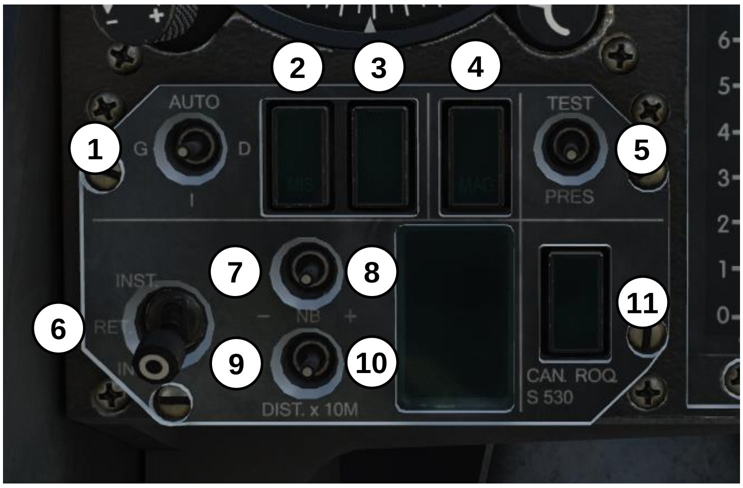
The stores are selected for jettison with the corresponding weapon selection button, a yellow S is lit up on the button to indicate that the store is selected for jettison. The selected stores are then jettisoned using the MiCRoB second stage trigger.

12 - WEAPONS PREPARATION PANEL

WEAPON PREPARATION PANEL

The weapon preparation panel (PPA – *poste de préparation armement*) is located to the right of the VTB. It is divided into 5 areas, each with their functions:

- Top-left: Super 530 missile selection, preparation and status.
- Top-center: Magic missile preparation and status.
- Top-right: Lights test and VTB aircraft loadout switch.
- Bottom-left: Bomb release configuration and fusing.
- Bottom-right: Weapon ripple selection.



1. MISSILE SELECTION SWITCH (*Sélecteur du missile à tirer*): Selects which Super-530D missile has the priority:
    - **G** (*Gauche* – Left): The left missile has priority.
    - **AUTO** (*Automatique* – Automatic): The SNA selects which missile has priority.
    - **D** (*Droite* – Right): The right missile has priority.
2. S530 PREPARATION BUTTON (*Touche de préparation S530*): Selects or deselects the preparation of the Super 530D missiles. The button also has 2 yellow lights:
    - P (*Préparation* – Warm-up):
        - Fixed, indicates that the Super 530D missiles are ready.
        - Flashing, indicates that the Super 530D missiles are either in the post-startup delay mode or executing the preparation sequence.
    - MIS (*Missile*): Indicates that Super 530D missiles are loaded on the aircraft.
3. S530 FIRE SELECTION BUTTON (*Touche de sélection tir automatique/manuel*): Selects either the automatic or manual fire mode for the Super 530D missiles:
    - AUT (*Automatique* – Automatic): The weapon fire command act as a weapon release consent, the aircraft fire the missile when the condition provides a good probability of kill
    - MAN (*Manuel* – Manual): The weapon fire command fires the missile when pressed.

This button is a remnant of earlier 2000C RDM versions and has no effect in our 2000C S-5 RDI. NO FUNCTION

4. MAGIC PREPARATION BUTTON (*Touche de préparation MAGIC*): Selects or deselects the preparation of the MAGIC II missiles. The button also has 2 yellow lights:
    - P (Préparation – Warm-up):
        - Fixed, indicates that the MAGIC II missiles are ready.
        - Flashing, indicates that the MAGIC II missiles are either in the post-startup delay mode or executing the preparation sequence.
    - MAG (*MAGIC*): Indicates that MAGIC II missiles are loaded on the aircraft.
5. LIGHT TEST AND STORES VISUALIZATION SWITCH (*Sélecteur de test touches et visualisation des présences*): 2 functions momentary switch:
    - **TEST**: Turns on all the PCA and PPA buttons yellow lights.
    - **PRES** (*Présences* – Stores): Displays the stores visualization screen on the VTB display. For more information see the **RADAR VTB SYMBOLOGY SUB-SECTION**.
6. FUSE SELECTION SWITCH (*Inverseur de sélection des fusées*): Selects which fuse to use for the selected weapon. This selection only impact bombs:
    - **INST.** (*Instantané* – Instantaneous):
        - Mk-82, Mk-82Snakeye/Air, GBU-12/16/24: Arms the nose and tail fuse.
        - BAP-100: Arms the retarded fuse.
        - BLG-66: Selects the short dispersion area.
    - **RET.** (*Retardé* – Retarded):
        - Mk-82, Mk-82Snakeye/Air, GBU-12/16/24: Arms the tail fuse.
        - BAP-100: Arms the retarded fuse.
        - BLG-66: Selects the long dispersion area.
    - **INERT.** (*Inerte* – Inert): No fuse is armed, the bombs won't explode.
7. SALVO BOMB QUANTITY SWITCH (*Inverseur nombre de bombes en salve*): Selects the quantity of bombs released per salvo as displayed on the salvo bomb quantity display.
8. SALVO BOMB QUANTITY DISPLAY (*Afficheur nombre de bombes en salve*): Displays the selected quantity of bomb released per salvo, from 00 to 18.
9. SALVO BOMB INTERVAL SWITCH (*Inverseur intervalle entre les bombes en salve*): Selects the interval between the impact point of each bombs of the salvo as displayed on the salvo bomb interval display.
10. SALVO BOMB INTERVAL DISPLAY (*Afficheur intervalle entre les bombes en salve*): Displays the selected interval between the impact point of each bomb of the salvo in tens of meters, from 00 to 20.
11. WEAPON SALVO SELECTION BUTTON (*Touche de sélection salve*): Selects between the salvo or total release for the guns, rockets and Super 530D missiles. The button has 2 yellow lights:

- TOT (*Total*):
  - Guns: The guns fire as long as the trigger is pressed.
  - Rockets: The rockets fire as long as the trigger is pressed.
  - Super 530: The 2nd missile will fire 2 seconds after the first if the trigger is held pressed.
- PAR (*Partiel* – Partial):
  - Guns: The guns fire in salvo of 0,5 or 1 second.
  - Rockets: The rockets fire in salvo of 1, 3 or 6 rockets.
  - Super 530: Only 1 missile is fired per trigger press.

13 - HEAD-UP DISPLAY

INTRODUCTION

The head-up display (VTH – visualisation tête haute) is a transparent display used to display navigation and weapon employment symbology. It works by reflecting the light generated by a CRT display on an angled glass in front of the pilot.

The VTH image is collimated to infinity, meaning that in order to see the symbology the pilot eyes needs to be focused on the outside word, not the glass.

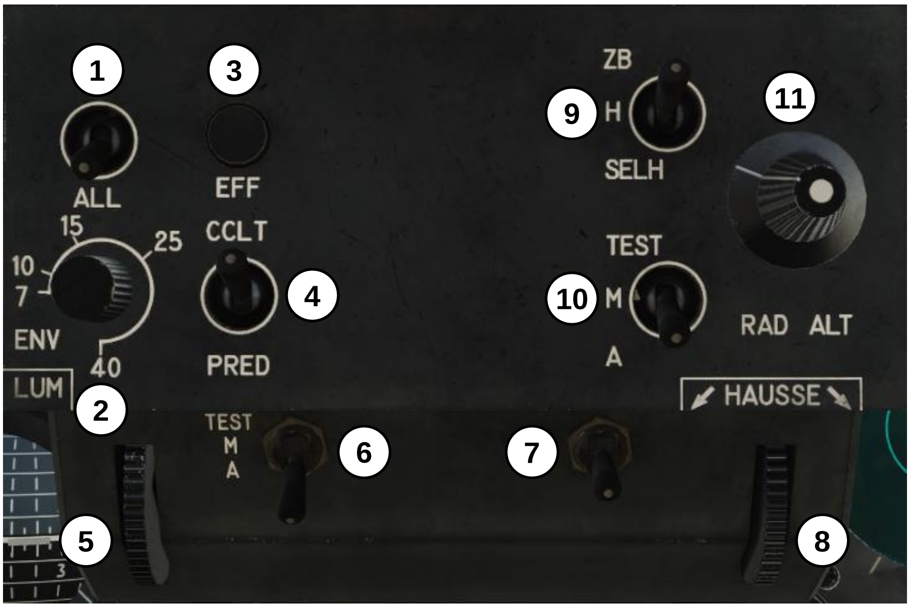
It is also parallax free, the image position relative to the outside word is fixed, irrelevant to the pilot's eyes position.

The Mirage 2000C VTH displayed all the important information relative to the aircraft attitude, altitude and speed at all times and specific symbology for landing, take-off as well as employment symbology for radar and weapon. It is the first advanced VTH in use by the French Air Force.

The Mirage's VTH can be used as a primary instrument, the aircraft can take-off, navigate and land only using the VTH.

13 – 1 - HEAD-UP COMMAND PANEL

The head-up command panel (PCTH – *poste de commande tête haute*) is located at the center dash, just above the VTB.



1. DECLUTTER SWITCH (ALL – *Allègement*): Toggles the decluttering of the VTH symbology, the up position is momentary.
2. TARGET WINGSPAN SCALE (ENV – *Envergure*): Sets the target wingspan for the tracer line in AA gun mode. The available values are between 7 and 40 meters.
3. FICTIVE MASTER ARM BUTTON (EFF – *Effacement*): Used as a safety for training or fictive weapons. **NOT FUNCTIONAL**
4. GUN SHOOT INCITATION SWITCH (*Incitation au tir canon*): Chooses if the gun shoot incitation symbology is activated or not.
   - **CCLT** (*Calcul continu de la ligne de traceurs* – Continuously calculated tracer line): Default mode, no incitation.
   - **PRED** (*Prédiction* – Predictive): The target objective square or coincidence triangle will duplicate if the shooting reticle is going to cross the target.
5. BRIGHTNESS CONTROL (LUM – *Luminosité*): Increases or decreases the VTH brightness.
6. POWER SWITCH: Used to power up and run the VTH test.
   - **A** (*Arrêt* – Off): The VTH is off.
   - **M** (Marche – On): The VTH is on.
   - **TEST**: The VTH enters in test mode. This position is momentary. **NOT FUNCTIONAL**
7. BACKUP FIXED SIGHT (*Hausse manuelle*): Displays the back-up sight for when the main symbology is not usable.

8. BACKUP FIXED SIGHT ADJUSTMENT: Sets the back-up sight deflection based on ballistic tables for the desired range for weapon delivery.
9. ALTITUDE DISPLAY SELECTOR SWITCH. Selects the altitudes to display on the VTH:
   - **ZB**: Only the barometric altitude is displayed.
   - **H**: The radar altitude is displayed in addition to the barometric altitude.
   - **SELH**: Displays the selected minimum altitude as well as the barometric altitude.
10. RADAR ALTIMETER SWITCH. Turns on and start the self-test of the radar altimeter.

CAUTION	Be aware that the radar altimeter has a limit of 5,000 feet AGL. Asterisks will be displayed when the aircraft AGL altitude is above 5,000 feet. Asterisks will also be displayed whenever the aircraft roll angle is higher than 20º, since at that angle the radar altimeter beam cannot give a reliable measure.

11. MINIMUM ALTITUDE SELECTOR (RAD ALT – Radar altitude): The Minimum Altitude (HG - *Hauteur de garde)* is the altitude at which the minimum altitude arrow will be displayed on the VTH an VTB. The minimum altitude selector is used to set the HG when the altitude display selector is in the SELH position. During landings and when the VTH is in APP mode, the HG also works as the Decision Height selector.

13 – 2 - VTH MASTER MODES

The VTH displays information based on the master mode and sub-mode or option. There are 3 master modes, each one has a number of sub-modes and options. Sub-modes are exclusive and options can be combined between them and with some sub-modes.

- NAV MODE: Default mode when no weapon is selected or when an air-to-ground weapon is selected but the SNA is in air-to-ground pre-selected or memorized sub-mode.
    - HEADING ERROR (*Erreur de route*): Default navigation mode, the VTH will display BUT navigation symbology.
    - GROUND (*Roulage*): Automatically displayed when the plane has weight on wheels.
    - APPROACH (*Approche*): Selected with the APP button on the PCA, used for approaches and landings.
    - RADAR FIX (*Recalage oblique*): Selected with the OBL button on the PCA, used to perform an INS radar fix.

  The following options can be selected at the same time:

    - DESIRED HEADING (*Route désirée*): Selected with the RD button on the PCA, used for navigation on a BUT while flying on a selected Heading.
    - DESIRED TIME (*Temps désiré*): Selected with the TOP button on the PCA, used to arrive to a BUT at a predefined time.
- AIR-TO-AIR MODE: Displayed when any air-to-air weapon is selected and in police mode.
    - MAGIC: Displayed when the MAGIC II missile is selected.
    - AIR-TO-AIR GUN: Displayed when the gun is selected in air-to-air mode.
    - 530: Displayed when the Super 530D missiles is selected.
    - POLICE: Used to intercept aircraft in peace times. Selected using the POL button on the PCA.

  The following options can be selected at the same time:

    - AUTO-LOCK: Indicates the currently selected auto-lock mode.

- Air-to-Ground mode: Displayed when an air-to-ground weapon is selected on the PCA and the SNA is in air-to-ground selected sub-mode.
  - Air-to-Ground gun or rocket: Displayed when the CAS (canon air-sol – air-to-ground gun) or the rockets are selected.
  - CCPI (*Calcul continu du point d'impact* – Continuously calculated impact point): Displayed when a high drag (*freinée*) or very high drag (*hyperfreinée*) bomb is selected.
  - CCPL (*Calcul continu du point de larguage* – Continuously calculated release point): Displayed when a low drag (*lisse*) or guided (*guidée*) bomb is selected.

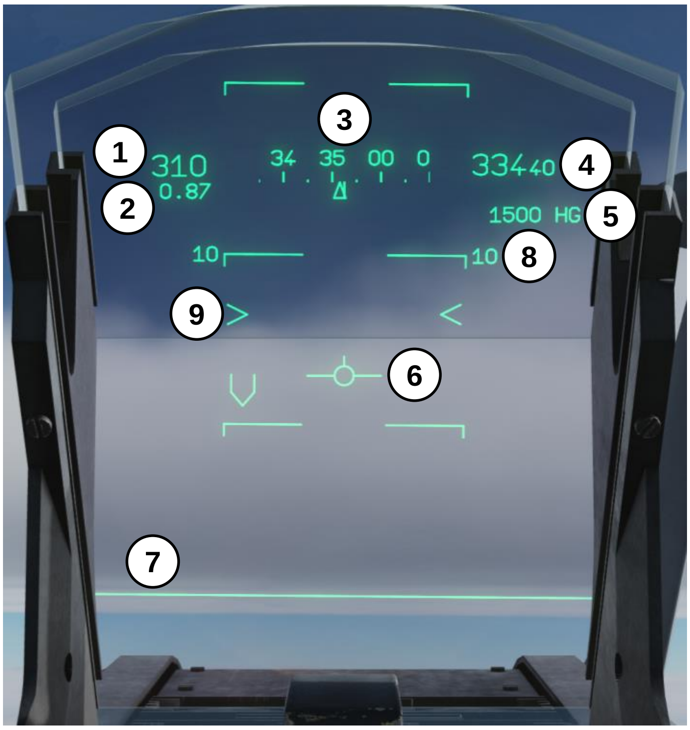
The following options can be selected at the same time:

- PI (*Point initial* – Initial point): Displayed with the PI button when a high drag, very high drag, low drag or guided bomb is selected.

13 – 3 - COMMON SYMBOLOGY

BASE SYMBOLOGY

No matter what Master Mode/Sub-mode is active, all of them share the following symbology.



1. CALIBRATED AIR SPEED (*Vitesse conventionnelle*): Located to the left of the Heading Scale, it shows the current aircraft airspeed in knots. Only shown when the airspeed is above 30 knots.
2. MACH NUMBER (*Mach*): The Mach number is displayed in all modes and only when the value is above 0.6 Mach.
3. HEADING SCALE (*Echelle de cap*): The Heading Scale is located at the top and center of the VTH and moves horizontally against a fixed index caret indicating aircraft heading from 0º to 360º. The scale is numbered tens of degrees, with a dot representing the 5 degrees halfway mark.
    - The vertical line | represents the aircraft heading (*cap*), meaning the direction where the nose of the aircraft is pointing.
    - The triangle Δ represents the aircraft bearing (*route*), meaning the direction where the aircraft is flying. There might be a difference between the aircraft heading and bearing due to the wind.
4. BARO-INERTIAL ALTITUDE (*Altitude baro-recalée*): Located to the right of the Heading Scale, it shows the current aircraft altitude above sea level. The bigger numbers represent the flight level and it can be negative.

CAUTION	The altitude value displayed here is the same as the one presented on the altimeter, it is therefore dependent on the altimeter pressure setting.

5. SELECTED MINIMUM ALTITUDE (*Hauteur de garde radio-altimètre*): Shows the selected minimum altitude. Only displayed when the altitude display selector switch is in the SELH position.

   All the above symbology is shifted to the middle left of the VTH in APP sub-mode and some AA and AG modes. The heading scale only moves in the APP sub-mode

6. FLIGHT PATH MARKER (*Réticule vecteur vitesse*): The FPM, also known as the Velocity Vector Indicator (VVI), is an aircraft shaped symbol that represent the aircraft's instantaneous flight path on the VTH. The wings of the symbol always remain parallel to the wings of the aircraft. The lateral position of the FPM takes the wind into account and will indicate the true path of the aircraft compared to the ground.

   In air-to-air modes and above 20000ft in NAV mode (except in APP), the FPM lateral position drift due to the wind is corrected.

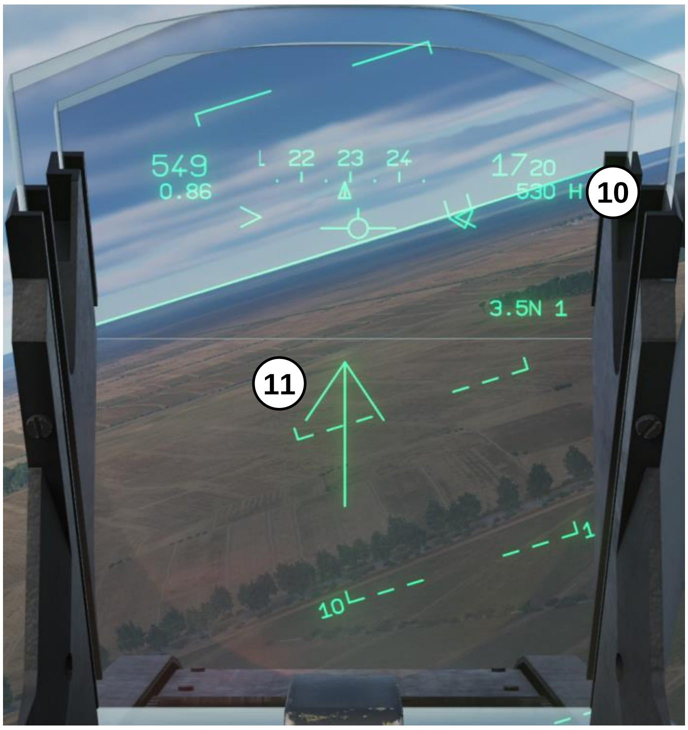
7. HORIZON LINE (*Barre principale d'horizon*): A component of the Flight Path Pitch Ladder in, it indicates the position of the horizon and covers the VTH width.

8. FLIGHT PATH PITCH LADDER (*Barres d'horizon*): The ladder (FPPL) represents the aircraft pitch and roll on the VTH. It moves laterally in relation to FPM. The angle lines are displayed for each 5º with the angle value being displayed every 10º between 0 and ±90º. Positive pitch lines are solid and negative pitch lines are dashed. The tabs at the end of each segment point towards the horizon.

9. ACCELERATION CHEVRONS (*Chevrons d'accélération*): Represents the aircraft longitudinal acceleration. The chevrons move in relation to the FPM:

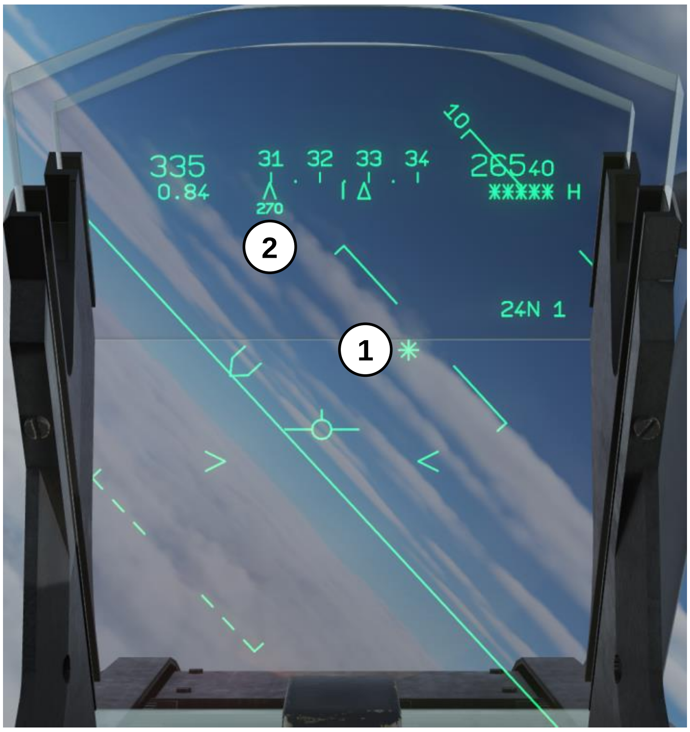
   - When the aircraft is neither accelerating nor decelerating the chevrons and the FPM are at the same level.
   - When the aircraft is accelerating the chevrons are above the FPM.
   - When the aircraft is accelerating the chevrons are below the FPM.

   The position difference between the FPM and the chevrons is relative to the acceleration or deceleration rate.



10. RADAR ALTIMETER (*Hauteur radio-altimètre*): Shows the altitude above the ground in feet. Asterisks will be displayed whenever the aircraft roll angle is higher than 20º or the altitude is higher than 5000 feet. Only displayed when the altitude display selector switch is in the H position. Can be shifted to the middle left of the VTH in APP sub-mode and some AA and AG modes.
11. MINIMUM ALTITUDE ALERT (*Alerte en hauteur radio-alimètre*): Displayed when the current radar altitude is below the selected minimum altitude. Flashing if the altitude display selector switch is in the SELH position, steady in the H position

AUTO-PILOT SYMBOLOGY



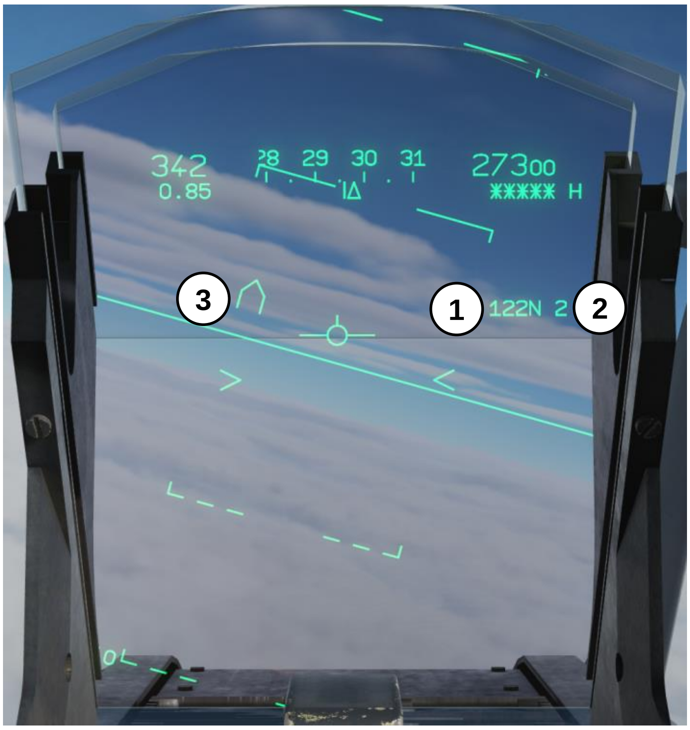
1. AUTOPILOT COMMANDED SLOPE (*Pente commandée pilote automatique*): Displayed when any mode is engaged and the autopilot is not on standby. Represents the pitch the autopilot is aiming to place the FPM at. The asterisk stays aligned with the center of the pitch ladder.
2. AUTOPILOT COMMANDED BEARING (*Route commandée pilote automatique*): The open triangle indicates the autopilot commanded bearing. If the commanded bearing is outside the heading scale limits, the commanded bearing is displayed below the indicator. When the commanded bearing is reached or the autopilot is disconnected, the commanded bearing symbol is merged with the aircraft bearing symbol.

13 – 4 - NAV MODE

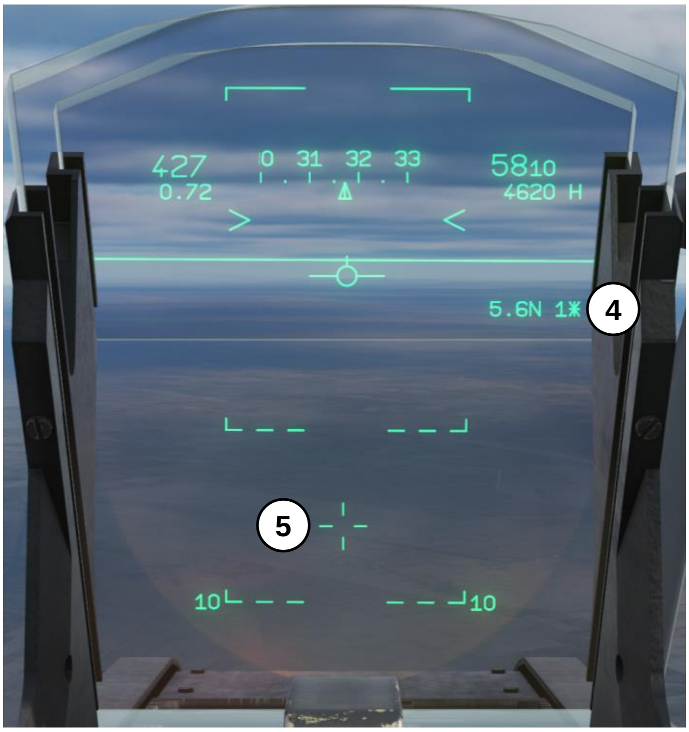
Navigation mode (NAV) is the aircraft's default Master Mode. It is automatically selected when no weapon is selected or when an air-to-ground weapon is selected but the SNA is in air-to-ground pre-selected or memorized sub-mode. Its ground sub-mode overrides any other master and sub-modes when the aircraft has weight on wheels.

HEADING ERROR SUB-MODE

Default navigation mode (*Erreur de route*), the VTH will display BUT navigation symbology.



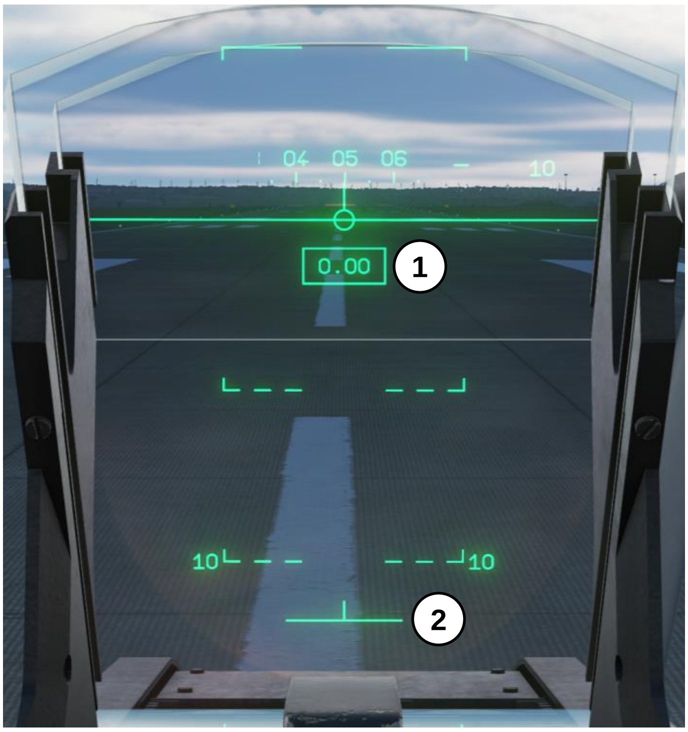
1. DISTANCE TO BUT (*Distance au BUT*): Indicates the distance to the currently selected DEST BUT in nautical miles. When the distance is below 10 nm, tenth of nm will also be displayed.
2. BUT NUMBER (*Numéro du BUT*): Separated from the distance to BUT by a N, indicate the current DEST BUT number.
3. HEADING ERROR INDICATOR (*Erreur de route*): Indicates the heading error to the current DEST BUT. It moves on a line parallel to the horizon, passing by the FPM. Its lateral offset to the FPM represents the heading error at the 1/7 scale. The orientation of the symbol indicates if the aircraft is fly toward the BUT or from the BUT.
    - Tip at the top, the BUT is in front of the aircraft.
    - Tip at the bottom, the BUT is behind the aircraft.



4. BAD SELECTED INDICATOR (*Rappel de la sélection BAD*): When present, the asterisk indicates that the current navigation informations are relative to the BAD.
5. BUT POSITION INDICATOR (*Réticule BUT*): When the distance to BUT is less than 10 nautical miles and the BUT physical position is in the VTH field of view, the heading error indicator is replaced by the BUT indicator which is projected at the exact geographical position of the BUT.

GROUND SUB-MODE

When the aircraft has weight on wheels, the VTH will be automatically switched to the ground sub-mode (*Roulage*). The VTH will display 2 specific symbologies.



1. LONGITUDINAL ACCELERATION (*Accélération longitudinale*): Shows the longitudinal acceleration/deceleration (Lx) in Gs. It can be negative and is used to check engine performance at take-off.
2. TAKE-OFF ROTATION INDEX (*Assiette de consigne au décollage*): Fixed at -13° to the horizon line, it is displayed when on the ground until 5 second after the gear is unlocked from the down position. Indicate the pitch to maintain at rotation when placed on the horizon line and can also be used for aero-braking.

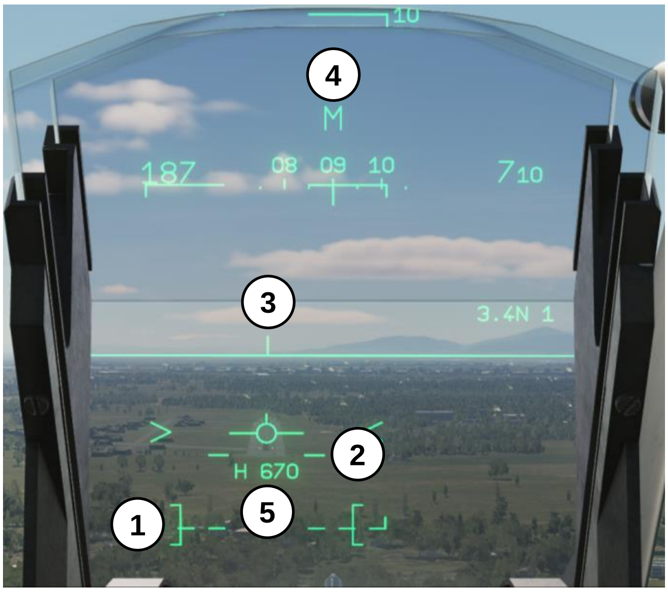
APPROACH SUB-MODE

Selected using the PCA, the approach sub-mode (*approche*) displays VFR or IFR landing symbology. The calibrated airspeed, mach number, heading tape, baro-inertial altitude, and radar altitude are shifted to the center of the VTH. This is done to allow the pilot to raise his seat and have a better visibility during landing.

The IFR related symbologies of the APP sub-mode depend on ILS and the current DEST BUT CP/PD INS parameters. See the **RADIO NAVIGATION VOR AND ILS SUB-SECTION** and **INS SECTION** for more information.

APPROACH MODE WITHOUT ILS

If the aircraft is not receiving an ILS signal it will display the VFR symbology.



1. ANGLE OF ATTACK GUIDE (*Guidage en incidence*): Indicates the optimum angle of attack for landing the aircraft relative to the FPM. The brackets represent an AoA value of 14º ± 0.5º and they flash when the difference between the aircraft AoA and the approach AoA is bigger than 3°. Approach AoA is achieved by placing the FPM inside the brackets.
2. DESIRED SLOPE MARKERS (*Pente désirée*): Indicates the desired slope as set in the current DEST BUT PD parameter. If the current DEST BUT PD parameter has not been set, the PD markers are merged in the horizon line as the default value is 00.0.
3. TRUE RUNWAY HEADING MARKER (*Repère cap vrai piste*): Displayed on top of the horizon line, it indicates the runway true heading as set in the current DEST BUT CP parameter.

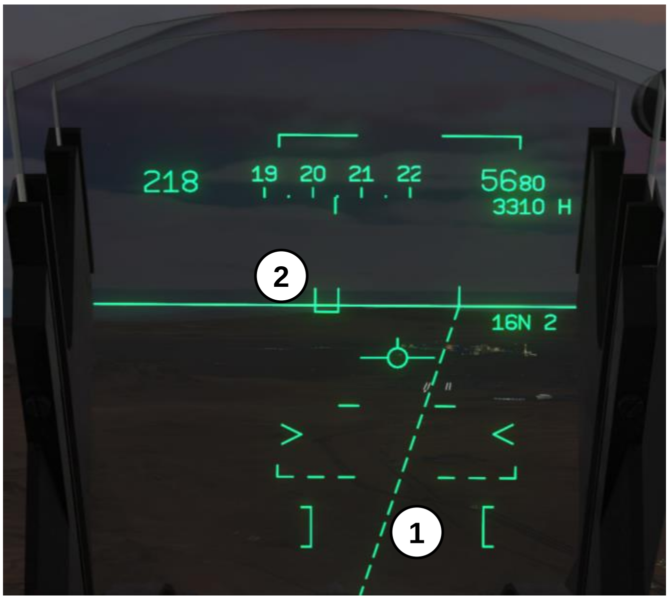
CAUTION	If the current DEST BUT CP parameter has not been set, it will be at 000.0 by default and the true runway heading marker will be shown at that heading. This can create confusion and lead to accidents, always be sure that this parameter is set correctly and that you selected to correct DEST BUT when in APP sub-mode.

4. MARKER SYMBOL (*Symbole marker*): Indicates that the aircraft is passing through the beam of an airfield marker beacon. The “M” flashed at the same frequency than the beacon.
5. DECISION HEIGHT (*Hauteur de décision*): Replaces the radar altitude and is displayed just below the FPM when the radar attitude is below the minimum altitude set by the pilot on the PCTH.

APPROACH MODE WITH ILS, LOC ONLY

If the aircraft is only receiving localizer signal from the ILS it will only display LOC guidance.

In this case the gear is still up and the VTH still displays the distance to BUT, BUT number and heading error indicator symbology.



1. RUNWAY AXIS LINE (*Axe de piste*): Represents a projection of the runway axis on the ground starting at the true runway heading marker and passing through the runway.
2. ILS DIRECTOR LOC ONLY (*Fenêtre de guidage*): Guides the aircraft on the ILS localizer. Placed on the horizon line, the pilot needs to place the FPM inside the box to lineup on the LOC. It is always displayed and keeps indicating the guidance direction when on the edge on the VTH field of view.

Approach mode with ILS, LOC and GLIDE

If the aircraft is receiving localizer and glide slope signals from the ILS it will display LOC and GLIDE guidance as well as the synthetic runway.

1. ILS Director. (*Fenêtre de guidage*): Guides the aircraft on the ILS localizer and glide slope. The pilot needs to place the FPM inside the box to be guided on the LOC and GLIDE. It is always displayed and keeps indicating the guidance direction when on the edge on the VTH field of view.
2. Synthetic Runway (*Piste synthétique*): The synthetic runway is an aid for locating the real runway, especially during low visibility conditions. It is only visible when:
   - The INS is NAV and functioning correctly.
   - The CP/PD data for the current DEST BUT correspond to the landing runway.
   - Both localizer and glideslope have been captured
   - The runway is less than 10 nautical miles away.
   - Lateral deviation is less than 7º.

   The synthetic runway is removed from the VTH as soon as there is weight on the main landing gear wheels.

CAUTION The synthetic runway and ILS director depend on the accuracy of the CP/PD parameter data, even a 0.1 degree error can throw off the representation. Always cross-check with the ILS needles of the IS as they show deviation from the LOC and GLIDE and are not dependent on the INS.

CAUTION The synthetic runway is not a perfect tool, it will often be displayed to the sides, before or after the real runway when the lateral or vertical deviation is too high from the ILS. But when on LOC and GLIDE, the representation should be very accurate.

3. Excessive deviation indicators (*Indicateurs d'écarts excessifs*): If the deviation from either glideslope or course is too large, a flashing triangle will appear indicating the direction of the required maneuver.

Approach mode with ILS and declutered

When in the ILS symbology is displayed, part of it can be hidden to allow better view of the runway. This is done using the Magic Slave/AG Designate/INS Position Update throttle command. All the ILS symbology will be hidden except the runway axis line and the desired slope symbology will be displayed.

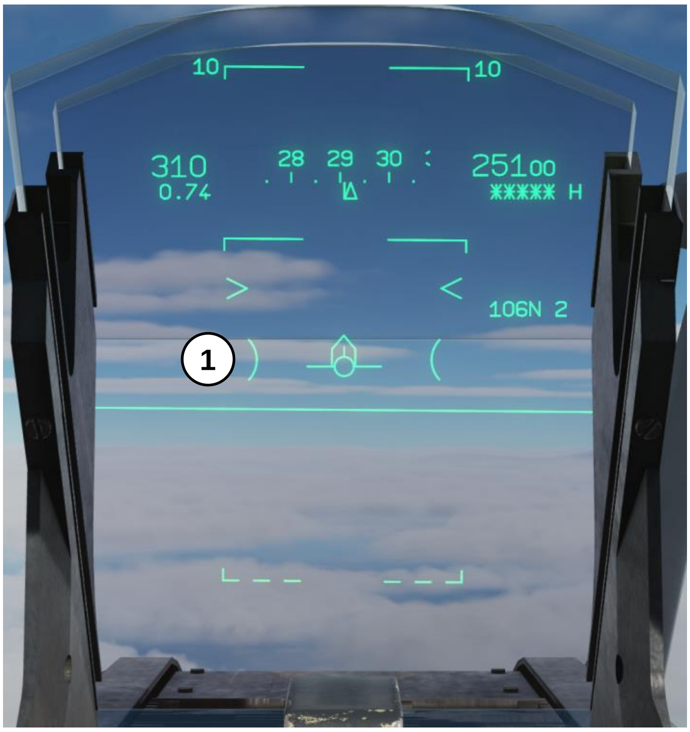
DESIRED HEADING OPTION

Selected using the PCA, the desired heading option (*route désirée*), provides lateral guidance on the VTH.

1. LATERAL GUIDANCE (*Guidage latéral*): Guides the aircraft on the desired heading. Vertically aligned on the FPM, the pilot needs to place the FPM inside the symbology to be guided on the RD.

DESIRED TIME OPTION

Selected using the PCA, the desired time option (*temps désiré*), provides speed guidance on the VTH.



1. SPEED GUIDANCE (*Guidage en vitesse*): Guides the aircraft in speed to attain the BUT as the desired time. Horizontally aligned on the FPM and vertically dependent on the needed speed change, the pilot needs to vertically align the acceleration chevron with the symbology to be guided in speed.

RADAR FIX SUB-MODE

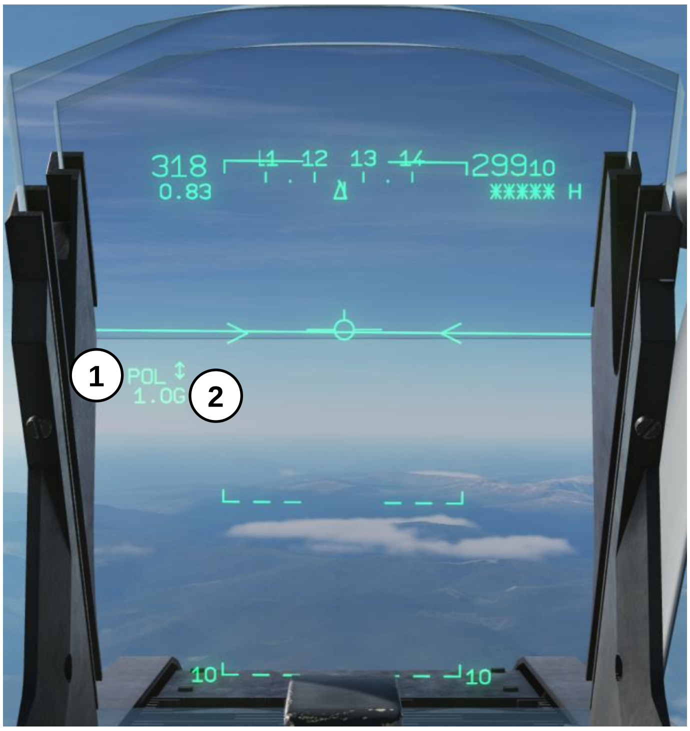
1. FIX/DESIGNATION DIAMOND (*Réticule de recalage/désignation*): Representation of the aiming point of the radar, must be placed over the surface feature.
2. RADAR SLANT RANGE (*Distance air-sol*): Indicates the slant distance to the ground at the currently radar designated point in kilometers.

13 – 5 - AIR-TO-AIR MODE

Air-to-air mode is automatically displayed when an air-to-air weapon or police mode is selected.

COMMON SYMBOLOGY

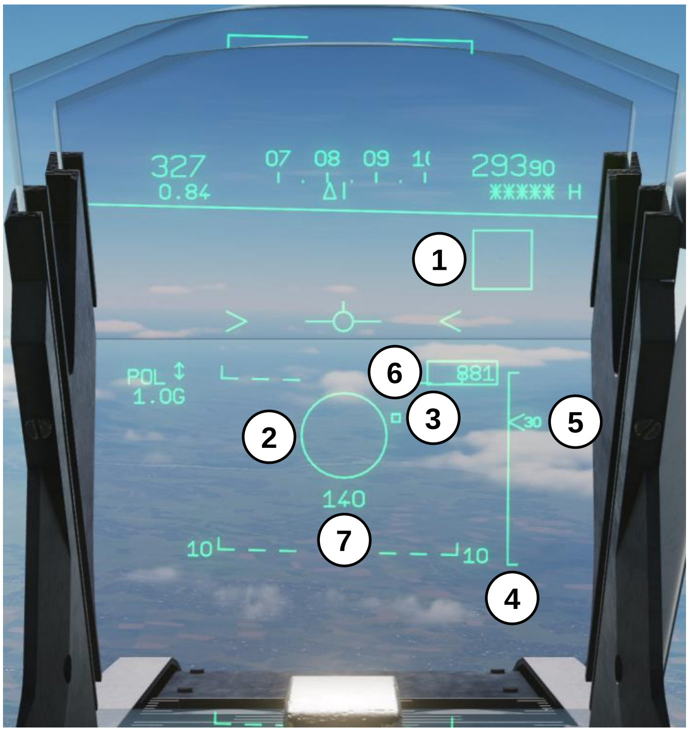
In every air-to-air sub-mode, the following symbology will be displayed.



1. AIR-TO-AIR SUB-MODE (*Mode en cours*): Represents the selected air-to-air sub-mode. Possible values are MAG, CAN, 530 and POL. Flashes if the master arm switch is not in the armed position, except in POL.
2. AIRCRAFT LOAD FACTOR (*Facteur de charge chasseur*): Represents the current load factor of the aircraft.

COMMON SYMBOLOGY WITH RADAR LOCK

In every air-to-air sub-mode with a PSID, SHB or PSIC radar lock, the following symbology will be displayed.



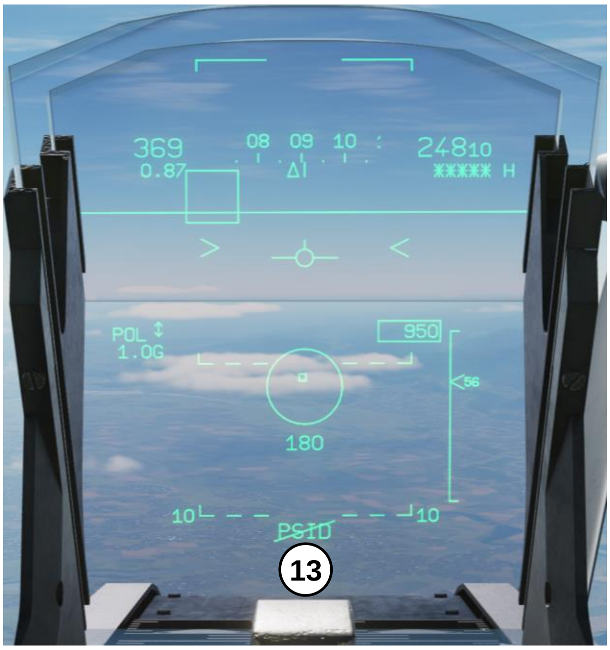
1. RADAR TARGET POSITION (*Carré but*): Displayed at the position of the contact on the VTH. If the contact position is outside the VTH field of view a dashed square will be displayed in the direction of the contact. The square will flash during a radar slave to MAGIC or when the radar is in RRAS auto-acquisition mode.
2. INTERCEPTION DIRECTOR CIRCLE (*Cercle du directeur d'ordre*): Fixed diameter circle placed at the center of the VTH. Flashes if the radar antenna is close to its gimbal limits or the target is flying an evasive maneuver.
3. INTERCEPTION DIRECTOR POINT (*Point du directeur d'ordre*): Positioned relative to the center of the interception director circle, indicates the maneuvers necessary to place the aircraft in the currently selected weapon employment zone. The pilot needs to place the point at the center of the interception director circle.
4. RANGE SCALE (*Echelle de distance*): Provides a range scale to the target range symbology. Possible max scale distances: 80, 40, 20, 10 and 2 nm.
5. TARGET RANGE (*Distance cible*): Represents the radar target range relative to the range scale. Displayed in nautical mile, with tenths and the unit under 10nm and in hectometers under 2nm.
6. TARGET CLOSING SPEED (*Vitesse de rapprochement cible*): Represents the combined speed of the aircraft and the target in knots. Positive when closing, negative when opening.
7. TARGET ASPECT ANGLE (*Angle de présentation cible*): Represents the target aspect angle (0 is nose cold, 180 is nose hot) from 0° to 180° and 5° by 5°.

8. IFF INTERROGATION IN PROGRESS (*Interrogation IFF en cours*): Indicate that the radar target is being interrogated by the IFF system.
9. IFF CORRELATION (*Corrélation IFF*): The A inside the radar target position symbology indicates that the radar target has replied as a friend to the IFF interrogation.

   The A is replaced by a D if radar as received a friendly reply from the target but the position of the IFF replying aircraft does not correspond to the target position.

10. MEMORY MODE INDICATION (*Indication mode mémoire*): The M inside the interception director circle indicates that the radar has lost the target and is in memory mode. In PSIC, the radar memory mode lasts 5 seconds during which the radar will continue to illuminate the last known trajectory of the target and try to reacquire the lock. Once those 5 seconds are elapsed, the radar will return to bar search.

11. JAMMING RADAR TARGET POSITION (*Carré but brouillé*): The hollowed out cross inside the radar target position square indicates that a jammer is hindering the radar. Only displayed when the radar is in PSIC.



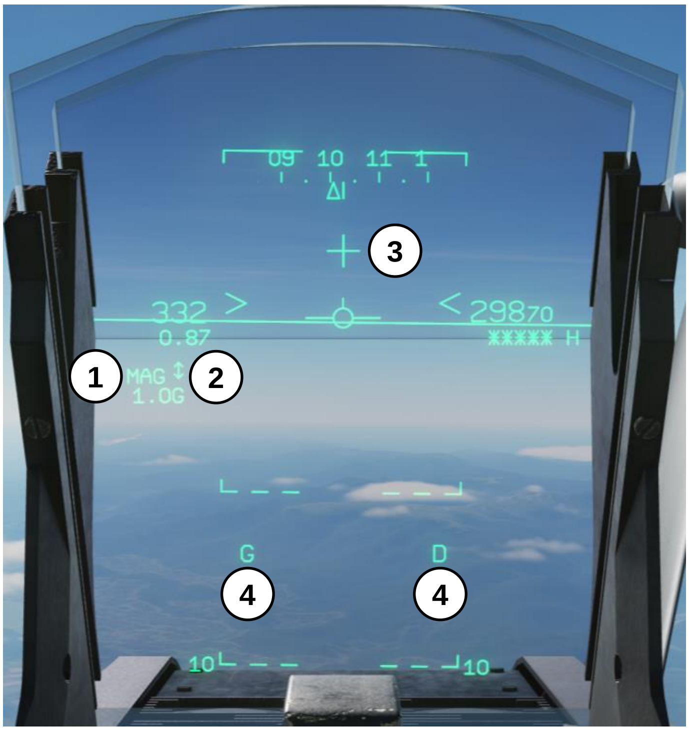
12. SWITCH TO PSIC INCITATION (*Incitation à passer en PSIC*): Displayed flashing when in PSID and the radar estimates that the noise to signal ratio from the contact is too low to maintain the PSID lock and that switching to PSIC is advised.

13. STAY IN PSIC INCITATION (*Incitation à rester en PSIC*): Displayed steady for 3 seconds in PSIC when the pilot has pressed PSIC toggle HOTAS command to switch to PSID but the radar estimates that the contact noise to signal ratio is too low to maintain a PSID lock. The radar can be forced in PSID if the PSIC toggle HOTAS command is pressed while the symbol is displayed.

MAGIC SUB-MODE

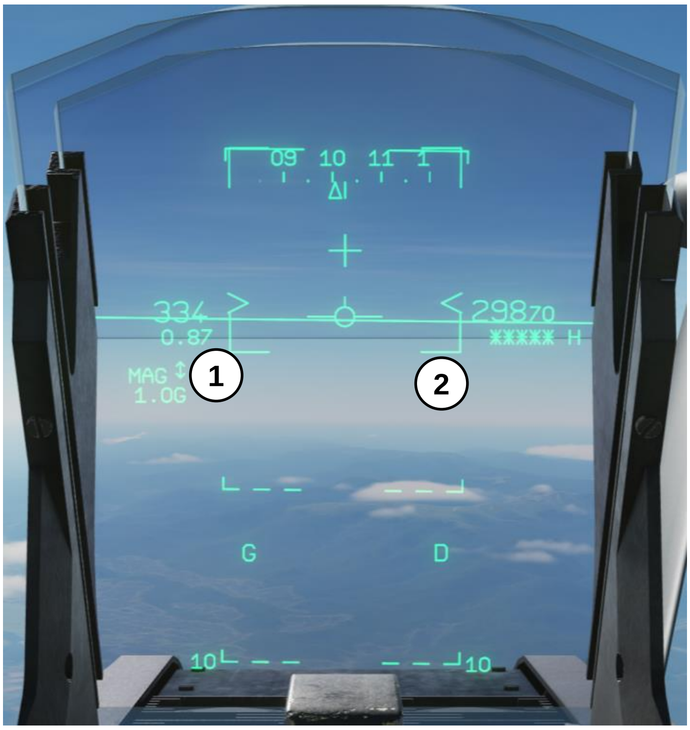
Displayed when the MAGIC II missiles are selected. In this mode, the calibrated airspeed, mach number, baro-inertial altitude and radar altitude are shifted to the center of the VTH.

MAGIC VERTICAL WIDE SEARCH



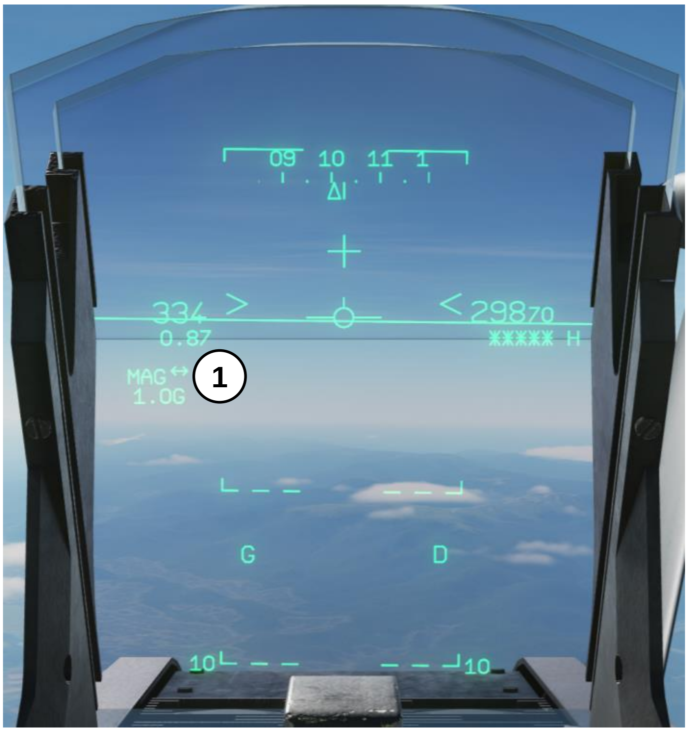
1. MAGIC SUB-MODE (*Mode MAGIC*): Indicates that the VTH is in the MAGIC air-to-air sub-mode. Flashes to indicate that the master arm is safe.
2. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): The double arrow indicates the current scan mode for the magic. Here the MAGIC search is in vertical mode.
3. GUN CROSS (*Croix canons*): Represents the gun and MAGICs boresight.
4. MISSILES STATUS (*Etat des missiles*): Indicates the presence of the left (G – *gauche*) and right (D – *droit*) missiles. Flashes when the missiles are not ready.

MAGIC VERTICAL NARROW SEARCH



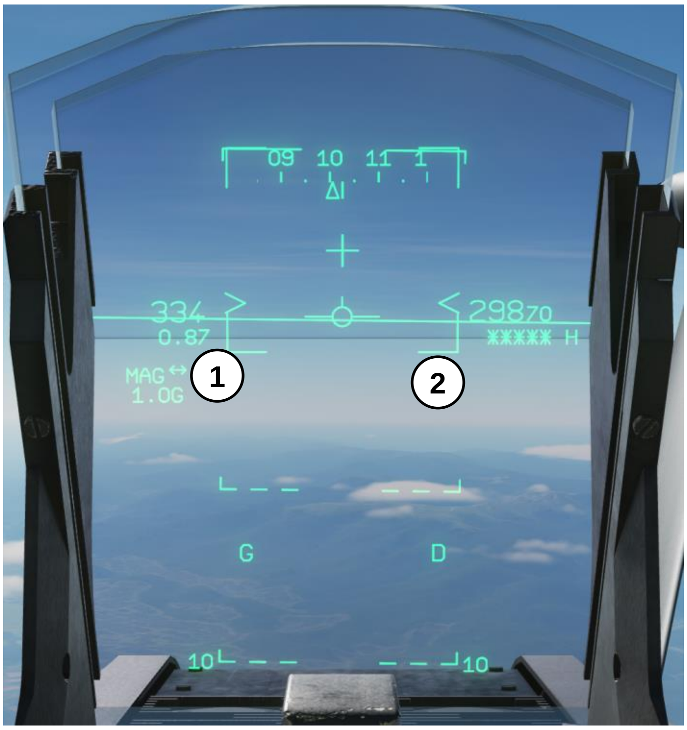
1. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): The double arrow indicates the current scan mode for the magic. Here the MAGIC search is in vertical mode.
2. MAGIC NARROW SEARCH (*Secteur étroit MAGIC*): The square corners indicate that the MAGIC is in narrow search mode and its limits.

MAGIC HORIZONTAL SEARCH



1. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): The double arrow indicates the current scan mode for the magic. Here the MAGIC search is in horizontal mode.

MAGIC HORIZONTAL NARROW SEARCH

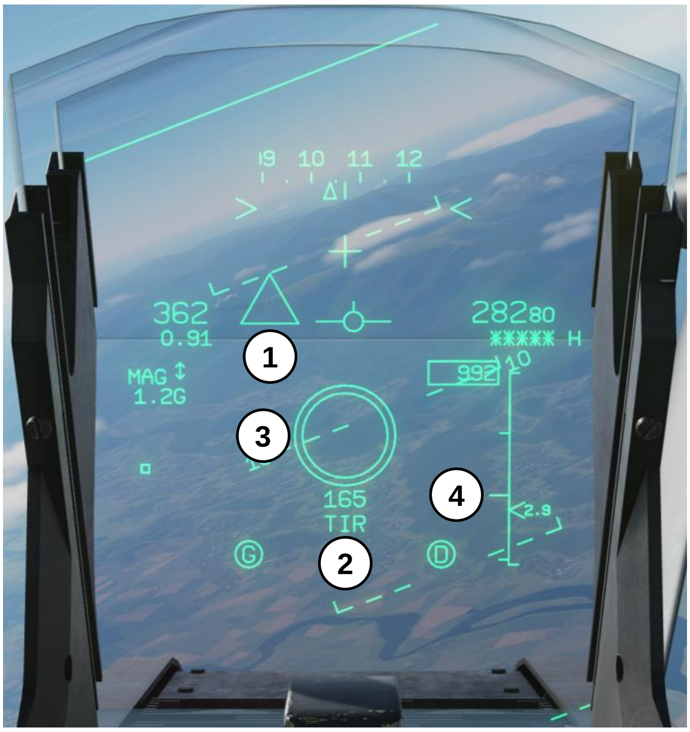


1. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): The double arrow indicates the current scan mode for the magic. Here the MAGIC search is in horizonal mode.
2. MAGIC NARROW SEARCH (*Secteur étroit MAGIC*): The square corners indicate that the MAGIC is in narrow search mode and its limits.

MAGIC LOCKED

1. MAGIC LOCK (*Direction d'accrochage MAGIC*): Indicates the direction of the priority MAGIC lock. If the lock direction is outside the VTH field of view a dashed circle will be displayed in the direction of the lock.
2. MISSILES STATUS (*Etat des missiles*): The circle indicates that the missile is ready to fire.

MAGIC AND RADAR COINCIDENCE



1. MAGIC AND RADAR COINCIDENCE (*Coïncidence radar MAGIC*): Replaces the radar target position indicator, it indicates that the radar and magic are locked on the same target.
2. SHOOT INDICATION (*Conseil de tir*): Indicates that the target is in the long limit with defensive maneuvers (*limite longue avec évasive*) envelope for the MAGICs.
3. DOUBLING OF THE INTERCEPTION DIRECTOR CIRCLE (*Dédoublage du cercle du directeur d'ordre*): Indicates that the target is in the long limit without defensive maneuvers (*limite longue sans évasive*) envelope for the MAGICs
4. LONG AND SHORT LIMITS (*Limites longues et courtes*): Relative to the radar range scale symbology, represents the radar calculated range envelope for the MAGICs. The 2 top lines represents the long limits and the bottom line represent short limit. The long limit without defensive maneuvers (*limite longue sans évasive*) line is thicker than the long limit with defensive maneuvers (*limite longue avec évasive*).

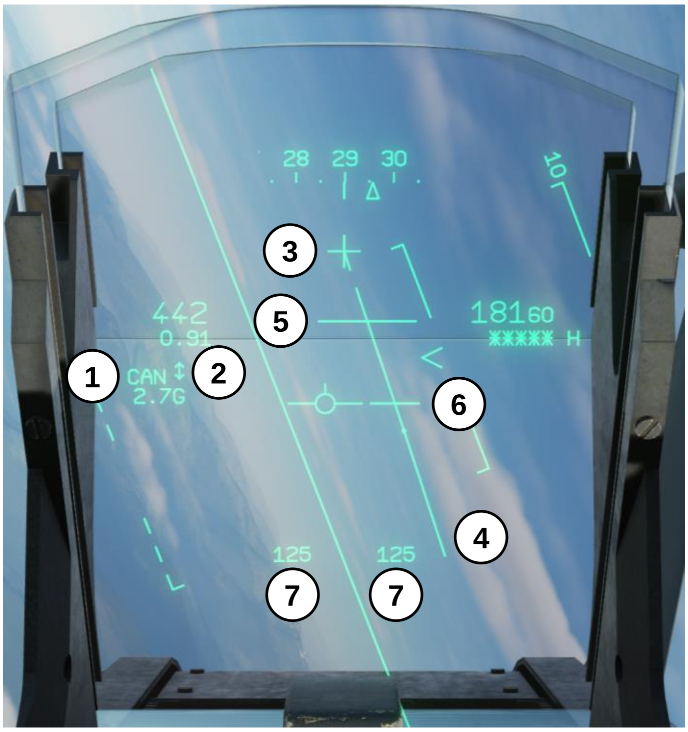
MAGIC DURING RADAR SLAVING

1. MAGIC LOCK CIRCLE INSIDE RADAR TARGET (*Direction d’accrochage MAGIC à l’intérieur du carré BUT*): When the MAGIC has been slaved to the radar (*ralliement MAGIC*), the MAGIC lock circle will flash inside the radar target indicator until the MAGIC is locked on the target.

AIR-TO-AIR GUN SUB-MODE

Displayed when the air-to-air gun is selected. In this mode, the calibrated airspeed, mach number, baro-inertial altitude and radar altitude are shifted to the center of the VTH.

AIR-TO-AIR GUN WITHOUT RADAR LOCK

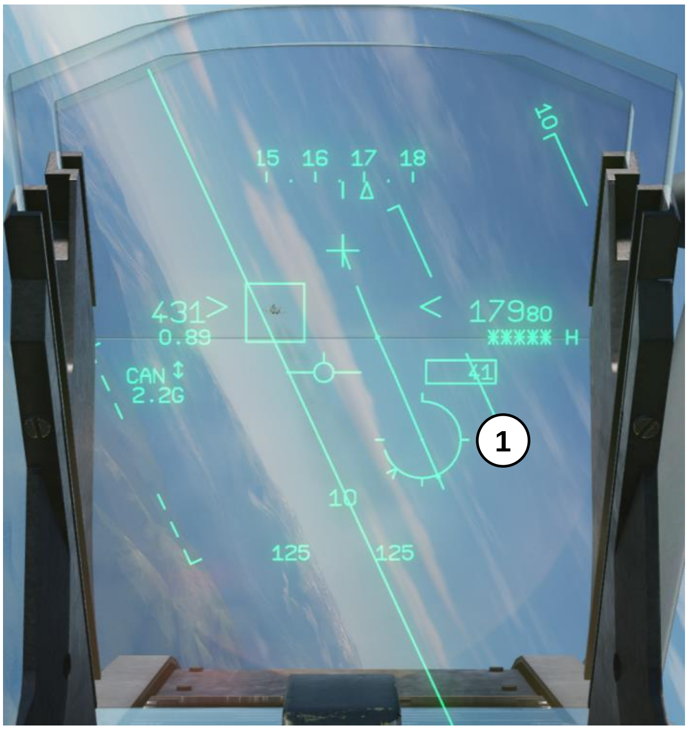


1. AIR-TO-AIR GUN SUB-MODE (*Mode canon air-air*): Indicates that the VTH is in the gun air-to-air sub-mode. Flashes to indicate that the master arm is safe.
2. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): In air-to-air gun sub-mode the MAGIC missiles are also active in search mode. The scan modes are the same than in MAGIC sub-mode.
3. GUN CROSS (*Croix canons*): Represents the gun and MAGICs boresight.
4. TRACER LINE AND SHELL MARKERS (*Ligne de traceurs et repères cyclistes*): Represents the calculated flight path of a cannon shell stream. It starts at the gun cross and finishes when the shell stream has traveled 1000 meters.

   The shell markers represent the speed of 2 virtual shells along the tracer line.
5. WINGSPAN MARKER 300M (Barre stadimétrique 300m)
6. WINGSPAN MARKER 600M (Barre stadimétrique 600m)

   These lines are present along the tracer line and are always parallel to the aircraft plane. They are used to estimate the target distance without radar use, by comparing the marker length to the target wingspan. The estimated target wingspan is set using the target wingspan scale on the PCTH.
7. REMAINING SHELLS (*Nombre d'obus restants*): Displays the remaining shells count for each DEFA 554 cannons.

AIR-TO-AIR GUN WITH RADAR IN PSIC

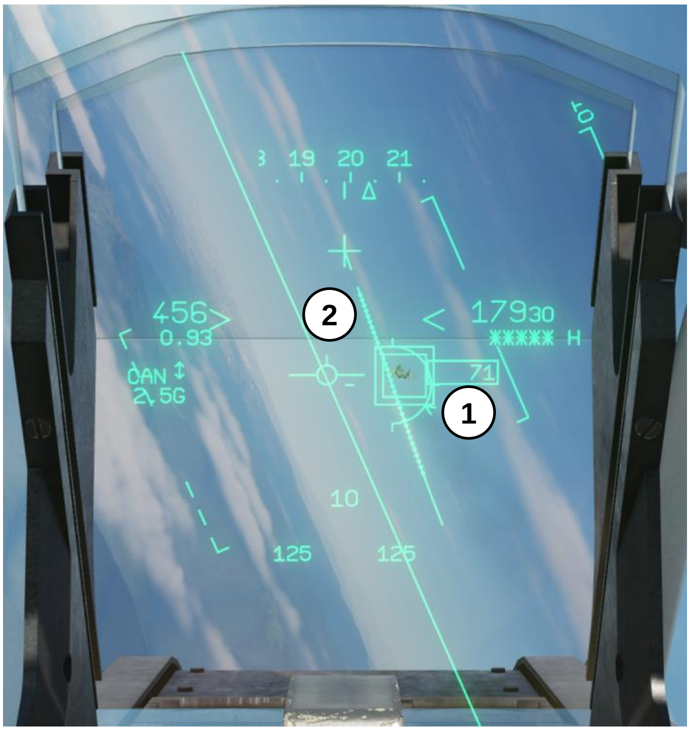


1. DISTANCE METER WITH SHOOTING RETICLE AND ANALOG CLOSING SPEED (*Distancemètre avec réticule de tir et vitesse de rapprochement analogique*): The shooting reticle (small center circle) is sliding along the tracer line to represent the “critical shell” (obus critique) that is at the same range as the target.

   The distance meter (outside circle) is centered on the shooting reticle. It unwinds counterclockwise to provide radar range relative to the 4 distance markers. It is displayed below 1nm to target and each circle quadrant represents 300m.

   Relative to the distance meter, the analog closing speed (chevron) represents the range at which the target will be in 5 seconds.

AIR-TO-AIR GUN WITH SHOOT INCITATION

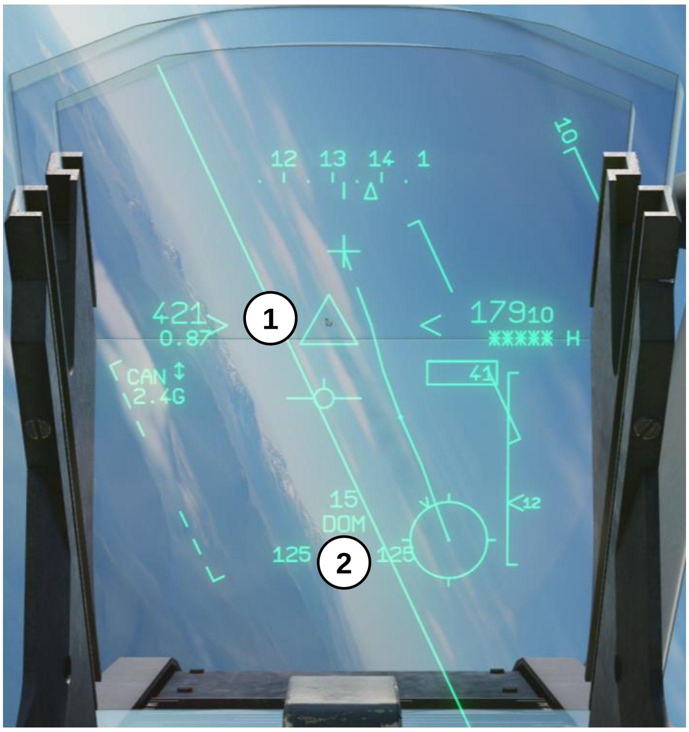


1. DOUBLED RADAR TARGET POSITION (*Dédoublement du carré but*): The doubled square represents the shoot incitation, present when the aircraft estimates that the current gun solution will result in a hit. Only displayed when the gun shoot incitation switch on the PCTH is in the PRED position.

   If the target position symbology is replaced by the coincidence triangle, it will also be doubled.

2. SALVO MARKERS (*Notation pilote*): The salvo markers (triangles along the tracer line) represent the trajectory of the shell salvo along the tracer line. Presented when the first or second stage of the MiCRoB trigger are pressed.

AIR-TO-AIR GUN WITH MAGIC AND RADAR COINCIDENCE



1. MAGIC AND RADAR COINCIDENCE (*Coïncidence radar MAGIC*): As MAGICs are active when in air-to-air gun sub-mode, the MAGIC and radar coincidence symbology is displayed instead of the radar target position indicator when the MAGICs are locked on the same target as the radar.
2. MAGIC ENVELOPE (*Domaine MAGIC*): Indicates that the target is inside the MAGICs most restrictive weapon envelope but outside the air-to-air gun employment range. Only displayed if MAGICs missiles are loaded on the aircraft and locked on the target.

530 SUB-MODE

Displayed when the Super 530D missiles are selected. In this mode, the calibrated airspeed, mach number, baro-inertial altitude and radar altitude stay at the top of the VTH.

530 WITHOUT RADAR LOCK

1. 530 SUB-MODE (*Mode 530*): Indicates that the VTH is in the 530 air-to-air sub-mode. Flashes to indicate that the master arm is safe.
2. MISSILES STATUS (*Etat des missiles*): Indicates the presence of the left (G – *gauche*) and right (D – *droit*) missiles. Flashes when the missiles are not ready.

530 WITH RADAR IN PSIC

1. SHOOT INDICATION (*Conseil de tir*): Indicates that the target is in inside the most restrictive firing domain (*domaine de tir le plus contraignant*), meaning closer that the long limit with defensive maneuvers (*limite longue avec évasive*) for the Super 530D.
2. DOUBLING OF THE INTERCEPTION DIRECTOR CIRCLE (Dédoublage du c*ercle du directeur d'ordre*): Indicates that the target is in inside the least restrictive firing domain (*domaine de tir le moins contraignant*), meaning closer than the long limit without defensive maneuvers (*limite longue sans evasive*) for the Super 530D.
3. LONG AND SHORT LIMITS (*Limites longues et courtes*): Relative to the radar range scale symbology, represents the radar calculated range envelope for the 530s. The 2 top lines represent the long limits and the bottom line represent short limit. The long limit without defensive maneuvers (*limite longue sans évasive*) line is thicker than the long limit with defensive maneuvers (*limite longue avec évasive*).

   The long limits can move above the range scale.
4. MISSILES STATUS AND MISSILES TIME OF FLIGHT (*Etat des missiles et temps de vol missiles*): The circle indicates that the missiles are locked and ready to fire and that the master arm is on.

   The number above missile status indicates the time it would take to the missiles to reach the target if they were to be launched now.

530 WITH RADAR IN PSIC SUPER 530

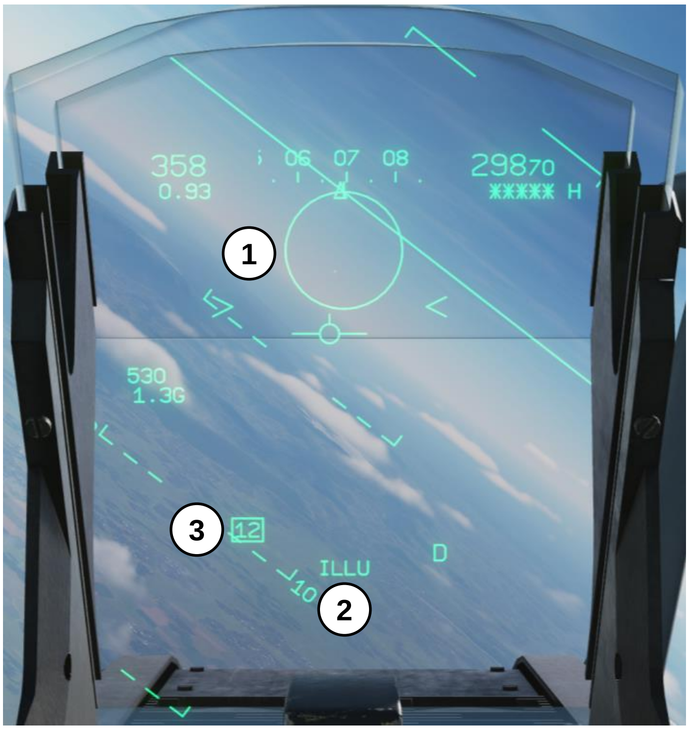
1. MEMORY MODE INDICATION (*Indication mode mémoire*): The M inside the interception director circle indicate that the radar has lost the target and is in memory mode. In PSIC Super 530 pointé, the radar memory mode lasts 8 seconds during which the radar will continue to illuminate the last know trajectory of the target and try to reacquire the lock.
2. TIME TO IMPACT *(Temps avant impact*): Once fired, the missile's time of flight changes to the missile's time to impact, it indicates the remaining time before the missile reaches the target as calculated by the aircraft.

   If 2 missiles have been fired, only the last one will have an accurate time to impact calculation, the first missile time to impact will switch to a count down from the last calculated value.

530 WITH RADAR IN FORCED ILLUMINATION

1. FORCED ILLUMINATION INDICATION (*Indication illumination forcée*): Indicates that the radar memory mode has run its course and the radar is in forced illumination mode. The radar will continue to illuminate the last know trajectory of the target but won't try to reacquire it.
2. TIME TO AUTO-DESTRUCTION *(Temps avant autodestruction*): In forced illumination, the rectangle around the time to impact indicates that it is replaced by the time remaining before the missile runs out of battery and self-destructs.

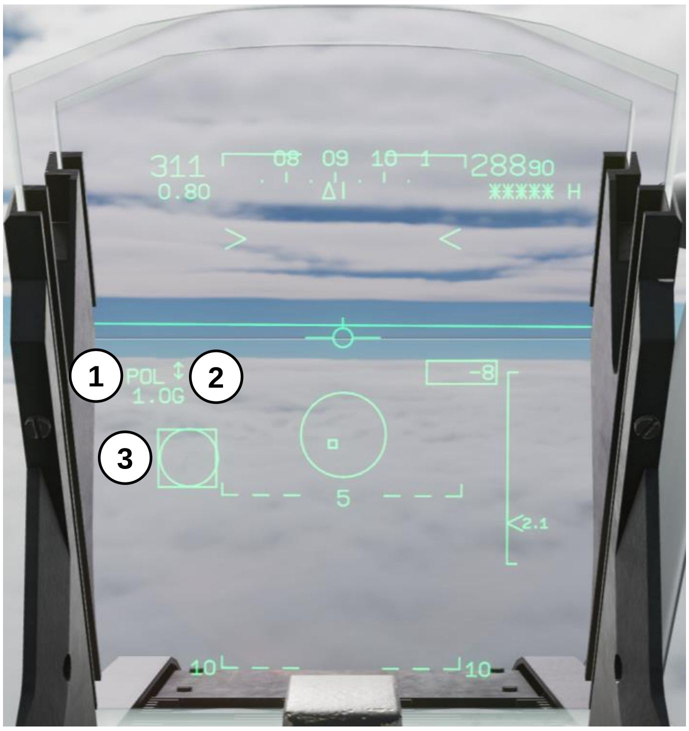
530 WITH RADAR IN PSIC SUPER 530 POINTÉ



1. PSIC SUPER 530 POINTÉ ILLUMINATION SECTOR (*Secteur illumination PSIC Super 530 pointé*): Represents the position and size of the radar beam.
2. FORCED ILLUMINATION INDICATION (*Indication illumination forcée*): The forced illumination indication is also present when the radar is in PSIC Super 530 pointé mode.
3. TIME TO AUTO-DESTRUCTION *(Temps avant autodestruction*): Just like in forced illumination, the rectangle around the time to impact indicates that it is replaced by the time remaining before the missile runs out of battery and self-destructs.

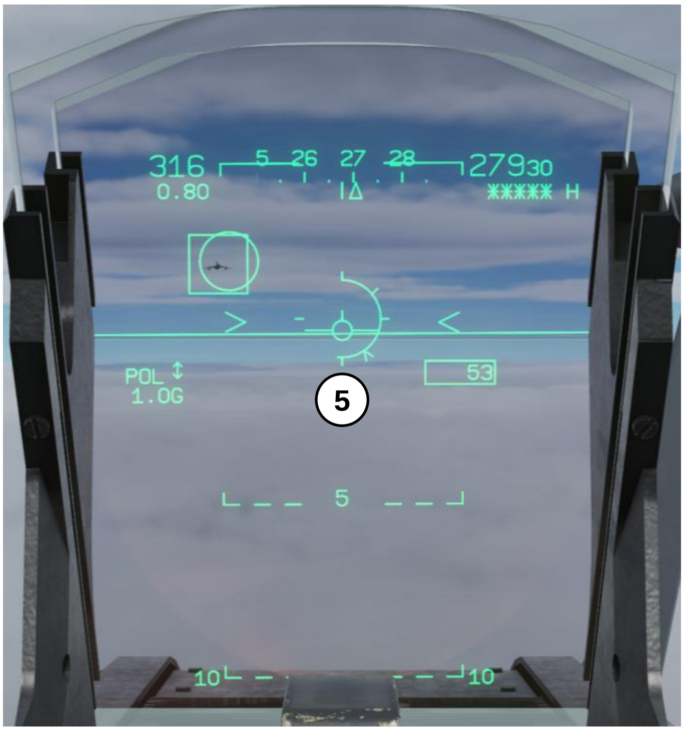
POLICE SUB-MODE

In police sub-mode all the VTH radar symbology is present but no weapon is selected.



1. POLICE SUB-MODE (*Mode Police*): Indicates that the VTH is in the Police air-to-air sub-mode. Opposite to all other weapons, flashes to indicate that the master arm is armed.
2. MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*): In air-to-air gun sub-mode the MAGIC missiles are also active in search mode to allow quicker weapon employment when switching from guns to MAGICs. The scan modes are the same than in MAGIC sub-mode.
3. MAGIC LOCK CIRCLE INSIDE RADAR TARGET (*Direction d'accrochage MAGIC a l'intérieur du carré BUT*): When the MAGIC has locked the same contact than the radar, the MAGIC lock circle will be displayed inside the radar target indicator. The radar and MAGIC coincidence symbology it not available in Police mode.

4. TURNAROUND LOAD FACTOR (*Facteur de charge de retournement*): Indicates the load factor required for the turn around maneuver to place the aircraft in a tail chasse from the target. Only displayed if the required load factor is over 1.3G.



5. DISTANCE METER, ANALOG CLOSING SPEED AND POLICE RANGE (*Distancemètre, vitesse de rapprochement analogique et point clé*):

The distance meter is fixed at the center of the VTH. It unwinds counterclockwise to provide radar range relative to the 4 distance markers. It is displayed below 1 nm to target and each circle quadrant represents 300m.

Relative to the distance meter, the analog closing speed (chevron) represents the range at which the target will be in 5 seconds.

The police range (dash at 1 o'clock on the distance meter) indicates the mimimum distance to keep while in police mode (166 m).

AUTO-ACQUISITION OPTIONS

The auto-lock options display information on the currently selected radar auto-acquisition mode.

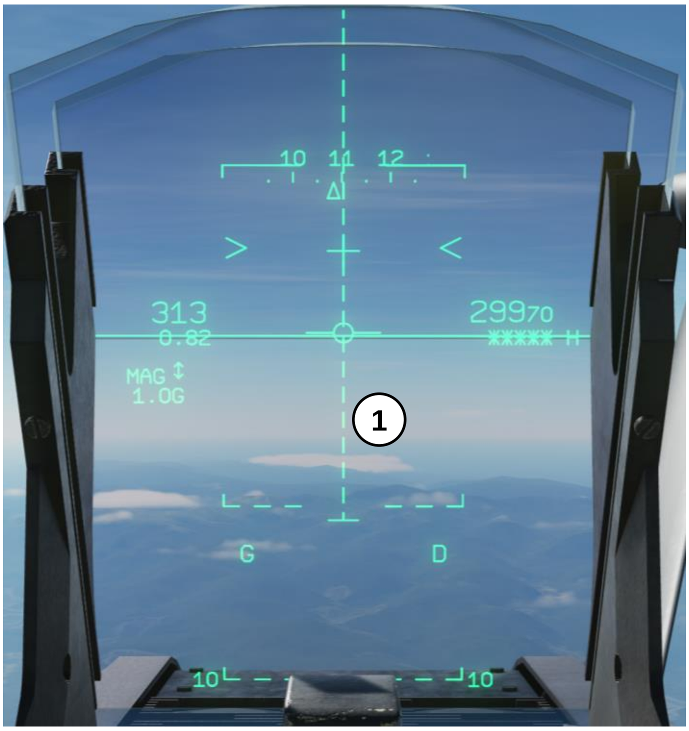
BORESIGHT

1. BORESIGHT AUTO-LOCK SECTOR (*Secteur de recherche pointage axe*): In this auto-lock mode, the circle indicates the radar position and field of view.

VTH SCAN

1. AUTO-LOCK TYPE (*Type d'accrochage radar*): In this auto-lock mode, the name of the auto-lock mode is displayed (SVI – *Spirale viseur*). In this auto-acquisition mode, the area scanned by the radar is rougthly the size of the VTH.

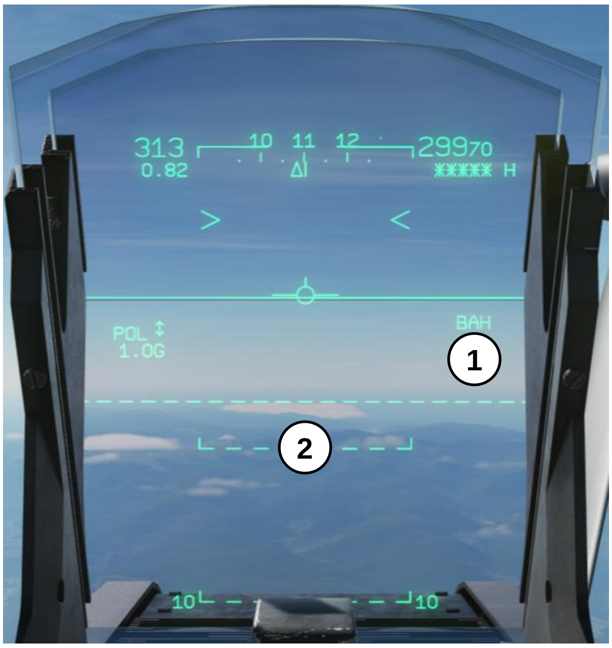
VERTICAL SCAN OPTION

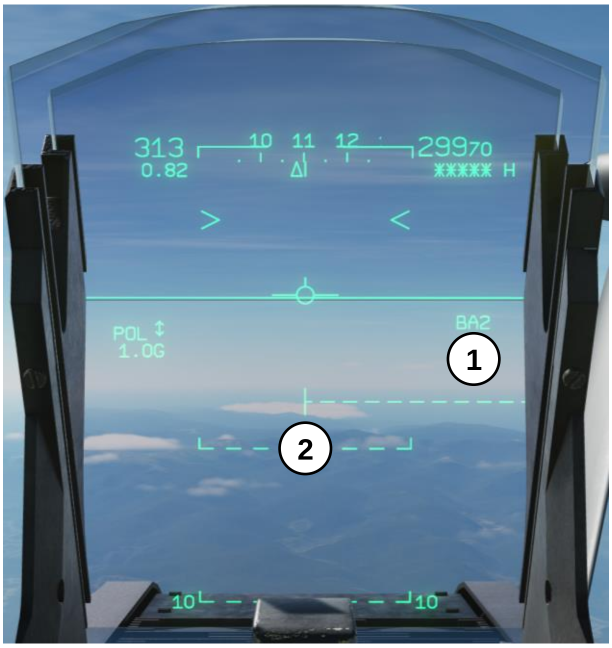


1. VERTICAL SCAN AUTO-LOCK SECTOR (*Secteur de recherche plan de symétrie*): In this auto-lock mode, the line indicates the radar lowest elevation and vertical scan plane.

HORIZONTAL SCAN OPTIONS

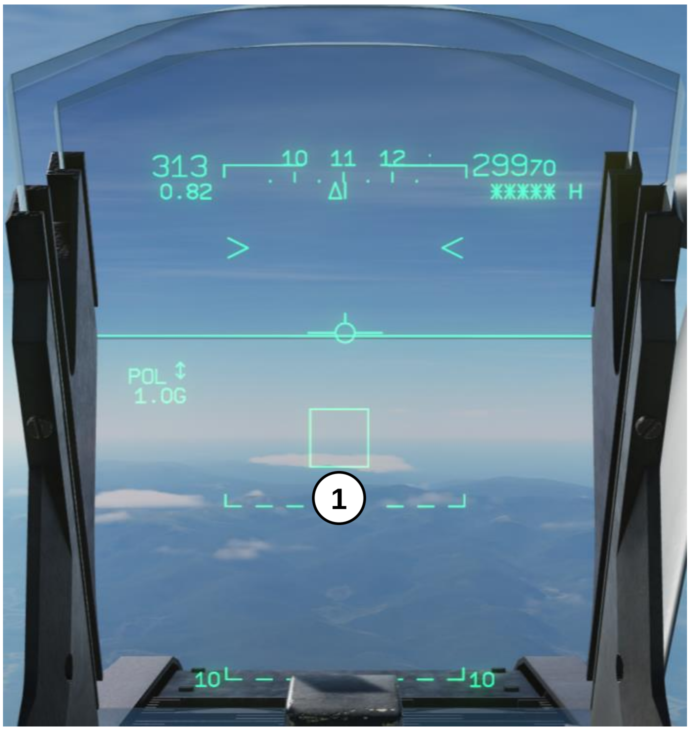
2 horizontal scan options are available and they are using the same symbology.





1. AUTO-LOCK TYPE (*Type d'accrochage radar*): In this auto-lock mode, the name of the auto-lock mode is displayed:
   - BAH (*Balayage acquisition en gisement type HFR*): The radar uses HFR (high PRF.
   - BA2 (*Balayage acquisition en gisement type MFR2*): The radar uses MRF2 (medium PRF)
2. RADAR SCAN ELEVATION (*Gisement radar*): Indicates the position and limits of the radar horizontal scan area. This area can be moved in azimuth and elevation using the TDC and the HOTAS antenna elevation command.

RADAR SLAVE TO TDC/ELEVATION AUTO-ACQUISITION



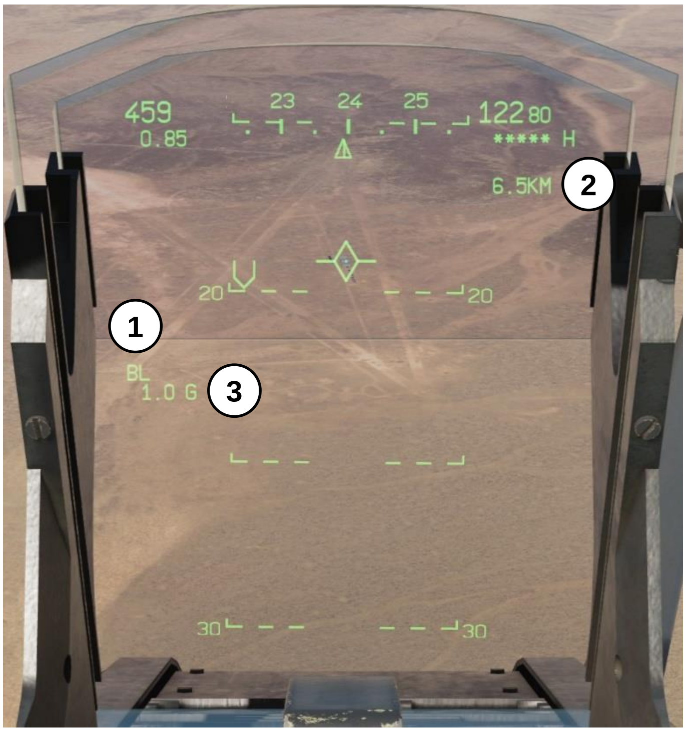
1. RADAR TARGET POSITION (*Carré but*): In RRAS, the radar target position flashes and its position indicates the direction of the radar antenna. The radar antenna can be moved in azimuth and elevation using the TDC and the HOTAS antenna elevation command.

13 – 6 - AIR-TO-GROUND MODE

Air-to-ground mode is displayed when an air-to-ground weapon is selected and the SNA is in air-to-ground selected sub-mode.

COMMON SYMBOLOGY

In every air-to-ground sub-mode, the following symbology will be displayed.

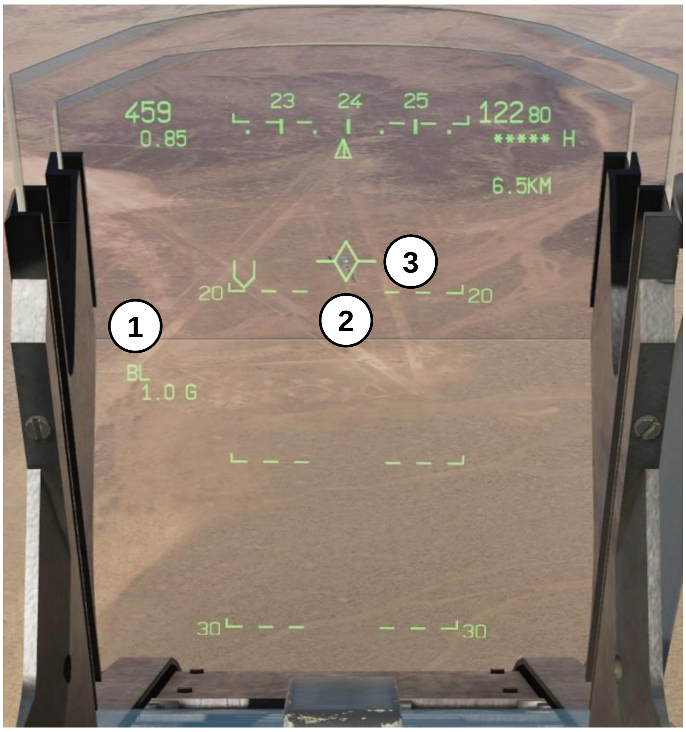


1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type. It flashes if the weapon is not ready to be released. Possible air-to-ground modes are: BL, BF, CAS and RK.
2. AIR-TO-GROUND RANGE (*Distance Air/Sol*): Indicates the slant range from the radar in km. Only displayed if the radar is emitting and in TAS mode (TAS is selected on the PCA top row) and the radar has a good lock on the ground.
3. AIRCRAFT LOAD FACTOR (*Facteur de charge chasseur*): Represents the current load factor of the aircraft.

BL SUB-MODE

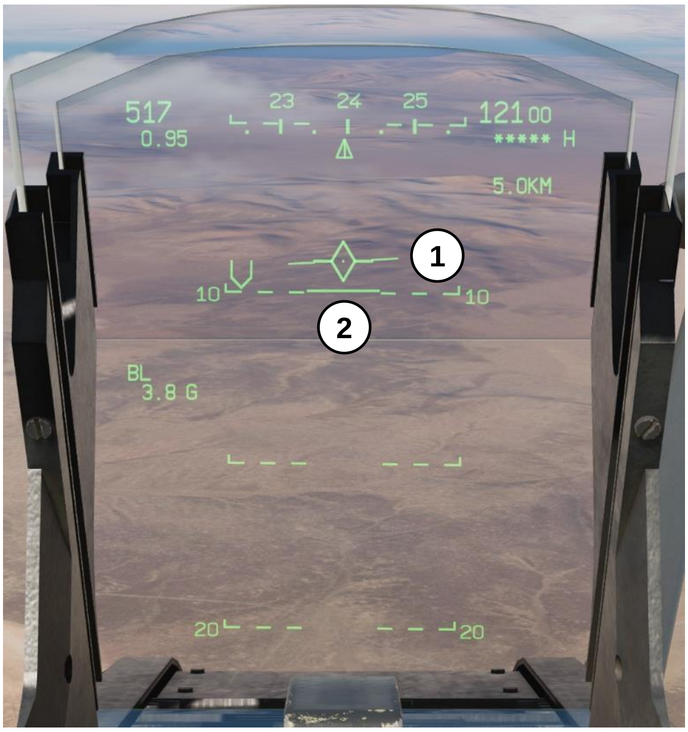
Displayed when a low drag or guided bomb is selected and the SNA is in air-to-ground selected sub-mode. This sub-mode is used to deliver bombs using CCPL (*Calcul continu du point de largage* – CCRP) delivery.

BL SUB-MODE BEFORE DESIGNATION



1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: BL. It flashes if the weapon is not ready to be released.
2. DESIGNATION DIAMOND (*Réticule de désignation*): Indicates the aiming point for the CCPL delivery.
3. WEAPON READY INDICATION (*Armement prêt*): The wings indicates that the weapon is ready for release.

BL SUB-MODE AFTER DESIGNATION

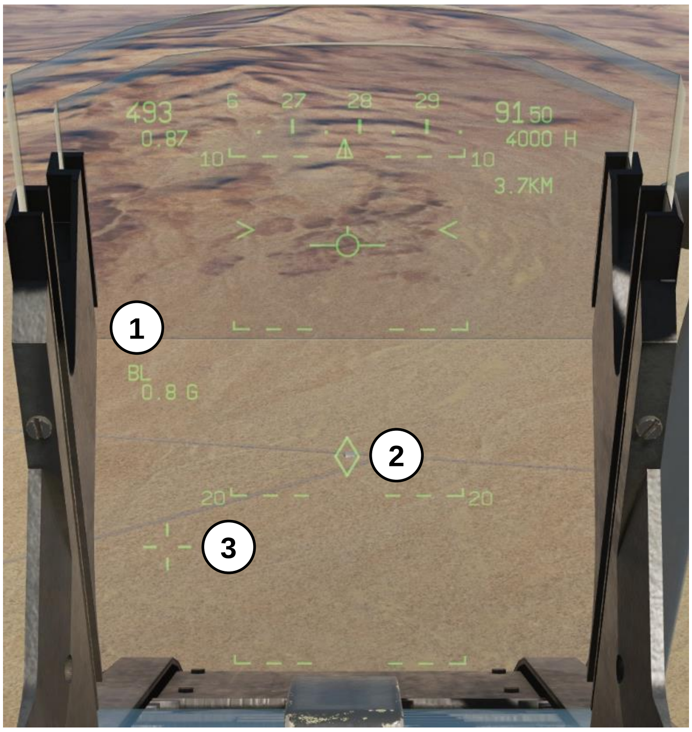


1. **Roll order** (*Ordre de roulis*): Guides the aircraft in roll to the release point.
2. **Release bar** (*Barre de largage*): Displayed when the aircraft is at a distance from the release point where a 6G pull-up will result in a release at 40° of pitch. The bombs are released when the bar reaches the center of the designation diamond, and is displayed as long the bomb salvo is not finished.

BL PI SUB-MODE

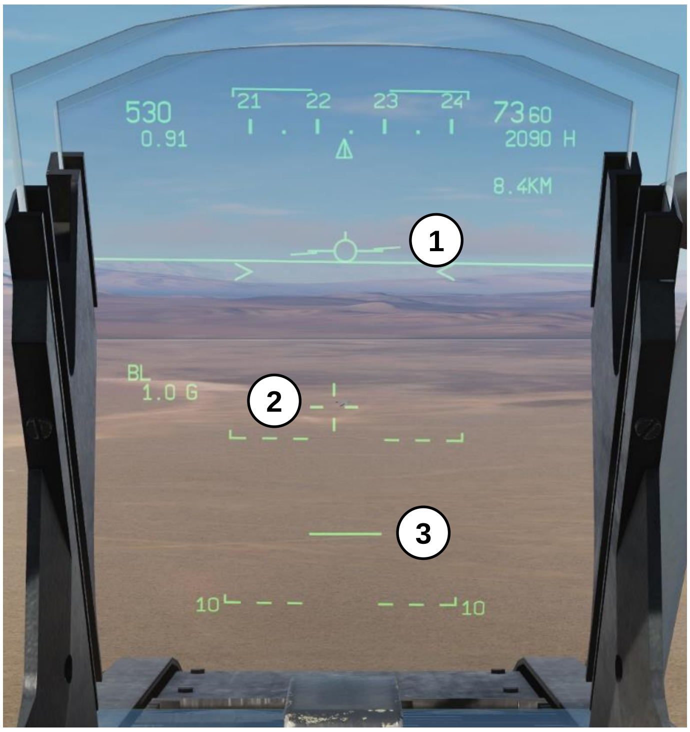
Displayed when a low drag or guided bomb is selected, the SNA is in air-to-ground selected sub-mode, the PI PCA option is selected and the current DEST BUT has a valid BAD. This sub-mode is used to deliver bombs using CCPL (*Calcul continu du point de largage* – CCRP) delivery with prior nav fix using an initial point.

BL PI SUB-MODE BEFORE PI DESIGNATION



1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: BL. It flashes if the weapon is not ready to be released.
2. DESIGNATION DIAMOND (*Réticule de désignation*): Indicates the aiming point for the PI designation.
3. BUT POSITION INDICATOR (*Réticule BUT*): Indicates the position of the PI, since the INS accumulates drift, it can be incorrect.

BL PI SUB-MODE AFTER PI DESIGNATION

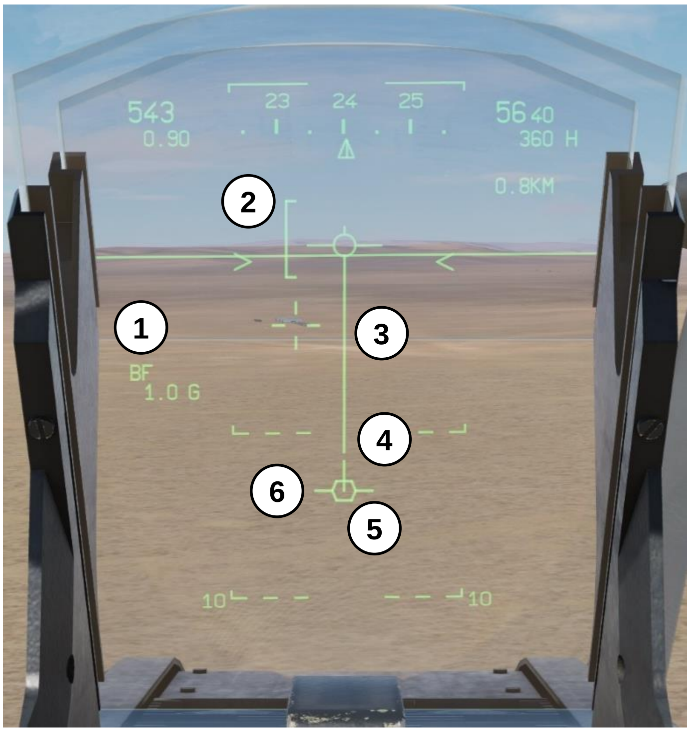


1. ROLL ORDER (*Ordre de roulis*): Guides the aircraft in roll to the release point.
2. BUT POSITION INDICATOR (*Réticule BUT*): Indicates the position of the target corrected by the PI designation.
3. RELEASE BAR (Barre de largage): Displayed when the aircraft is at a distance from the release point where a 6G pull-up will result in a release at 40° of pitch. The bombs are released when the bar reaches the center of the designation diamond, and is displayed as long the bomb salvo is not finished.

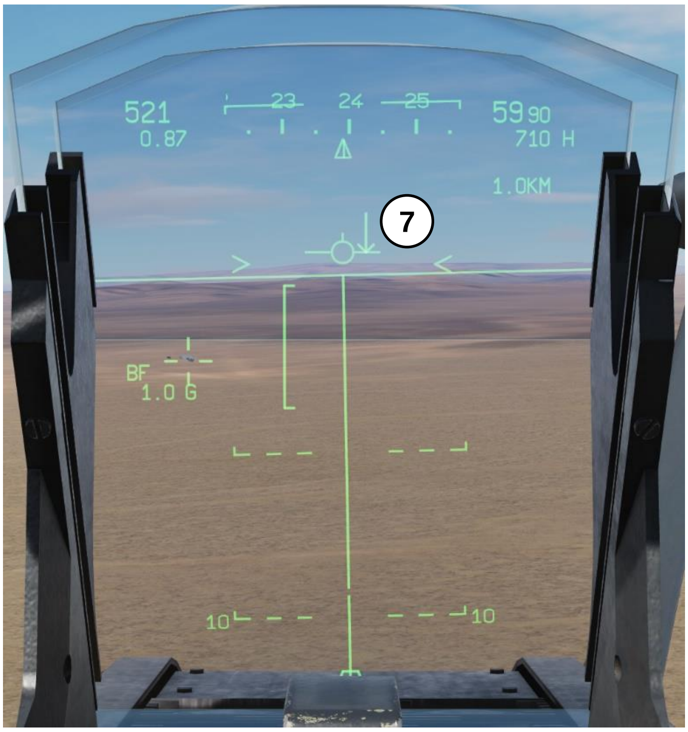
BF SUB-MODE

Displayed when a high or very-high drag bomb is selected and the SNA is in air-to-ground selected sub-mode. This sub-mode is used to deliver bombs using CCPI (*Calcul continu du point d'impact* – CCIP) delivery.

BF SUB-MODE BEFORE TRIGGER PRESS

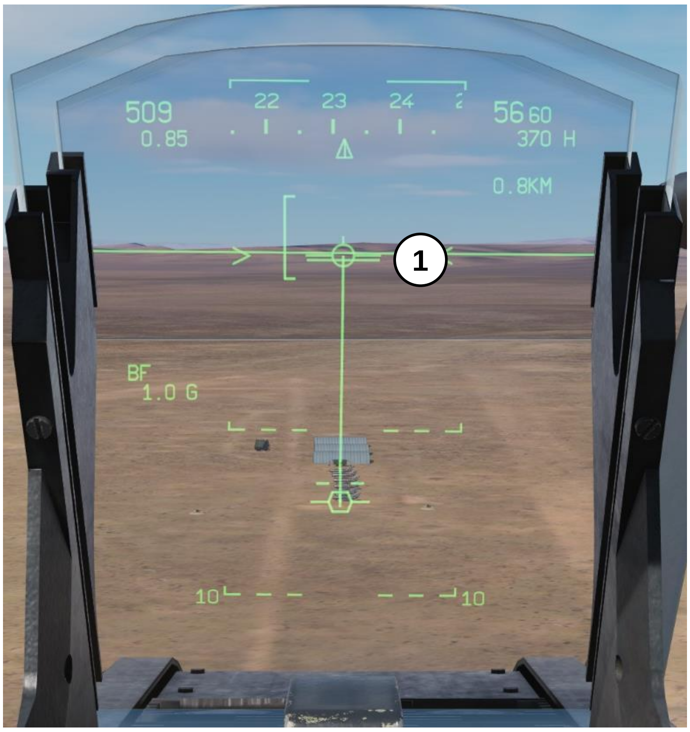


1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: BF. It flashes if the weapon is not ready to be released.
2. BOMB RELEASE DOMAIN (*Domaine de largage*): Indicates the altitude and vertical speed release domain for the selected bombs relative to the FPM.
3. BOMB FALL LINE (*Ligne de chute des bombes*): Represents the bomb ground impact line. It connects the aiming reticle to the FPM, the line is not drawn above the horizon and is then connect to the projected FPM position on the horizon.
4. LAST BOMB INDICATOR (*Trou dans la ligne de chute*): Represents the last bomb impact point considering the number of bombs and the release interval.
5. AIMING RETICLE (*Réticule de visée*): Indicates the first bomb inpact point.
6. WEAPON READY INDICATION (*Armement prêt*): The wings indicate that the weapon is ready for release.



7. Too low/high for bomb domain (*Domaine vers le bas/haut*): Indicates that the aircraft is outside the release domain for the selected bomb. The direction of the arrow indicates the direction of the release domain.

BF SUB-MODE AFTER TRIGGER PRESS

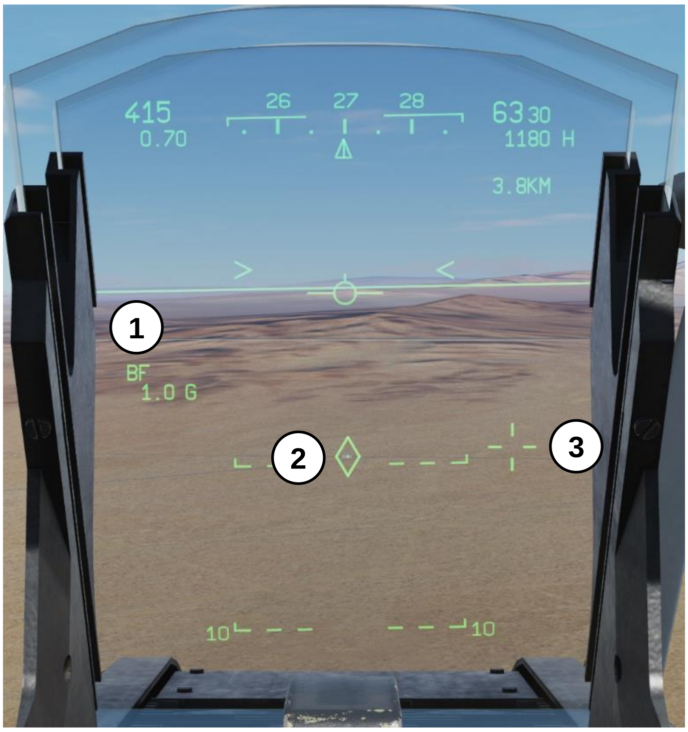


1. RELEASE BAR (*Barre de largage*): Displayed when the trigger is pressed, the bombs are released when the bar reaches the center of the FPM, and is displayed as long the bomb salvo is not finished.

BF PI SUB-MODE

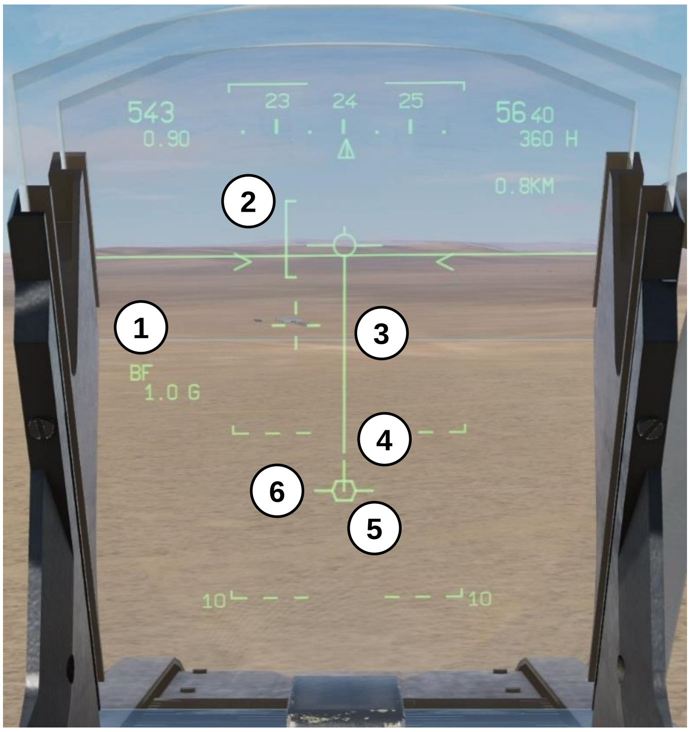
Displayed when a high or very-high drag bomb is selected, the SNA is in air-to-ground selected sub-mode, the PI PCA option is selected and the current DEST BUT has a valid BAD. This sub-mode is used to deliver bombs using CCPI (*Calcul continu du point d'impact* – CCIP) delivery with prior nav fix using an initial point.

BF PI SUB-MODE BEFORE PI DESIGNATION

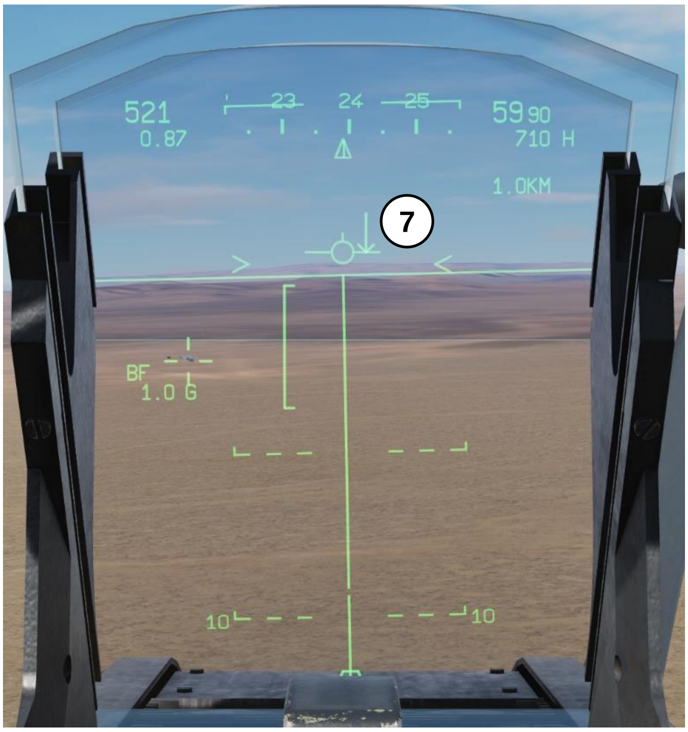


1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: BF. It flashes if the weapon is not ready to be released.
2. DESIGNATION DIAMOND (*Réticule de désignation*): Indicates the aiming point for the PI designation.
3. BUT POSITION INDICATOR (*Réticule BUT*): Indicates the position of the PI, since the INS accumulates drift, it can be incorrect.

BF PI SUB-MODE AFTER PI DESIGNATION

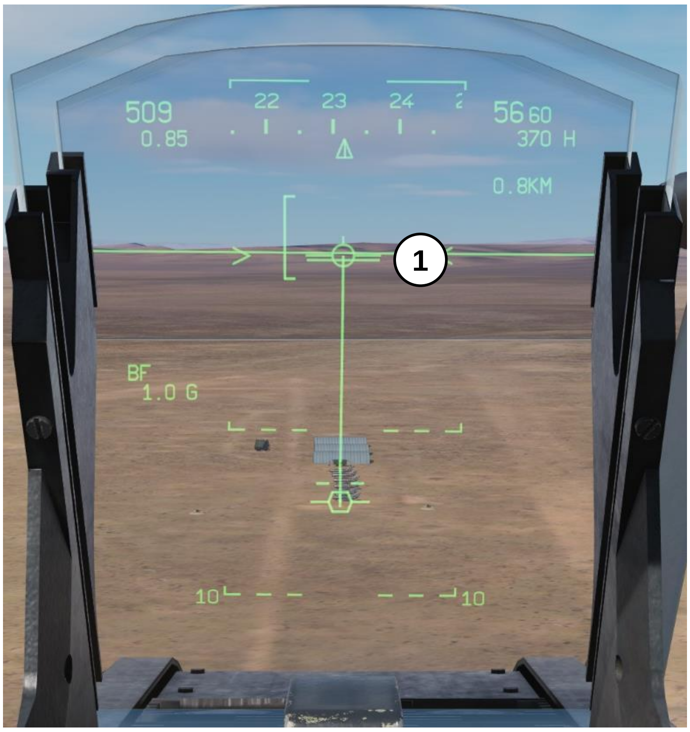


1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: BF. It flashes if the weapon is not ready to be released.
2. BOMB RELEASE DOMAIN (*Domaine de largage*): Indicates the altitude and vertical speed release domain for the selected bombs relative to the FPM.
3. BOMB FALL LINE (*Ligne de chute des bombes*): Represents the bomb ground impact line. It connects the aiming reticle to the FPM, the line is not drawn above the horizon and is then connect to the projected FPM position on the horizon.
4. LAST BOMB INDICATOR (*Trou dans la ligne de chute*): Represents the last bomb impact point considering the number of bombs and the release interval.
5. AIMING RETICLE (*Réticule de visée*): Indicates the first bomb inpact point.
6. WEAPON READY INDICATION (*Armement prêt*): The wings indicate that the weapon is ready for release.



7. TOO LOW/HIGH FOR BOMB DOMAIN (*Domaine vers le bas/haut*): Indicates that the aircraft is outside the release domain for the selected bomb. The direction of the arrow indicates the direction if the release domain.

BF PI SUB-MODE AFTER TRIGGER PRESS

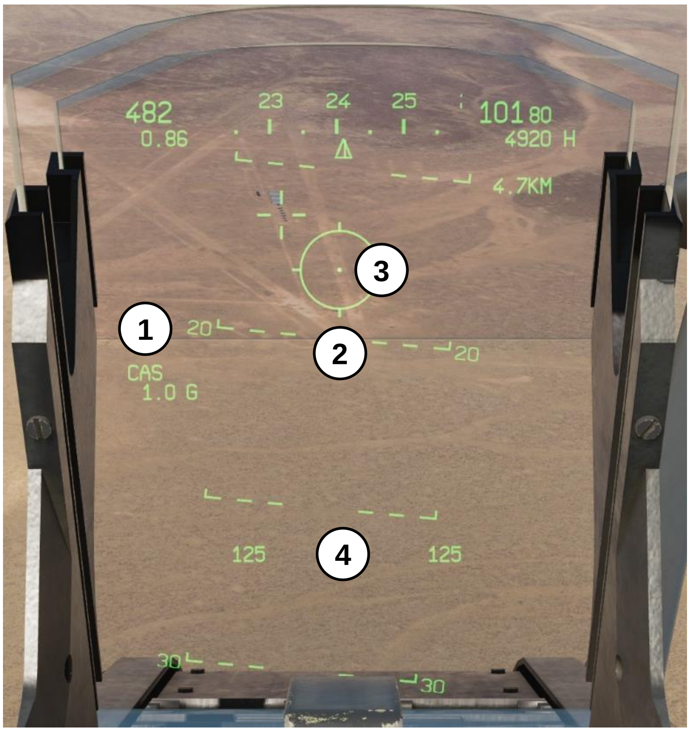


1. RELEASE BAR (*Barre de largage*): Displayed when the trigger is pressed, the bombs are released when the bar reaches the center of the FPM, and is displayed as long the bomb salvo is not finished.

CAS sub-mode

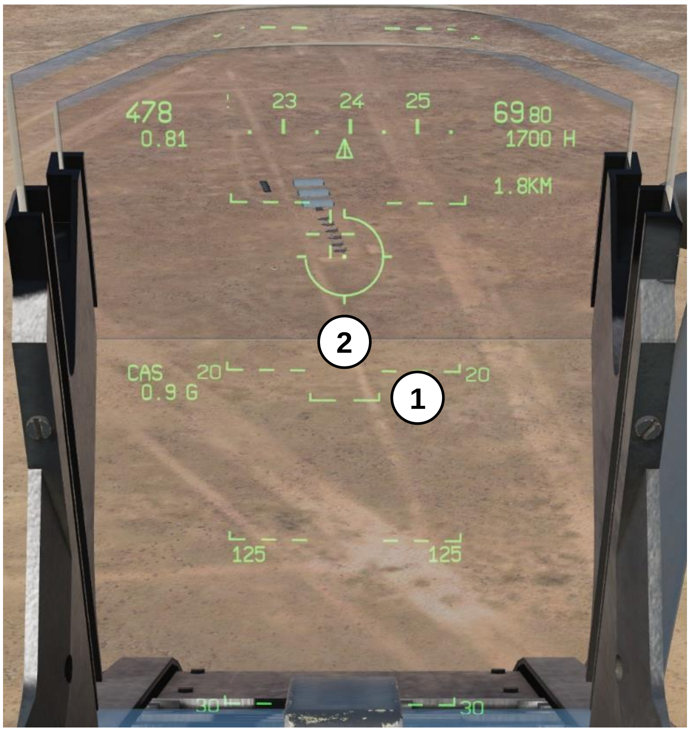
Displayed when the guns are selected in air-to-ground mode and the SNA is in air-to-ground selected sub-mode. This sub-mode is used to fire the guns using CCPI (*Calcul continu du point d'impact* – CCIP) delivery.

CAS SUB-MODE OUT OF RANGE



1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: CAS. It flashes if the weapon is not ready to be released.
2. GUNS/ROCKETS FIRE DOMAIN (*Domaine de tir canons/roquettes*): Unwinds counter clockwise to indicate the guns employment domain. A full circle indicates that the aircraft is out of range for the guns and that the symbology is not yet indicating the shells impact point.
3. GUNS/ROCKETS AIMING RETICLE (*Réticule de visée canons/roquettes*): Indicates the shells impact point on the ground once the aircraft is in the employment domain.
4. REMAINING SHELLS (*Nombre d'obus restants*): Displays the remaining shells count for each DEFA 554 cannons.

CAS SUB-MODE AT MAXIMUM RANGE

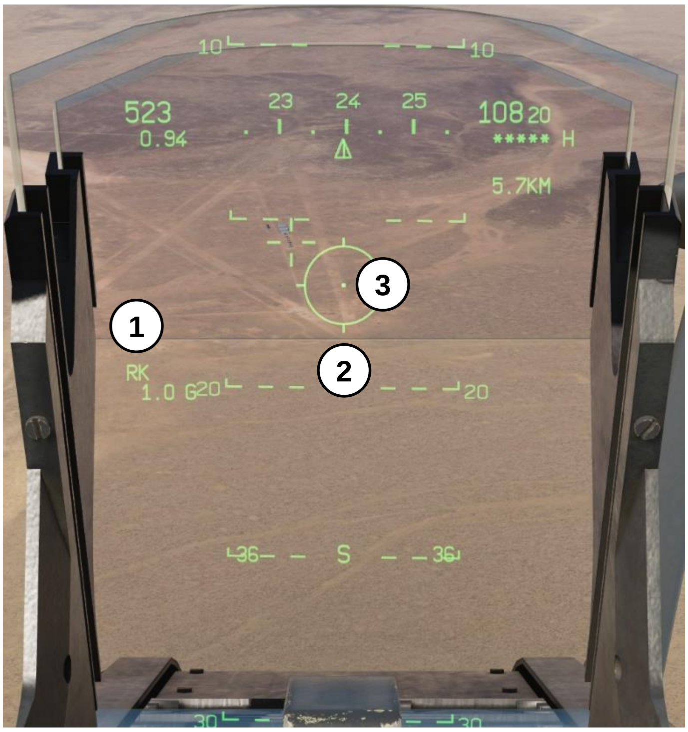


1. SAFETY BAR (*Barre de sécurité*): Represents the remaining time before the aircraft enters the blast zone or goes under the safety height. When it reaches the aiming reticle, the pilot needs to do an immediate 6G pull up.
2. GUNS/ROCKETS FIRE DOMAIN (*Domaine de tir canons/roquettes*): Indicates the guns employment domain:
   - 12 o'clock: 2100m, out of range.
   - 9 o’clock: 1800m, maximum range.
   - 6 o’clock: 1200m, optimum range
   - 3 o’clock: 600m, minimum range.

RK sub-mode

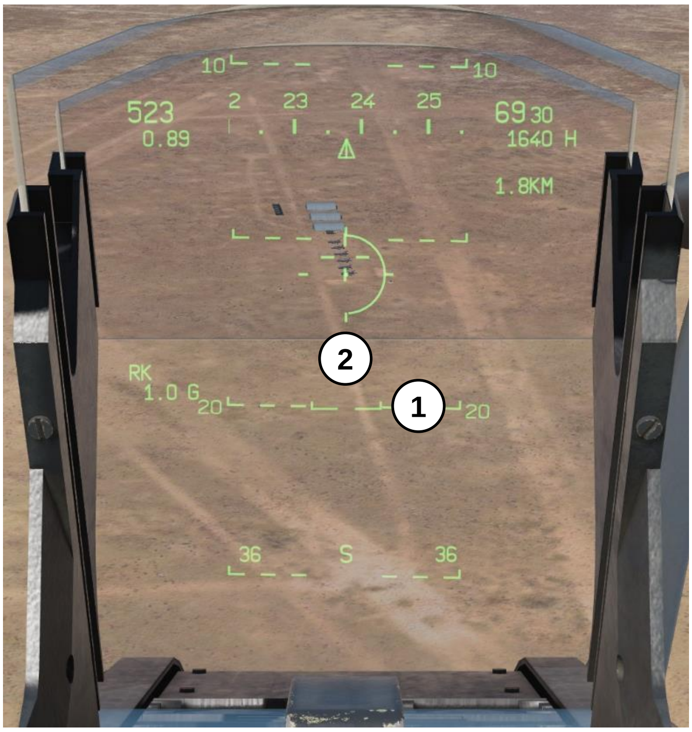
Displayed when rockets are selected and the SNA is in air-to-ground selected sub-mode. This sub-mode is used to fire rockets using CCPI (*Calcul continu du point d'impact* – CCIP) delivery.

RK SUB-MODE OUT OF RANGE



1. CURRENT AIR-TO-GROUND MODE (*Mode Air/Sol en cours*): Indicates the selected weapon type: RK. It flashes if the weapon is not ready to be released.
2. GUNS/ROCKETS FIRE DOMAIN (*Domaine de tir canons/roquettes*): Unwinds counter clockwise to indicate the rockets employment domain. A full circle indicates that the aircraft is out of range for the rockets and that the symbology is not yet indicating the rockets impact point.
3. GUNS/ROCKETS AIMING RETICLE (*Réticule de visée canons/roquettes*): Indicates the rockets impact point on the ground once the aircraft is in the employment domain.

RK SUB-MODE AT OPTIMUM RANGE

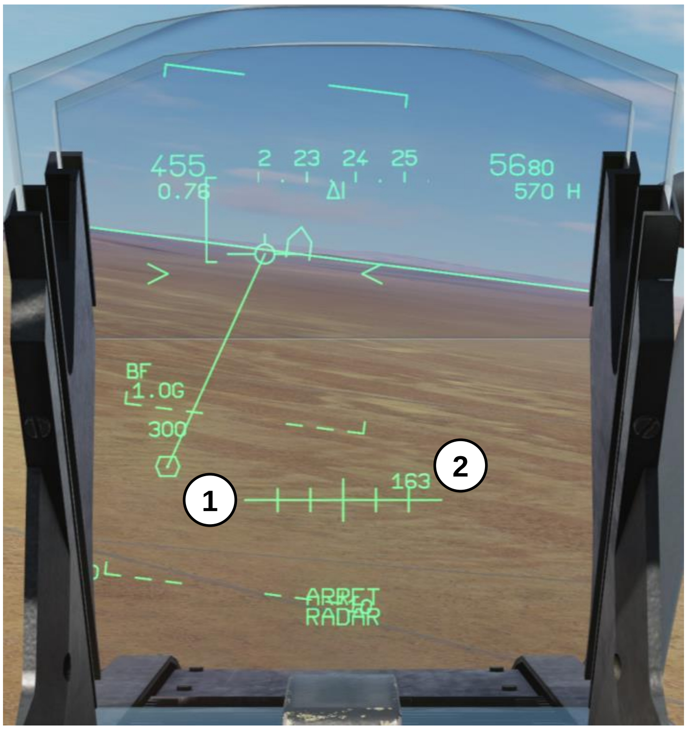


1. SAFETY BAR (*Barre de sécuritée*): Represents the remaining time before the aircraft enters the blast zone or goes under the safety height. When it reaches the aiming reticle, the pilot needs to do an immediate 6G pull up.
2. GUNS/ROCKETS FIRE DOMAIN (*Domaine de tir canons/roquettes*): Indicates the rockets employment domain:
   - 12 o'clock: 2700m, out of range.
   - 9 o'clock: 2400m, maximum range.
   - 6 o'clock: 1800m, optimum range
   - 3 o'clock: 1200m, minimum range.

13 – 7 - OTHER SYMBOLOGY

BACK-UP FIXED SIGHT

The backup fixed sight can be displayed in any mode using the backup fixed sight switch on the PCTH. Its vertical position can be adjusted backup fixed sight wheel.



1. BACKUP FIXED SIGHT (*Hausse manuelle*): Used to employ air-to-ground ordinance when the main mode is unavailable.
2. BACKUP FIXED SIGHT SETTING (*Position hausse manuelle*): The number indicate the backup fixed sight position in mrad down from the aircraft waterline.

JAMMING SYMBOLOGY

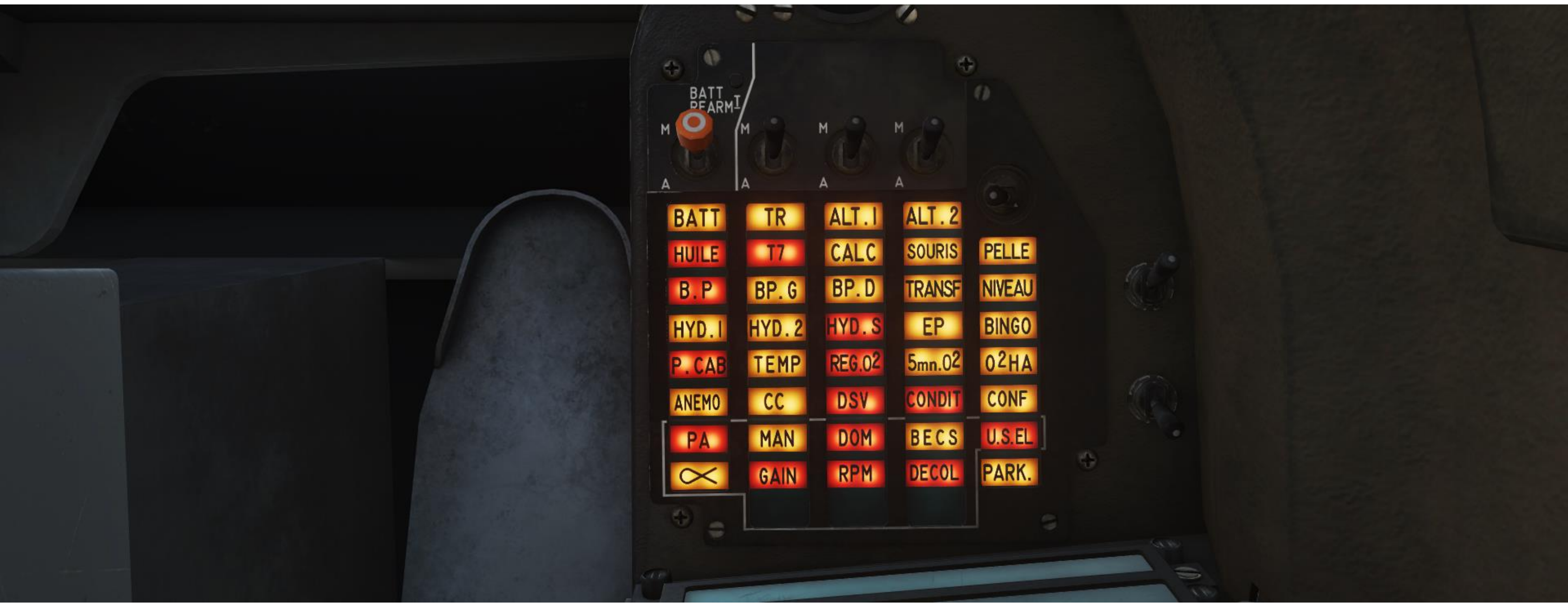
The following jamming symbology is displayed on the VTH when it is in NAV or air-to-air mode

1. JAMMING INDICATION (*Ambiance brouillée*): Flashing for 5 seconds when displayed, then steady, indicates that the radar is being jammed.

13 – 8 - WARNING SYMBOLOGY

WORK IN PROGRESS

14 - WARNING SYSTEM



14 – 1 - FAULT INDICATOR BUTTON

The fault indicator button (*Voyant-poussoir répétiteur de PANNE*) is located at the top left of the front dash. It consists of 2 lights, amber for cautions and red for warnings.

It indicates the type of faults present on the alarm panel and allows to acknowledge them to silence the warning tones.

There are 2 type of fault:

- **CAUTION:** Indicates a fault that is not an immediate danger to the aircraft or the pilot.

When a caution occurs, the corresponding light will light up on the alarm panel as well as the amber caution light on the fault indicator button.

20 seconds after the caution light turns on, a caution fault audio warning (double chime) will be heard, repeating every 3.5 seconds.

- **WARNING:** Indicates a fault that require immediate action from the pilot.

When a warning occurs, the corresponding light will light up on the alarm panel as well as the red warning light on the fault indicator button.

The warning fault audio warning will be heard as soon as the fault is detected, it is a loud tone that repeats every second.

14 – 2 - ALARM PANEL

INTRODUCTION

The alarm panel is located on the right vertical panel and indicate the faults detected by the aircraft. It indicates the fault name and type, amber for **CAUTIONS** and red for **WARNINGS**. The light stays on as long as the caution/warning condition exists.

Each fault light is back lighted by 2 light bulbs for redundancy.

FAULT LIGHTS DESCRIPTION

ALARM PANEL LIGHT	DESCRIPTION	MORE INFORMATION
BATT	Main battery is disconnected or has failed.	
TR	Main or aux transformer is disconnected or has failed.	
ALT.1	Alternator 1 is disconnected or has failed.	
ALT.2	Alternator 2 is disconnected or has failed.	
HUILE	Low oil pressure.	
T7	Engine T7 temperature is above 850º Celsius.	
CALC	Engine controller functionality compromised.	
SOURIS	Engine inlet cones failure or forced retracted by the inlet cones operation switch.	
PELLE	Engine intakes scoops failure or forced retracted by the scoops operation switch.	
BP	Low fuel pressure.	
BP.G	Left (*Gauche*) fuel pump is OFF.	
BP.D	Right (*Droite*) fuel pump is OFF.	
TRANS	A non-empty tank pressure is low, inducing fuel transfer problems.	
NIVEAU	Remaining fuel is below 500 kg.	
HYD.1	Hydraulic system 1 pressure is below 195 bars.	
HYD.2	Hydraulic system 2 pressure is below 195 bars.	
HYD.S	Hydraulic system 2 pressure is below 140 bars or emergency pump switch is set to OFF.	
EP	emergency pump is active for more than 6 seconds.	
BINGO	Remaining fuel is below the set BINGO level.	
P. CAB	Canopy not sealed or cabin pressure > 30,000 ft.	
TEMP	Overheat in the cockpit. **NOT FUNCTIONAL**	

REG.O^2	ECS Oxygen regulator fault. **NOT FUNCTIONAL**	
5mn.O^2	Only 5 minutes of oxygen supply remaining.	
O^{2}HA	**NO FUNCTION**	
ANEMO	Air Data Sensors heating is disabled or has failed.	
CC	Indicates a DC Low Voltage. DC Sec. bus automatically switched Off, expect only 30 minutes of power on the DC buses.	
DSV	Engine bypass ratio slats fault. **NOT FUNCTIONAL**	
CONDIT	ECS Heat Exchanger overheat. **NOT FUNCTIONAL**	
CONF	The FBW mode switch is in the wrong position for the current loadout.	
PA	Autopilot system failure.	
MAN	Flight Controls single failure on a multi-redundant system, restricting the maneuverability. (*manoeuvrabilité*)	
DOM	Flight Controls dual failure on a multi-redundant system or an actuator, restricting the flight envelope. (*domaine de vol*)	
BECS	Slats failure.	
U.S.EL	Last Emergency enabled for elevons. (*Ultime Secours Elevons*)	
ALPHA	Angle of Attack sensors fault (incoherent values or total failure).	
GAIN	FBW automatic gains calculation failure or emergency gains switch is set to the emergency position.	
RPM	Engine Low RPM alarm.	
DECOL	Take-off configuration incorrect (not all the required checks performed / systems on).	
PARK	Parking brake is engaged.	

15 - LIGHTING

15 – 1 - COCKPIT LIGHTING

INTRODUCTION

The Mirage 2000C cockpit is lit by green floodlights as well as white floodlights for the front dash and all the panel and instruments are backlighted in red.

INTERNAL LIGHTING CONTROLS

The internal light control panel (*boite de commande éclairage*) is located at the rear of the right console. It provides control over the green and white cockpit floodlights, the front dash, vertical panels and consoles backlight and the indicator lights intensity.

Just above it is the NVG switch (*Inverseur JVN*) that disable all back lighting to reduce NVG glare.

1. FRONT DASH LIGHTING KNOBS (*Potentiomètres éclairage planche de bord*):
   - FRONT DASH BACKLIGHT (*Rétroéclairage planche de bord*): Top knob, sets the front dash indication and instrument backlighting.
   - FRONT DASH GREEN FLOODLIGHT (*Eclairage planche de bord*): Bottom knob, sets the front dash green floodlights.
2. CONSOLE LIGHTING KNOBS (*Potentiomètres éclairage banquettes*):
   - CONSOLE BACKLIGHT (*Rétroéclairage banquettes*): Top knob, sets the console indication and instrument backlighting.
   - CONSOLE GREEN FLOODLIGHT (*Eclairage banquettes*): Bottom knob, sets the consoles green floodlights.
3. INDICATOR LIGHTS INTENSITY KNOB (*Potentiomètre luminositée voyants*): Sets the intensity of all the cockpit indicator lights and front dash segment displays (Alarm

panel, after-burner light, engine fire lights, auto-pilot control panel, configuration panel, PCA, PPA, fuel flow indicator, V/UHF frequency repeater)

In the *Jour* (Day) position the knob is at the clockwise stop, in this position the knob is in a notch and the indicator lights intensity is at its maximum. Turning the knob counterclockwise past the notch into the *Nuit* (Night) reduces the indicator lights intensity. The counterclockwise stop is just before the *Jour* (Day) position were the indicator lights intensity is at its lowest.

4. FRONT DASH WHITE FLOODLIGHT (*Potentiomètre éclairage blanc planche de bord*): Sets the front dash white floodlights.
5. NVG SWITCH (*Inverseur JVN*): Disable all panels, consoles and instruments backlight for use with NVGs.

15 – 2 - EXTERIOR LIGHTS

INTRODUCTION

The Mirage 2000C have all the standard navigation, anti-collision lights and taxi/landing lights as well as formation lights, a night time identification (police) light, a retractable refueling light and a refueling probe light.

EXTERNAL LIGHTS SWITCHES

1. ANTI-COLLISION LIGHTS SWITCH (*Sélecteur feux anti-collision*): Turns on or off the anti-collision lights and sets their intensity:
    - **A.** (Arret – OFF).
    - **FAIB.** (*Faible* - Low).
    - **FORT** (High).
2. NAVIGATION LIGHTS SWITCH (*Sélecteur feux de navigation*): Turns on or off the navigation lights and sets their intensity:
    - **A.** (Arret – OFF).
    - **FAIB.** (*Faible* - Low).
    - **FORT** (High).
3. FORMATION LIGHTS SWITCH (*Sélecteur feux de formation*): Turns on or off the formation lights and sets their intensity:
    - **A.** (Arret – OFF).
    - **FAIB.** (*Faible* - Low).
    - **FORT** (High).
4. REFUELING LIGHTS INTENSITY KNOB (*Potentiometre luminosite phare ravitaillement en vol*): Sets the intensity of the retractable refuel light and refueling probe light. NOT FUNCTIONAL

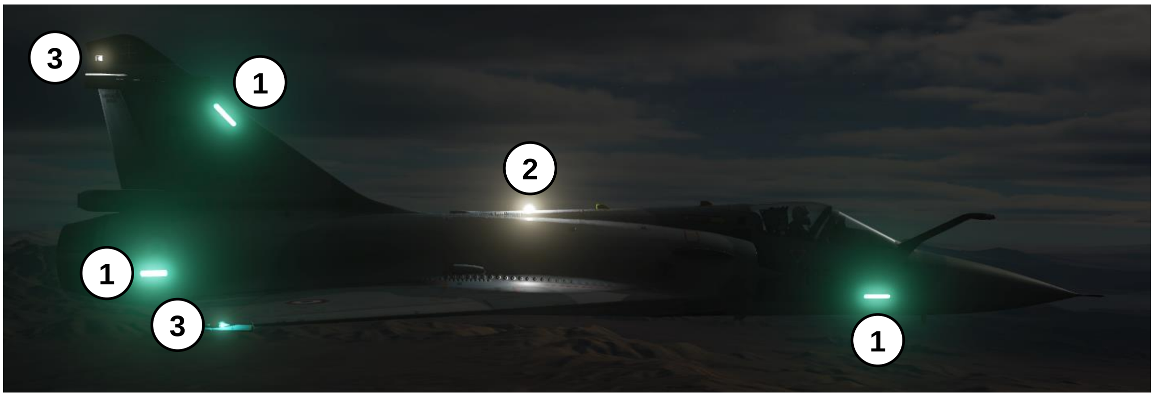
5. POLICE LIGHT SWITCH (*Interrupteur phare de police*): Turns the police light on or off. **NOT FUNCTIONAL**

6. LANDING LIGHTS SWITCH (*Sélecteur phare d'atterrissage et de roulage*): Turns on or off the landing lights and selects their position:
   - **A.** (Arrêt – OFF): The landing lights are turned off.
   - **ROUL.** (*Roullage* – taxi): The landing lights are turned on and lit up a wide area in front of the aircraft.
   - **ATT.** (*Atterissage* – landing): The landing light are turned on and lit up an area about 14° bellow the aircraft waterline to illuminate the runway when landing.

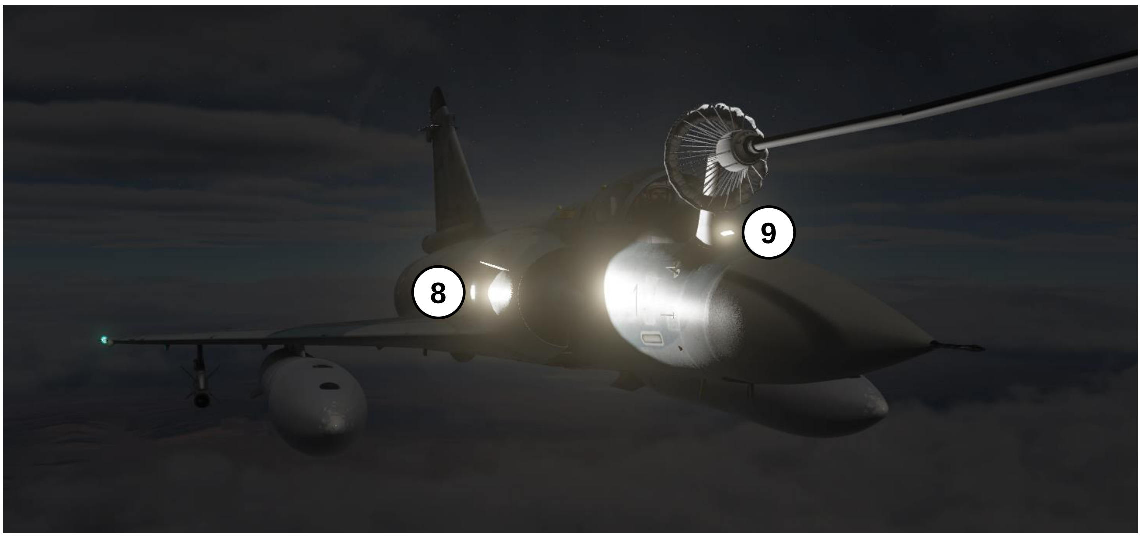
7. INFLIGHT REFUELING SWITCH (*Inverseur commande ravitaillement en vol*): the top-most **RVT.N** (*ravitaillement nuit* – night refueling) position turns on the retractable refueling light and refueling probe light.

EXTERIOR LIGHTS

The exterior lighting is composed of five separate systems with different purpose:



1. FORMATION LIGHT (*Feux de formation*): Formation lights are low intensity lights that provide visual cues for night time formation flight. The Mirage have 6 of those, 3 on each side.
2. ANTI-COLLISION LIGHTS (*Feux anti-collidion*): Anti-collision lights provides long distance visual position indication by the mean of 2 white strobe lights. They are located on middle of the aircraft spine and on the underside between the front gear and the center pylon.
3. NAVIGATION LIGHTS (*Feux de navigation*): Navigations lights provides visual position and orientation indication. 3 lights compose the navigation lights:
    - Green the right wingtip.
    - Red on the left wingtip.
    - White at the top of the tail fin.



8. Retractable refueling light (*Phare de ravitaillement en vol*): The retractable refueling light provides illumination of the refueling basket during night time aerial refueling operations. It is retractable to allow for a good position while maintaining aerodynamism.
9. Refueling probe light (*Phare de la perche de ravitaillement en vol*): The refueling probe light provides illumination to the aircraft's refueling probe during night time aerial refueling operation.

10. Police light (*Phare de police*): The police light allows night time aircraft identification by illumination during air policing duties. Located on the left side of the aircraft, behind the air intake, is a high intensity floodlight oriented up and to the left.

11. LANDING LIGHTS (*Phare d'atterrissage et de roulage*): The landing lights provide forward illumination during ground operation, take-off and landing. The 2 head lights are located on the front wheel strut and are automatically turned off when the gear is not locked in the down position.

15 – 3 - NIGHT VISION GOGGLES

The Mirage 2000C can be equipped with NVGs (night vision goggles – *jumelles de vision nocturne*). Most of the front dash instruments have Plexiglas plates covers to reduce NVG glare.

The NVGs are installed on a mount at the front on the pilot's helmet and are powered by a battery pack installed on the back. The mount allows the NVG to be quickly raised or lowered to the pilot's eyes and are placed at a distance to allow to look below them.

The NVG are stored in a bag at the back of the right console. There is also an NVG mount on top of the left side of the front dash to store NVG when not in the bag.

The NVG bag is automatically installed at night and can otherwise be requested to the ground crew.

The NVGs are focused to infinity to focus on objects outside the aircraft, this means that the image will be blurred when looking inside the cockpit. In order to look at instruments, the pilot needs to raise the NVG out of his field of view or look below them. The only instrument that is in focus with the NVGs is the VTH as it is also focused to infinity, only the luminosity needs to adjusted.

16 - OTHER SYSTEMS

16 – 1 - DRAG CHUTE

INTRODUCTION

The Mirage 2000C is fitted with an emergency drag chute, it is a safety feature that can be used to reduce the landing distance or during aborted take-off. The parachute container is located on the underside of the aircraft, between the exhaust nozzle and the centerline pylon.

If desired, the drag chute container can be replaced by the ÉCLAIR chassis. For more information, see the **ELECTRONIC WARFARE ÉCLAIR SUB-SECTION**.

An emergency field hook assembly can also replace the drag chute but this feature is not supported by DCS and is **NOT FUNCTIONAL**.

CONTROLS

The drag chute command lever (*commande parachute frein*) is located on the left cockpit wall at the base of the windshield. When pulled full aft, the drag chute deploys, when pushed back forward, the drag chute is separated from the aircraft.

CAUTION	The drag chute must not be deployed until the nose gear is on the ground, in order not to damage the engine nozzle.

16 – 2 - CANOPY

CANOPY LEVER

The canopy locking and pressurization mechanism is controlled via the canopy lever (*commande verrière*) located on the right cockpit wall at the base of the windshield:

- Pulled back, the canopy is unlocked and moves up, this position is momentary and the handle will return to the center position.
- Center position, the canopy is unlocked and can be closed or opened.
- Pushed forward, if the canopy is closed, it is locked and sealed.

HALF-OPENING HANDLE

The half-opening handle (*Poignée entrebailleur*) locks the canopy in a half-opened position. This position can be used to reduce outside noise while keeping the air fresh.

WARNING	The canopy must be closed and sealed before take-off, the canopy could be ripped at high taxi speed.

CANOPY HANDLES

The canopy handles (*Poignées ouverture verrière*) are used to pull up or down the canopy from the open or half-open position.

CANOPY FRACTURE LEVER

The canopy fracture lever (*Commande de fragilisation verrière*) activates the built-in canopy detonation cords. This might be useful to exit a crashed aircraft with a stuck canopy.

17 - RADIO NAVIGATION

INTRODUCTION

The Mirage 2000C is equipped with TACAN, VOR and ILS radio navigation systems.

The TACAN (Tactical air navigation) system is a military radio navigation system similar to the VOR-DME system. Its operating frequencies are stored in preset channels, consisting of a letter (X or Y) and numbers, providing for a total of 248 possible combinations. TACAN systems can be found on airbases, ships, and big aircrafts like tankers.

The VOR (very high frequency omni-directional range) system is a civil radio navigation beacon that provides direction and distance when the station is collocated with a DME (distance measuring equipment). The Mirage 2000C VOR equipment only supports bearing indication. VOR operating frequencies are from 108.0 MHz to 117.95 MHz.

The ILS (instrument landing system) system is a civil radio navigation system that provides short range runway approach guidance for landing at night or in bad weather. Its operating frequencies are the same than the VOR system, from 108.0 MHz to 117.95 MHz.

17 – 1 - TACAN

INTRODUCTION

In the Mirage 2000C, TACAN bearing and distance is displayed on the IDN, for more information see the see the AVIONICS NAVIGATION INDICATOR SUB-SECTION. The station identification Morse code volume can be adjusted via the SIB panel.

TACAN can also be used to provide distance between 2 TACAN equipped aircrafts. The system works with 1 leader and 1 or multiple followers, all the followers will have the distance to the leader while the leader will have the distance to the more powerful (closer) follower. To setup the system:

- The leader needs to set his TACAN to A/A mode and set an agreed upon channel.
- The followers need to set their TACAN to A/A mode and set the lead's channel plus 63 (lead on channel Y14, followers on channel Y77).

TACAN PANEL

1. TACAN CHANNEL WINDOW (*Fenêtre d'affichage canal TACAN*): Displays the selected TACAN channel. Ranges from 1 to 124, plus the X or Y band. Channel 0 is not active.
2. LEFT CONCENTRIC KNOBS (*Rotateur concentrique gauche*): The two-position outer rim knob sets the X or Y band. The inner knob sets the tens and hundreds for the TACAN channel.
3. RIGHT CONCENTRIC KNOBS (*Rotateur concentrique droit*): The four-position outer rim knob or mode knob selects the TACAN operational mode:
   - **OFF**: The TACAN system is not powered.
   - **REC** (Receive): The TACAN system listens to the TACAN station to determine its bearing. In this mode, the aircraft's TACAN system is not emitting.
   - **T/R** (Transmit/Receive): The TACAN system communicates with the TACAN station to determine its bearing and range.
   - **A/A** (Air-to-air): The TACAN system communicates with other aircraft TACAN systems to determine range.

17 – 2 - VOR AND ILS

INTRODUCTION

In the Mirage 2000C, VOR bearing is displayed on the IDN, for more information see the AVIONICS NAVIGATION INDICATOR SUB-SECTION. The ILS localizer and glideslope can be visualized on the IS and the VTH, the autopilot also uses the ILS in automatic approach mode, for more information see the AVIONICS FLIGHT INSTRUMENTS SUB-SECTION, HEAD-UP DISPLAY NAV MODE SUB-SECTION and AUTOPILOT SUB-SECTION section. The ILS identification Morse code volume can be adjusted via the SIB panel.

VOR/ILS PANEL

1. VOR/ILS FREQUENCY WINDOW. Displays the selected operating frequency. ILS frequencies range are 108.000 to 119.95 MHz.
2. LEFT CONCENTRIC KNOBS. The two-position outer rim knob sets the system to **ON** (M - *Marche*) or **OFF** (A - *Arrêt*). The inner knob sets the frequency units, tens and hundreds from 108 to 119.
3. RIGHT CONCENTRIC KNOBS. The two-position outer rim knob select the HG (*haut-gauche* – high-left) or BD (*bas-droite* – low-right) test positions. The inner knob sets the frequency tenths and hundredths from 00 to 95 by increments of 5.

18 - INS


N 42 08.0 E 042 37.5
01 18
P
PREP
DEST
RD/TD
L/G
ALT
CP/PD
D/RLT
TR/VS
DV/FV
DEC
ΔL/ΔG
ΔALT
P/θ
BUT
BAD
BAD
REC
MRC
VAL
TST
LUM
EFF
INS
0

18 – 1 - INERTIAL NAVIGATION SYSTEM INTRODUCTION

INS OPERATING PRINCIPLE

The INS is an autonomous navigation system that requires no external communication (VOR beacons, GPS satellites...) to operate. Based on a start position (the exact latitude / longitude and altitude of the starting point needs to be known) and using a very complex set of accelerometers and gyroscopes, it keeps track of the aircraft movement in space and calculates in a continuous manner the current position, route, speed, attitude and altitude.

SAGEM ULISS 52 UNI

The Sagem ULISS 52 UNI (*unité de navigation intertielle* – INS*)* is the heart of the M-2000C navigation system. This INS is composed of a computer that commands the INS platform and allows communication with panels or instruments. It also stores essential information used by the platform as well as navigation information used by the aircraft like the flight plan. The INS provide the aircraft with its position in the word as well as speed, heading, attitude and altitude. It can also provide course to a geographical point and various information to help the pilot perform navigation or weapon delivery.

The INS computer can store the following information:

- 20 BUTs that are navigation waypoints or ground attack targets. They can store the following information:
    - Latitude and Longitude (L/G).
    - Altitude (ALT).
    - Runway true heading (CP – *Cap Piste*).
    - Runway approach glideslope (PD – *Pente Désirée*).
    - Desired arrival time (TD – *Temps Désiré*).
    - Desired arrival track (RD – *Route Désirée*).

  Each BUT can also store a BAD (*BUT Aditionnel*) which is an offset waypoint or offset ground attack target. They can store the following information:
    - Latitude and Longitude offset (ΔL/ΔG).
    - Altitude offset (ΔALT).
- 3 *Marques* (MRQ) that are mark-points. They store the following information:
    - Latitude and Longitude.
    - Creation time.
- The magnetic declination (DEC)

The INS provide the following information:

- Aircraft geographical position (Latitude and Longitude).
- Horizontal components (Vx, Vy) of the inertial speed.
- Ground Speed.

- Ground Track.
- Direction and Strength of the Wind.
- True Heading.
- Magnetic Heading.
- Acceleration components (Ax, Ay, Az).
- Bearing and distance to a waypoint.
- Track error.
- Magnetic lateral deviation from desired track.
- Track error from desired track.
- Approach glideslope.
- Remaining time to reach waypoint.
- Time difference between remaining time and desired arrival time in order to maintain a constant speed.
- The aircraft load factor.

Interface with INS is done though 2 dedicated panels in the cockpit:

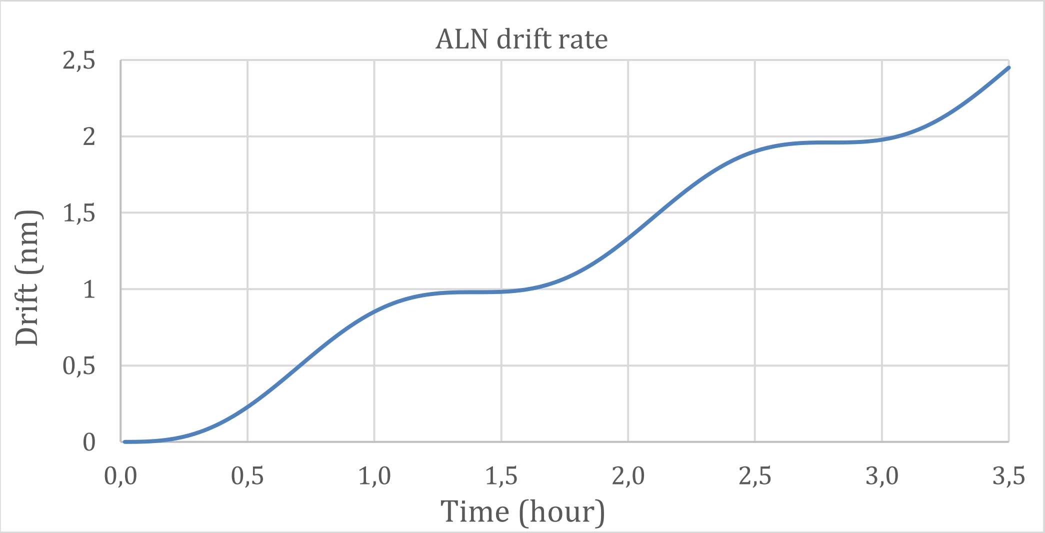
- The PCN (*poste de commande navigation* - navigation control panel)
- The PSM (*poste sélecteur de modes* - mode selector panel)

The INS computer provides information to the following instruments:

- VTH
- Radar
- VTB
- IS
- IDN
- PCN

PLATFORM DRIFT

The INS is not a perfect tool, and suffers from integration drift - accumulated small errors in its velocity and orientation measurements. It will result in a difference between the real position of the aircraft and were the INS thinks the aircraft is, this error in position is growing with time. This drift can be measured by drift rate commonly using the nautical mile per hour (nm/h) unit. Due to the earth being round the drift rate is not linear or exponential in time but rather follows the Schuler period.



Mirage 2000C INS mean drift rate after a normal alignment

As illustrated in the graphic above, the drift rate will be at its highest at 42 minutes and its lowest at 84 minutes.

The experienced drift rate will rarely look like the above graph as any change in attitude will influence the drift rate. The more changes, the more chaotic the drift will become. It is even common that the accumulated drift decreases at some point during long flight.

The ULISS 52 UNI is a class 1 INS, meaning that it can achieve less that 1nm/h of drift rate on average. The real drift rate of this particular system is closer to 0,7nm/h but keep in mind that the chaotic nature of the system allows for large differences between flights. Even aircraft flying the same mission can have very different drift patterns.

The accumulated drift can be corrected by performing an INS position fix, for more information see the HEAD-UP DISPLAY NAV MODE SUB-SECTION.

18 – 2 - MODE SELECTOR PANEL

The mode selector panel (PSM – *Post sélecteur de modes*) is located in the center of the right console, it controls both the PCN and INS operational modes.

1. MODE SELECTOR KNOB (*Sélecteur de mode*): Sets the INS operating mode:
   - **AR** (*Arrêt* - OFF): Turns Off both the INS and the PCN
   - **VEI** (*Veille* - Standby): The gyros remain off but the system is powered and thermal regulation is on. The PCN is available for data entry and visualization.
   - **CAL** (*Calibration*): Reserved for maintenance. NOT FUNCTIONAL
   - **TST** (*Test*): Reserved for maintenance. NOT FUNCTIONAL
   - **ALN** (*Alignement normal* - Normal alignment): Sets the INS to do a normal alignment. (See INS ALIGNMENT SUB-SECTION for more information)
   - **ALCM** (*Alignement sur cap mémorisé* - Stored heading alignment): Sets the INS to do a fast alignment. (See INS ALIGNMENT SUB-SECTION for more information).
   - **NAV** (*Navigation)*: Navigation mode.
   - **SEC** (*Secours* - Emergency): Emergency mode, the INS provides only gyroscopic information (attitude and heading).
2. DATA CARTRIDGE SLOT (*Trappe du module d'insertion de paramètres*): Used by the ground crew or the pilot to insert data into the INS using a data cartridge (MIP). NOT FUNCTIONAL
3. OPERATIONAL MODE SELECTOR KNOB (*Sélecteur de mise en œuvre*): Sets the PCN operating mode :
   - **N** (*Normal*): Normal operating mode, for data entry and visualization.
   - **STS** (*Status*): Used to display alignment status in ALN and ALCM modes and to start maintenance tests in TST mode.
   - **DCI** (*Données codées inertielles* - Inertial coded data): Used to visualize or enter certain parameters into the INS memory. Maintenance only. NOT FUNCTIONAL
   - **CRV** (*Compte-Rendu de vol* - Flight report): Used to generate a flight report for INS performance tracking. Maintenance only. NOT FUNCTIONAL
   - **MAIN** (*Maintenance*): Used for maintenance only. NOT FUNCTIONAL

18 – 3 - NAVIGATION CONTROL PANEL

The navigation control panel (PCN - *poste de commande navigation*) is located at the front on the right console and it is responsible for the interface between the pilot and the INS. It is the main tool used for navigation, creating waypoints (BUTs) and displaying different flight parameters, including current aircraft position, ground speed and true heading.

The main functions of the PCN are as follows:

- Visualization of the navigation data in the memory of the INS.
- Data input into the memory of the INS.
- Visualization of the INS alignment status.
- Selection of PREP and DEST BUT, BAD and MRQ waypoints.
- Creation, validation and rejection of MRQ mark-points.
- Creation, validation and rejection of INS position fixes.

Below you will find description of all the displays and buttons:

1. UPPER LEFT VISUALIZATION WINDOW: 6 digits separated by 5 points with symbols **N**, **S**, **+** and **–**. Displays INS data.
2. UPPER RIGHT VISUALIZATION WINDOW: 7 digits separated by 6 points with symbols **E**, **W**, **+** and **–**. Displays INS data.
3. LOWER VISUALIZATION WINDOWS: Displays 2 numbers just above the PREP and DEST buttons, they represent the selected BUT in PREP and DEST.

4. STATUS LIGHTS: Displays the status of the INS system, operational mode, alignment state and MRQ status.

- PRET (*Prêt* - Ready):
  - Flashing, indicates that the ALN has reached the minimum class 4 and can be interrupted by setting the INS into NAV mode.
  - Steady, indicates that the ALN or ALCM is finished and the INS is ready to go into NAV mode or that a maintenance test was successful.
- ALN (*Alignement* – Alignment):
  - Flashing, indicates that the INS is not aligned and is ready to start the currently selected alignment.
  - Steady, indicates that the INS is aligning and is not ready to be set in NAV mode
- MIP (*Module d'Insertion de Paramètres* - Data catridge): NOT FUNCTIONAL
  - Flashing, indicates that the data transfer has failed.
  - Steady, indicates that the data transfer is in progress.
- N.DEG (*Navigation Dégradée* - Degraded navigation): Flashing or steady, indicates that the INS has detected a fault in the inertial assembly and is warning the pilot that the navigation data might be inaccurate.
- SEC (*Secours* - Emergency): Steady, indicates that the INS is in emergency mode, commanded by the mode selector knob or by the INS built in tests. If the light is turned on by the built in tests, the UNI light will also be turned on.
- UNI (*Unité de Navigation Inertielle* - Inertial navigation system): Steady, indicates that the INS has detected a major fault with the inertial assembly and or that the mode selector knob in the **AR** position.

5. FUNCTION KEYS: They have different function described below and are composed of a left green half with a yellow light bulb and a right orange half with an orange light bulb and the key name. The orange bulb is always turned on at half intensity when the panel in powered.

- **BAD** (*But Additionnel* - Offset waypoint): Selects the BAD for the current DEST BUT as the new DEST. The yellow and orange bulb turn on to indicate that a BAD is selected.
- **REC** (*Recalage* - Navigation fix): Triggers or cancels the INS overfly position update process. The yellow and orange bulb turn on to indicate that a *recalage* is awaiting validation.
- **MRQ** (*Marque* - Mark-point): Triggers or cancels the creation of a *marque* with the current aircraft coordinates. The yellow and orange bulb turn on to indicate that a *marque* is awaiting validation.
- **VAL** (*Validation*): The yellow and orange bulb turn on to indicate that the key can be used to validate a position fix or the creation of an MRQ and to start the currently selected alignment process.

6. BUT SELECTION KEYS: Used to select BUTs and have a yellow light bulb that turns on when the button is pressed and the PCN is waiting for the pilot to input the desired BUT number.
    - **PREP** (*Préparation* - Preparation): Selects the preparation BUT for data display or entry on the PCN.
    - **DEST** (*Destination* - Navigation): Selects navigation BUT that is going to provide information for the VTH and IDN.
7. NUMERIC KEYPAD: Used to enter data into the INS. Consists of:
    - NUMERIC KEYS: from 0 to 9. Including keys to designate North, South, East, West, + and -.
        - **EFF** (*Effacement* - Delete): Restarts the current input process.
        - **INS** (*Insertion* - Insert): Tries to insert the new data into the INS.
8. PARAMETER SELECTOR KNOB: Used to choose which data will be visualize or edit on the upper visualization windows.
9. LIGHT INTENSITY KNOB: Used to test and increase or decrease the brightness of the function keys, visualization windows, as well as EFF and INS keys on the numeric keypad.

NOTE	The intensity of the backlight of the PCN keypad is set by the console backlight knob on the interior lights panel.

18 – 4 - USING THE PCN

INTRODUCTION

In order to be able to use the PCN:

- The INS have to be powered either by the ground power or the engine.
- The PSM mode selector needs to be in the **VEI**, **ALN**, **ALCM** or **NAV** position.
- The PSM operating mode selector needs to be in the **N** position.

DATA VISUALIZATION

In order to visualize data on the PCN, the concerned BUT needs to be selected in PREP, then the 11 position PCN parameter selector needs to be rotated to the desired parameter. The data will then be displayed on the 2 windows of the PCN. If 2 data are under the same parameter selector position, they are displayed in the same order as in the selector position name, otherwise the data is displayed in the right window. The only exception is the altitude, the selector position name is **ALT** or **ΔALT** the left window displays the altitude in feets while the right window displays the altitude in meters.

The PCN can display 3 types of data: coordinates, signed values and unsigned values.

Below is a table containing the summary for each of the positions and after that tables detailing each position.

DATA SELECTION SUMMARY					
	NAME	EDITABLE	DATA TYPE	BUT 00	BUT 01-20
L/G	BUT latitude / longitude	Can be edited	Coordinates	Yes	Yes
ALT	BUT altitude	Can be edited	Signed	Yes	Yes
CP/PD	Runway heading / Glideslope *Cap vrai piste / Pente désirée*	Can be edited	Unsigned	No	Yes
D/RLT	Range / Bearing *Distance / Relèvement*	Read only	Unsigned	Yes	Yes
TR/VS	Remaining time / Ground speed *Temps restant / Vitesse sol*	Read only	Unsigned	Yes	Yes
DV/FV	Wind direction / Wind speed *Direction vent / Force vent*	Read only	Unsigned	Yes	Yes
DEC	Magnetic variation *Déclinaison magnétique*	Read only	Signed	Yes	Yes
P/Θ	BAD offset using polar Rho / Theta	Can be edited	Unsigned	No	Yes
ΔALT	BAD altitude difference	Can be edited	Signed	No	Yes
ΔL/ΔG	BAD offset using latitude / longitude difference	Can be edited	Signed	No	Yes
RD/TR	Desired heading / Desired time *Route désirée / Temps désiré*	Can be edited	Unsigned	Yes	Yes

BUT (*SECTEUR BUT* - WAYPOINT)

Used for visualization and edition of BUT parameters.

L/G	BUT LATITUDE / LONGITUDE				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Current latitude (degrees)	N/S 90.00.0	Current longitude (degrees)	E/W 180.00.0
	DESCR.	Allow the visualization of the current coordinates of the aircraft.			
CAN BE EDITED	BUT 01-20	BUT latitude (degrees)	N/S 90.00.0	BUT longitude (degrees)	E/W 180.00.0
SIGNED VALUE	DESCR.	Allow the visualization or edition of the PREP BUT coordinates.			
MORE INFORMATION					
NOTES		While the INS visualization windows can only display the coordinates down to the tenth of a minute, the INS can save the hundreds and thousands of a minute. The input format is the following: N/S 90.00.000 or E/W 180.00.000			

ALT	BUT ALTITUDE				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Aircraft altitude (feet)	+/- 99 999	Aircraft altitude (meters)	+/- 30 480
	DESCR.	Allow the visualization of the current INS altitude of the aircraft.			
CAN BE EDITED	BUT 01-20	BUT altitude (feet)	+/- 99 999	BUT altitude (meters)	+/- 30 480
SIGNED VALUE	DESCR.	Allow the visualization or edition of the PREP BUT altitude.			
MORE INFORMATION					
NOTES		If entered in feet, the altitude is converted in meters. This might result in a small difference between the entered and saved altitude			

BUT (continued)

CP/PD	RUNWAY HEADING / GLIDESLOPE *CAP VRAI PISTE / PENTE DESIREE*				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Not used	
	DESCR.	Cannot be set for the BUT 00.			
CAN BE EDITED	BUT 01-20	Runway heading (degrees)	min 0.0 max 359.9	Glideslope (degrees)	min 0.0 max 90.0
UNSIGNED VALUE	DESCR.	Allow the visualization or edition of the PREP BUT runway heading and glideslope information, used by the approach symbology.			
MORE INFORMATION					
NOTES		The runway heading needs to be in true north.			

OTHER PARAMETERS

Used solely for data visualization.

D/RLT	RANGE / BEARING *DISTANCE / RELEVEMENT*				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Aircraft true heading (degrees)	min 0.0 max 359.9
	DESCR.	Left window is blank while the right window displays the aircraft true heading.			
READ ONLY	BUT 01-20	Distance to the PREP BUT (nm)	min 0.0 max 999.9	Bearing to the PREP BUT (degrees)	min 0.0 max 359.9
UNSIGNED VALUE	DESCR.	Displays the distance and bearing to the PREP BUT.			
MORE INFORMATION					
NOTES					

TR/VS	REMAINING TIME / GROUND SPEED *TEMPS RESTANT / VITESSE SOL*				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Aircraft ground speed (kt)	min 0 max 1990
	DESCR.	Left window is blank while the right window displays the aircraft ground speed.			
READ ONLY	BUT 01-20	Remaining time to the PREP BUT (minute, second)	min 0.0 max 719.59	Aircraft ground speed (kt)	min 0 max 1990
UNSIGNED VALUE	DESCR.	Displays remaining time to reach current PREP BUT if ground speed remains constant. Right window displays the aircraft ground speed.			
MORE INFORMATION					
NOTES					

Other parameters (continued)

DV/FV	WIND DIRECTION / WIND SPEED *DIRECTION VENT / FORCE VENT*				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Wind direction (degrees)	min 0 max 359.9	Wind speed (kt)	min 0 max 999
	DESCR.	Displays the current aircraft direction and speed			
READ ONLY	BUT 01-20	Wind direction (degrees)	min 0 max 359.9	Wind speed (kt)	min 0 max 999
UNSIGNED VALUE	DESCR.	Displays the current aircraft direction and speed			
MORE INFORMATION					
NOTES					

DEC	MAGNETIC VARIATION *DÉCLINAISON MAGNÉTIQUE*				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Magnetic variation (degrees)	+/- 99.9	Not used	
	DESCR.	Displays the magnetic variation in degrees between true and magnetic north.			
CAN BE EDITED	BUT 01-20	Magnetic variation (degrees)	+/- 99.9	Not used	
UNSIGNED VALUE	DESCR.	Displays the magnetic variation in degrees between true and magnetic north.			
MORE INFORMATION					
NOTES					

BAD (*SECTEUR BUT ADDITIONNEL* - OFFSET POINT)

Used for visualization and edition of BAD parameters.

P/Θ	BAD OFFSET USING POLAR RHO / THETA				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Not used	
	DESCR.	Cannot be set for the BUT 00.			
CAN BE EDITED	BUT 01-20	BAD distance from PREP BUT (nm)	min 0.1 max 99.9	BAD bearing from PREP BUT (degrees)	min 0.0 max 359.9
UNSIGNED VALUE	DESCR.	Allow the visualization or edition of the BAD distance and bearing from the PREP BUT.			
MORE INFORMATION					
NOTES					

ΔALT	BAD ALTITUDE DIFFERENCE				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Not used	
	DESCR.	Cannot be set for the BUT 00.			
CAN BE EDITED	BUT 01-20	BAD altitude difference from PREP BUT (feet)	+/- 24 999	BAD altitude difference from PREP BUT (meters)	+/- 7 619
UNSIGNED VALUE	DESCR.	Allow the visualization or edition of the BAD altitude difference from the PREP BUT.			
MORE INFORMATION					
NOTES					

BAD (CONTINUED)

ΔL/ΔG	BAD OFFSET USING LATITUDE / LONGITUDE DIFFERENCE				
	MODE	LEFT WINDOW		RIGHT WINDOW	
	BUT 00	Not used		Not used	
	DESCR.	Cannot be set for the BUT 00.			
CAN BE EDITED	BUT 01-20	BAD latitude difference from PREP BUT (meters)	N/S 99 997	BAD longitude difference from PREP BUT (meters)	E/W 99 997
UNSIGNED VALUE	DESCR.	Allow the visualization or edition of the BAD coordinate difference from the PREP BUT.			
MORE INFORMATION					
NOTES					

COMMON TO BUT AND BAD

The RD and TD are parameters common to a BUT and its BAD.

<table>
<tr><th>RD/TD</th><th colspan="5">DESIRED HEADING / DESIRED TIME
ROUTE DÉSIRÉE / TEMPS DÉSIRÉ</th></tr>
<tr><td rowspan="3">
</td><td>MODE</td><td colspan="2">LEFT WINDOW</td><td colspan="2">RIGHT WINDOW</td></tr>
<tr><td>BUT 00</td><td>Ground track (degrees)</td><td>min 0.0
max 359.9</td><td>INS chronometer (minute, second)</td><td>min 0.0
max 399.9</td></tr>
<tr><td>DESCR.</td><td colspan="4">Displays the ground track of the aircraft and the time since the INS has been turned ON.</td></tr>
<tr><td>CAN BE EDITED</td><td>BUT 01-20</td><td>Desired heading (degrees)</td><td>min 0.0
max 359.9</td><td>Desired time (minute, second)</td><td>min 0.0
max 399.9</td></tr>
<tr><td>UNSIGNED VALUE</td><td>DESCR.</td><td colspan="4">Allow the visualization or edition of the desired heading and desired time for the current PREP BUT or BAD.</td></tr>
<tr><td colspan="2">MORE INFORMATION</td><td colspan="4"></td></tr>
<tr><td colspan="2">NOTES</td><td colspan="4"></td></tr>
</table>

DATA EDITION

The PCN uses 3 types of data:

- COORDINATES: Data that needs a cardinal direction (North or South, East or West).
- SIGNED DATA: Data that needs its sign to be specified (+ or -).
- UNSIGNED DATA: Data that don't need a sign or cardinal direction and is assumed to be always positive.

To edit the data:

1. Select the BUT to edit as PREP.
2. Select the parameter to edit by rotating the parameter selector.
3. To select which top display window to edit:
    - Left window: Press the **1** or **7** keys on the numeric keypad.
    - Right window: Press the **3** or **9** keys on the numeric keypad.
4. Both the **INS** and **EFF** keys will light up, indicating that the PCN is in edit mode.
5. The selected window will show a series of dashes, indicating the number of digits to be entered.

   If the data type is signed, both signs will be displayed on the left

   If the data type is coordinates, the N/S for the left window and the E/W for the right window will be displayed.
6. If the data is not unsigned, the sign or cardinality need to selected first.

   To select a sign:

    - **1** or **7** for negative (-).
    - **3** or **9** for positive (+).

   To select a cardinality:

    - **2** for North (N).
    - **8** for South (S).
    - **6** for East (E).
    - **4** for West (W).

7. The data can then be entered using the numeric keypad. Leading zeros are not needed in most cases. Be careful for the decimal point, 1 or 2 trailing zeros might be needed for round values.

NOTE	The L/G data is a special case, the displayed data is shorter than the stored data. The PCN will display the coordinates up to a tenth of a minute while the INS can store up to a thousand of a minute. In order to input full coordinates, the hundred and thousand of a minute needs to be typed in even if the PCN does not react to input. Entering a full longitude is the only case where a leading zero is needed when the degrees are under 100. Full coordinate entry is not necessary.

EXAMPLES

BUT COORDINATES

This example will use the coordinates of Nellis Air Force Base: 36°14,129N 115°02,049W

1. Select the desired BUT in PREP.
2. Set the PCN parameter selector to the **L/G** position.
3. To enter the latitude, press the **1** or **7** keys to edit the left window. The left window will display NS --.--.- and the **INS** and **EFF** keys will light up.
4. The latitude cardinality first needs to be set. Since Nellis Air Force Base latitude cardinality in north, press the **2** key on the numeric keypad. The left window will display N --.--.-.
5. Then the coordinates can be entered, type **3614129**. The left window will display N 36.14.1. The last 2 digits are saved by the system but not displayed.
6. Press the **INS** key to insert the data into the INS memory.
7. To enter the longitude, press the **3** or **9** keys to edit the left window. The left window will display EW ---.--.- and the **INS** and **EFF** keys will light up.
8. The longitude cardinality first needs to be set. Since Nellis Air Force Base latitude cardinality in west, press the **4** key on the numeric keypad. The left window will display W ---.--.-.
9. Then the coordinates can be entered, type **11502049**. The left window will display N 115.02.0. The last 2 digits are saved by the system but not displayed.
10. Press the **INS** key to insert the data into the INS memory.
11. If the input contained an error, the edited window can be reset with the **EFF** key.

Pressing the **EFF** key with an incorrect value or no value will exit the edition mode and reset the data to its previous value.

Pressing the **PREP** key or changing the parameter knob position will cancel the edition.

BUT ALTITUDE

This example will use the altitude of Nellis Air Force Base: 4867 ft

1. Select the desired BUT in PREP.
2. Set the PCN parameter selector to the **ALT** position.
3. To enter the altitude in feet, press the **1** or **7** keys to edit the left window. The left window will display +- ----- and the **INS** and **EFF** keys will light up.
4. The altitude sign first needs to be set. Since Nellis Air Force Base altitude is positive press the **1** key on the numeric keypad. The left window will display + -----.
5. Then the altitude can be entered, type **4867**. The left window will display + -4867. The leading zero is not needed.
6. Press the **INS** key to insert the data into the INS memory.
7. If the input contained an error, the edited window can be reset with the **EFF** key.

Pressing the **EFF** key with an incorrect value or no value will exit the edition mode and reset the data to its previous value.

Pressing the **PREP** key or changing the parameter knob position will cancel the edition.

BUT RD

This example will use a RD of 85°.

1. Select the desired BUT in PREP.
2. Set the PCN parameter selector to the **RD/TD** position
3. To enter the RD, press the **1** or **7** key to edit the left window. The left window will display ---.- and the **INS** and **EFF** keys will light up.
4. The RD heading can be entered, type **850**. The left window will display -85.0. The leading zero is not needed.
5. Press the **INS** key to insert the data into the INS memory.
6. If the input contained an error, the edited window can be reset with the **EFF** key.

Pressing the **EFF** key with an incorrect value or no value will exit the edition mode and reset the data to its previous value.

Pressing the **PREP** key or changing the parameter knob position will cancel the edition.

BUT

A BUT (*But* – waypoint) is navigation point composed of a latitude, a longitude, an altitude and other parameters that represent a location in space. They can be used for navigation, as a position fix point, as surface target, as a Bullseye or as a landing point.

The Mirage 2000C INS can store 20 of them (from 01 to 20) in addition to the BUT 00 that represent the aircraft's current position.

All BUTs can be selected at all times, by default if a BUT in not part of a flight plan or has been edited, its coordinates will be at 00.00.0 and 000.00.00 and the, the altitude will be at the maximum value and other parameters will be at zero.

The PCN is the only interface where the pilot can visualize, input and edit BUTs parameters.

PREP vs DEST

The PCN allows to select 2 different BUTs at the same time for different purpose:

- PREP (*Préparation* – Setup): Setting a BUT in PREP allows for the visualization and edition of its parameters. The PREP BUT informations are only displayed on the PCN and does not affect any other systems.
  The PREP BUT is also the BUT of which the coordinates and altitude are going to be used when starting an alignment.
- DEST (*Destination* – Navigation): Setting a BUT in DEST allows for the navigation to this BUT. The DEST BUT informations are sent to the VTH and IDN for navigation use.

The selection of a BUT in PREP or DEST is done using the BUT selection keys:

1. Press the **PREP** or **DEST** key.
2. The pressed key will light up.
3. Use the numeric keypad to type the BUT number.

NOTE	The BUT number always need to be 2 digits. In order to select the BUT 06 in DEST, press the **DEST** key and press 0 then 6 on the numeric keypad.

4. As you type the second number, the BUT will be selected and the pressed BUT key will turn off.

The BUTs can also be transferred between PREP and DEST and vice versa using the following procedure:

1. Press the BUT key you wish to be copied on by the other BUT selection.
2. The BUT key will light up.
3. Press the same key again.

4. The BUT key turns off and the other selected BUT number will be copied on this BUT selection.

NOTE	In order to copy the DEST BUT (06) in PREP, press the PREP key 2 times. The PREP BUT will now be the BUT 06.

The DEST BUT can be incremented or decremented using the DEST BUT Increment/Decrement buttons on the left of the front dash

BUT 00 vs BUT 01 - 20

The BUT 00 is not a navigation BUT but rather the current position of the aircraft. Not all of the data that is normally visualizable on the PCN can be viewed BUT 00. Also, some parameters display different information in BUT 00. Its parameters are not editable.

The BUT 00 can only be selected as a PREP BUT, it can never be selected in DEST.

BAD

A BAD is (*BUT Additionel* – Offset Waypoint) is waypoint of which is position is in reference to its parent BUT. A BAD cannot exist alone and is always linked to a BUT. They are most commonly used as surface targets or divert airfield. Each BUT can be parent to a BAD, that makes 20 BADs.

3 out of 11 positions on the PCN parameter selector are dedicated to setting up a BAD, under the BAD bracket.

BAD Setup

1. Select the parent BUT in PREP.
2. Input the BAD offset distance from the BUT to the North/South and East/West in kilometers in the **ΔL/ΔG** parameter.

   OR

   Input the BAD bearing and distance from the BUT in nm in the **ρ/θ** parameter.
3. Input the altitude different between the BUT and the BAD in the **ΔALT** parameter. It can be positive or negative and be set in feet or meters.

BAD Selection

1. Select the parent BUT in DEST.
2. Press the **BAD** key.
3. The **BAD** key will light on to indicate that the DEST BAD is selected.
4. If the BAD is invalid, the **BAD** key will flash.
5. To deselect a BAD, press the **BAD** key again and the key will turn off.

MRQ

The Mirage 2000C INS is capable of saving up to 3 mark-points (MRQ – *Marques*). They take the BUT number 91, 92 and 93.

Once the 3 MRQs have been created they cannot be deleted or overwritten with a new MRQ. MRQs can only store coordinates and cannot be set as PREP, they can only be selected in DEST.

MRQ SETUP

1. Fly the aircraft over the point where you want to create the MQR.
2. Press the **MRQ** key on the PCN. It will light up with the **VAL** key to indicate that an MRQ slot is available and the PCN is in MRQ creation mode.
3. The PCN top window will show the MRQ coordinates for review.
4. To create the MQR press the **VAL** key. Both the **MRQ** and **VAL** keys will turn off and the MQT will be created.
5. If no MQR slot is available, the **MRQ** key will flash and the **VAL** key will stay off.

MQR SELECTION

An MRQ is selected just as a normal BUT using their number (91, 92 or 93) but they can only be selected in DEST. Trying to select an MRQ in PREP will reset PREP to the preciously selected BUT.

VTB BUT DISPLAY

The VTB can display the position of BUT to provide better situational awareness and help with INS navigation. A BUT can be displayed as navigation BUT or a tactical BUT.

NAVIGATION BUT

The VTB navigation BUT is displayed when the SNA is in navigation or air-to-ground mode and represents the position of the current DEST BUT. It is always displayed unless the SNA is in air-to-air mode.

TACTICAL BUT

Up to 5 tactical BUTs can be displayed simultaneously on the VTB. They are displayed in all modes and differentiated from the navigation BUT by the BUT number displayed next to them.

TACTICAL BUT DISPLAY

1. Select the BUT to display on the VTB as a tactical BUT as PREP.
2. Press the **VAL** to display the tactical but.

Once a tactical BUT is displayed it can be removed by doing the same procedure. Trying to add a sixth tactical BUT will replace the first.

All tactical BUTs can be removed at once using VTB declutter command.

18 – 5 - ALIGNMENT

INTRODUCTION

The core of the INS houses a small platform bearing accelerometers and 3 gyroscopes. This platform needs to be calibrated in order to give accurate data and reduce drift rate. This calibration is called alignment.

The alignment process can be divided in 4 phases:

- PLATFORM CAGING AND SETUP, consisting of roughly setting up the platform horizontally and in azimuth, heating it up to operating temperature (70°) and spinning up the gyroscopes. This phase lasts about 35 seconds.
- ROUGH ALIGNMENT, consisting of recording the horizontal and azimuth bias of the platform and correcting them. This phase lasts about 20 seconds
- FAST GYROCOMPASS ALIGNMENT, same as the ROUGH ALIGNMENT but with a longer sampling, allowing finer correction and calculation of the platform heading using the earth rotation. This phase lasts about 80 seconds
- FINE GYROCOMPASS ALIGNMENT, consists of repeated FAST GYROCOMPASS ALIGNMENT. This phase can be interrupted after the first FAST GYROCOMPASS ALIGNMENT and lasts around 300 seconds.

Aligning an INS is a complex procedure that require a lot of precision. It is very important that is aircraft is not moved during the INS alignment or the procedure will be canceled and will need to be restarted.

CAUTION

Refueling and rearming the aircraft will not cancel the alignment process, however hanging heavy ordinances (wing fuel tanks or bombs on twin racks) will result in the aircraft moving on its suspensions due to the added weight. This can be enough to stop the process so refueling or rearming better be done before or after the alignment.

The INS allow 3 types of alignments:

- NORMAL ALIGNMENT (ALN - *Alignement normal*): Last 8 minutes and result in a 0,7nm/h drift rate.
- INTERRUPTED NORMAL ALIGNMENT (ALNI - *Alignement normal interrompu*): Last between 4 and 8 minutes and result in a drift rate between 4nm/h and 2nm/h.
- STORED HEADING ALIGNMENT (ALCM - *Alignment sur cap mémorisé*): Last 1 minute 30 seconds and result in a 3nm/h drift rate

The alignment type is selected on the PSM mode selector and stated using the **VAL** key on the PCN. When the alignment is in progress you can check its status using the STS position on the PSM operating mode selector. In ALN and ALNI the remaining time to the next class is also displayed.

The INS also need to know its initial location. This is done by setting a BUT with the current aircraft's coordinates and altitude and starting the alignment process while having this BUT selected in PREP. BUT 00 to 20 can be used for this and as soon as the alignment has started the PREP BUT can be changed.

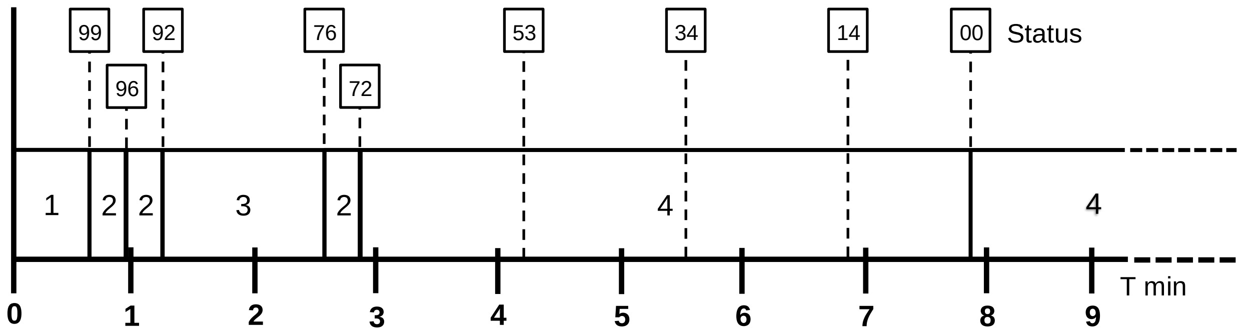
NORMAL ALIGNMENT

The normal alignment (ALN – *Alignment normal*) is required at each cold start if the aircraft has been moved since the last time it stopped. This alignment lasts 8 minutes and results in a drift rate of about 0,7nm/h. This process combines all the available phase in order to achieve the most accurate alignment possible.

This alignment process is selected by turning the PSM mode selector in the **ALN** position, the **ALN** status light will flash to indicate that the alignment can be started. During the first half of the alignment the **ALN** status light is steady to indicate that the process is uninterruptible, after around 4 minutes and achieving the status 53, the **ALN** light will turn off and the **PRET** light will flash to indicate that the alignment is now interruptible. At the end of the 8 minutes and when the status reaches 00 the **PRET** light will turn steady to indicate that the INS is ready to go into NAV mode.

When the ALN is finished the INS will restart the fine gyrocompass alignment phase to reduce the drift rate until the PSM mode selector in turned to NAV mode. NOT FUNCTIONAL

NORMAL ALIGNMENT TIMELINE



1. PLATFORM CAGING AND SETUP
2. ROUGH ALIGNMENT
3. FAST GYROCOMPASS ALIGNMENT
4. FINE GYROCOMPASS ALIGNMENT

PROCEDURE

1. Set the PSM Operational Mode to **N**.
2. Set the PSM Mode in **VEI**.
3. Select a BUT in PREP that contains the current aircraft's coordinates and altitude.

   In DCS, if the M-2000C Special option "Fast alignment (ALCM) ready" is not checked the BUT 00 coordinates won't correspond to the aircraft position because it is assumed that the aircraft has been moved since the last time it was stopped.

   If such BUT does not exist, it has to be created. The alignment BUT needs to have its coordinates and altitude set in order to have a precise alignment. The aircraft coordinates and altitude can be found on the kneeboard "Pilot signout sheet" page.

NOTE	Any BUT can be used for alignment but the most convenient one would be the BUT 20, as 20 waypoint flight plan is seldom used.
NOTE	The INS will accept values up to the hundredth and thousandth of a minute. but display will only show tenth of minute. Nevertheless, introduce full position into the system!
NOTE	An uninitialized BUT will have the maximum possible value for altitude, don't forget to set it too or the alignment quality will be reduced.

4. Set the PSM Mode to **ALN** when your PREP BUT is set to the correct coordinates. Once the PSM is in **ALN**, the following will happen on the PCN:
   - The **ALN** light will blink.
   - The **VAL** key will light up.
5. Click on the **VAL** key to start the alignment process.
   - The **ALN** light will become steady, indicating that the INS is aligning.
   - The **VAL** key will revert to half lit.
6. At this time, you can switch your PREP BUT and insert or edit data.

7. The alignment process will abort if you turn the PSM Mode knob to another position.

   The alignment process status can be checked by turning the PSM Operational Mode knob on the **STS** position. The right window will display the alignment status, going from 100 to 0. The right window will display the alignment class, from 4 to 1 after the status reaches 53 and a timer counting down to the next class.

8. The ALN light will turn off when the status reaches 53 and the INS is in class 4. At the same time the PRET light will start to flash indicating that the alignment can be interrupted.

9. When the status reaches 00, the PRET light will turn steady, indicating that the ALN is finished. The PSM Mode selector can now be turned to the **NAV** position.

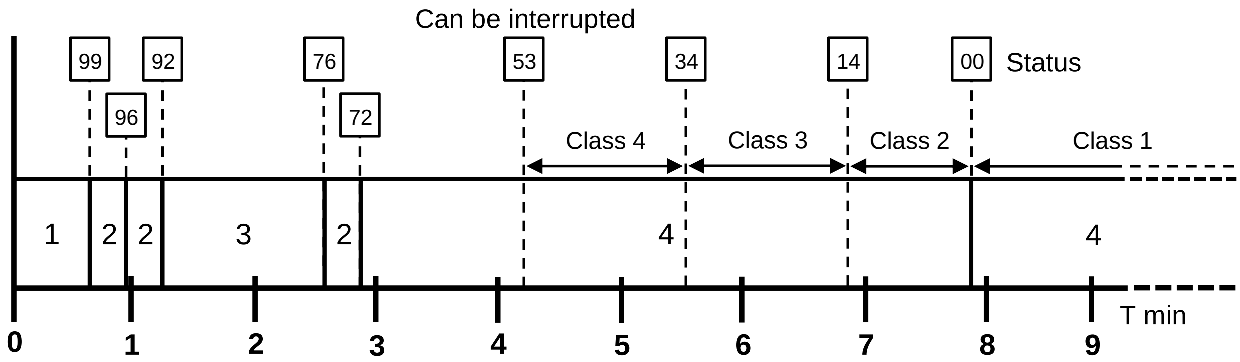
INTERRUPTED NORMAL ALIGNMENT

The interrupted normal alignment (ALNI - *Alignement normal interrompu*), also called fast alignment (ALR – *Alignement rapide),* is a normal alignment that is stopped before its completion. This alignment lasts between 4 and 8 minutes and result in a drift rate between 4nm/h and 2nm/h. This process combines all the available phase in order to achieve the most accurate alignment possible.

This alignment process is selected by turning the PSM mode selector in the **ALN** position, the **ALN** status light will flash to indicate that the alignment can be started. During the first half of the alignment the **ALN** status light is steady to indicate that the process is uninterruptible, after around 4 minutes and achieving the status 53, the **ALN** light will turn of and the **PRET** light will flash to indicate that the alignment is now interruptible. At the end of the 8 minutes and when the status reaches 00 the **PRET** light will turn steady to indicate that the INS is ready to go into NAV mode.

When the ALN is finished the INS will restart the fine gyrocompass alignment phase to reduce the drift rate until the PSM mode selector in turned to NAV mode. NOT FUNCTIONAL

INTERRUPTED NORMAL ALIGNMENT TIMELINE



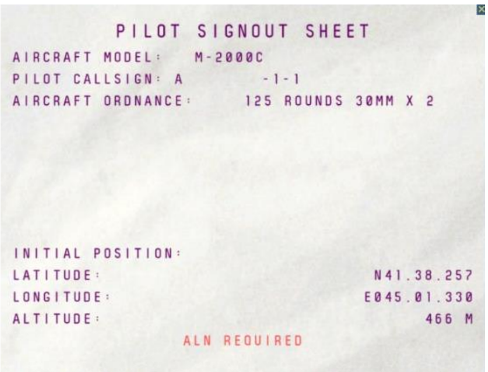
1. PLATFORM CAGING AND SETUP
2. ROUGH ALIGNMENT
3. FAST GYROCOMPASS ALIGNMENT
4. FINE GYROCOMPASS ALIGNMENT

PROCEDURE

1. Set the PSM Operational Mode to **N**.
2. Set the PSM Mode in **VEI**.
3. Select a BUT in PREP that contains the current aircraft's coordinates and altitude.

   In DCS, if the M-2000C Special option "Fast alignment (ALCM) ready" is not checked the BUT 00 coordinates won't correspond to the aircraft position because it is assumed that the aircraft has been moved since the last time it was stopped.

   If such BUT does not exist, it has to be created. The alignment BUT needs to have its coordinates and altitude set in order to have a precise alignment. The aircraft coordinates and altitude can be found on the kneeboard "Pilot signout sheet" page.



NOTE	Any BUT can be used for alignment but the most convenient one would be the BUT 20, as 20 waypoint flight plan is seldom used.
NOTE	The INS will accept values up to the hundredth and thousandth of a minute. but display will only show tenth of minute. Nevertheless, introduce full position into the system!
NOTE	An uninitialized BUT will have the maximum possible value for altitude, don't forget to set it too or the alignment quality will be reduced.

4. Set the PSM Mode to **ALN** when your PREP BUT is set to the correct coordinates. Once the PSM is in **ALN**, the following will happen on the PCN:
   - The **ALN** light will blink.
   - The **VAL** key will light up.
5. Click on the **VAL** key to start the alignment process.
   - The **ALN** light will become steady, indicating that the INS is aligning.
   - The **VAL** key will revert to half lit.
6. At this time, you can switch your PREP BUT and insert or edit data.

7. The alignment process will abort if you turn the PSM Mode knob to another position.

   You can check the alignment process status by turning the PSM Operational Mode knob on the **STS** position. The right window will display the alignment status, going from 100 to 0. The right window will display the alignment class, from 4 to 1 after the status reaches 53 and a timer counting down to the next class.

8. The **ALN** light will turn off when the status reaches 53 and the INS is in class 4. At the same time the **PRET** light will start to flash indicating that the alignment can be interrupted.

9. When the status reaches 00, the **PRET** light will turn steady, indicating that the ALN is finished. The PSM Mode selector can now be turned to the **NAV** position.

STORED HEADING ALIGNMENT

The stored heading alignment (ALCM – *Alignment sur cap mémorisé*) is a fast alignment method that can be used if the aircraft has not been moved since the last time its INS was stopped. The INS save its last heading when it is stopped and if the aircraft has not been moved the gyroscopes won't have moved too far from their aligned position. This allows for less alignment phases resulting in a quicker procedure at the cost of increased drift rate due to gyroscope and accelerator errors not being canceled as well as in an ALN. This alignment lasts 1 minute 30 seconds and the resulting drift rate is dependent on the quality and time since the last normal alignment.

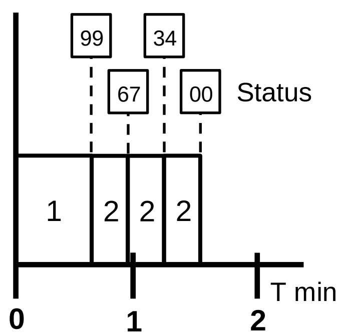
After a normal alignment followed by a standard flight and half a day rest for the aircraft, the drift rate will be about 3 nm/h. Doing an ALCM just after a normal alignment or at the end of QRA duty will result a drift rate equivalent to the previous alignment rate.

This alignment process is selected by turning the PSM mode selector in the **ALCM** position, the **ALN** status light will flash to indicate that the alignment can be started. During the alignment the **ALN** status light is steady to indicate that the process is uninterruptible, after 1 minute and 30 seconds and achieving the status 00, the **ALN** light will turn of and the **PRET** light will turn steady to indicate that the alignment is finished and that the INS is ready to go into NAV mode.

Alternatively, the ALCM can be started by turning the PSM mode selector directly in the **NAV** position. **NOT FUNCTIONAL**

In DCS, ALCM can be made available on ramp start by checking the "Fast alignment (ALCM) ready" special option checkbox. It will set the aircraft in à ALCM ready state and set the aircraft current coordinates on the BUT 00. The aircraft is then assumed to have been stopped a few hours before after an ALN followed by an uneventful flight. This option can also be used to start a normal alignment on PREP 00 as its coordinates will be correct.

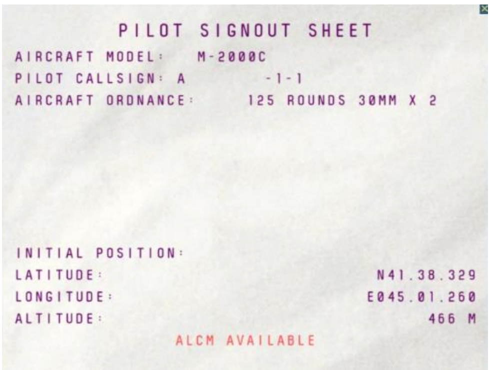
STORED ALIGNMENT TIMELINE



1. PLATFORM CAGING AND SETUP.
2. ROUGH ALIGNMENT.

PROCEDURE

1. Set the PSM Operational Mode in **N**.
2. Set the PSM Mode in **VEI**.
3. Check in the kneeboard "Pilot signout sheet" page that ALCM is possible as indicated by the red text "ALCM AVAILABLE" below the aircraft starting coordinates.


PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2

INITIAL POSITION:
LATITUDE: N41.38.329
LONGITUDE: E045.01.260
ALTITUDE: 466 M
ALCM AVAILABLE

4. Set the BUT 00 in PREP and check that its coordinates and altitude are correct to the aircraft current position.
5. Set the PSM Mode knob in **ALCM** position. Once the PSM is in this mode, the following will happen:
   - The ALN light will flash.
   - The VAL key will light up.
6. Click on the VAL key to start the alignment process.
   - The ALN light will become steady, indicating that the INS is aligning.
   - The VAL key will go dark.

   Alternatively, you can turn the PSM mode selector in **NAV** mode, this will start the ALCM automatically without needing to press VAL. NOT FUNCTIONAL
7. The alignment process will abort if you turn the PSM mode selector from **ALCM**.

   You can check the alignment process status by turning the PSM Operational Mode knob on the **STS** position. The right window will display the alignment status, going from 100 to 0. The right window will stay blank.
8. The ALN light will turn off and the PRET light will turn on when the alignment process has ended.

   If the ALCM was started by placing the PSM mode selector in **NAV**, the PRET light will only turn on momentarily.
9. Now you can turn the PSM mode selector to **NAV**.

18 – 6 - POSITION FIX

INTRODUCTION

INS drift can cause issues in all phases of a mission because as it is used for navigation and weapon employment. In order to correct the accumulated drift, the pilot can use a method called position fix (*Recalage*) that will provide the INS the means of correcting itself.

This method consists of providing the INS with the real position of a point in space of which it knows the coordinates. The INS can then compare the points real position with its stored position, deduce by how much it drifted and in which direction, and apply this difference to itself to correct the drift.

In the Mirage 2000 this is done using a BUT and a remarkable surface feature. The BUT needs to be place on the coordinates of the feature and at the altitude of the ground, then the pilot can use 2 methods to provide the position of this point to the INS:

- OVERFLY FIX (*Recalage vertical*): Consist of triggering the position fix when the aircraft is precisely over the surface feature.
- RADAR FIX (*Recalage oblique*): Consist of using the radar in TAS (*Télémétrie Air-Sol* – Radar ranging) to designate the surface feature through the VTH to get the slant range.

Both methods precisions are dependent of the overfly and designation fix accuracy, a moderate drift can be worsened by a fix on the wrong surface feature.

NOTE	The INS system will refuse to validate a position fix that is greater than 15nm. Such case should not happen but if it does, the only way to fix the drift is to designate halfway between the BUT and the surface feature to cut the distance between them in half and then designate the surface feature.

OVERFLY FIX

This method is viable for low altitude flying and on relatively flat terrain as it is easier to estimate our position on the ground from low altitude.

To perform an overfly fix:

1. Select the fix BUT in DEST.
2. Fly the aircraft toward the fix BUT. As soon as the surface feature is in sight fly toward it and ignore the navigation cues.
3. When the aircraft is precisely over the surface feature, press the **REC** key on the PCN.

   If the PCA is in NAV mode and MAV is not selected, the "Magic Unlock / Position update" HOTAS command will also trigger the fix procedure.
4. The **REC** key will turn on and depending on the parameter selector's position, the PCN will show the following information:
   - **ΔL/ΔG**: the left window will show the difference in latitude and the right window will show the difference in longitude between the aircraft's position at the time the procedure was triggered and the BUT position in kilometer.
   - **ρ/θ**: The left window will show the distance in nm and the right window will show the bearing of the aircraft's position at the time the procedure was triggered and the BUT position.
   - **ΔALT**: The left window will show the altitude difference in meter and the right window will show the altitude difference in feet of the aircraft's position at the time the procedure was triggered and the BUT position.

   In any other position the information displayed on the PCN is relative to the PREP BUT and not the navigation fix.
5. If the difference between aircraft and landmark position is less than 15 nautical miles, the **VAL** key will turn on.
6. If the position difference between the fix and the BUT coordinate presented on the PCN is coherent, press the **VAL** key to accept the fix. The INS will apply the fix, the **REC** and **VAL** keys will turn off and the PCN will revert to normal operations.
7. If the difference between aircraft and landmark position is more than 15 nautical miles, the **VAL** key will remain dark and the **REC** key will flash. In this situation the only possible action is to reject the fix.
8. If the fix is not satisfactory, press the **REC** key. The INS will revert to normal operations.

RADAR FIX

This method is viable for high to low altitude and all kind of terrain. The only needed condition is line of sight to the surface feature.

To perform a radar fix:

1. Select the fix BUT in DEST.
2. Select OBL on the PCA. Check that the radar is working in TAS mode.
3. Fly the aircraft toward the fix BUT. As soon as the surface feature is in sight fly toward it and ignore the navigation cues.
4. Maneuver the aircraft to put the designation diamond over the surface feature.
5. Use the “Magic Slave/AG Designate/INS Position Update” HOTAS command to trigger the fix procedure.
6. The **REC** key will turn on and the PCN top window will show the following information:
    - **ΔL/ΔG**: the left window will show the difference in latitude and the right window will show the difference in longitude between the radar designated position and the BUT position in kilometer.
    - **ρ/θ**: The left window will show the distance in nm and the right window will show the bearing of the radar designated position and the BUT position.
    - **ΔALT**: The left window will show the altitude difference in meter and the right window will show the altitude difference in feet of the radar designated position and the BUT position.

    In any other position the information displayed on the PCN is relative to the PREP BUT and not the navigation fix.
7. If the position difference between the fix and the BUT coordinate presented on the PCN is coherent, press the **VAL** key to accept the fix. The INS will apply the fix, the **REC** and **VAL** keys will turn off, the PCN will revert to normal operations and the radar will return to its previous mode.
8. If the difference between aircraft and landmark positions are more than 15 nautical miles, the **VAL** key will remain dark and the **REC** key will flash. In this situation the only possible action is to reject the fix.
9. If the fix is not satisfactory, press the **REC** key. The INS will revert to normal operations and the radar will return to its previous mode.

The radar fix will be cancelled if:

- The Master ARM switch is set to ARM**.**
- The VTH is set in any other mode than radar fix sub-mode.
- The SNA is set in any other mode than NAV.

19 - IFF


MODE - I
MODE - 3A
IDENT
OUT
MIC
M-I
M-2
M-3A
M-C
OUT
MASTER
REPLY
ON
OUT
HOLD
ZERO
A
B
CODE
AUDIO
OUT
LIGHT
MODE - 4
EMER
N
SBY
OFF
IFF
TEST
FAULT

SECTION 19

IFF

INTRODUCTION

IFF (identification friend or foe) is an identification system that allow military aircraft to identify other aircraft as friendly using their radar. An IFF system is composed of 2 elements:

- An interrogator.
- A transponder.

IFF interrogator are mostly used on aircraft equipped with radars. The interrogator sends an IFF interrogation and waits for its reply. Once the reply is received it is decoded and if the code corresponds to the IFF code set on interrogator, the replying aircraft is considered friendly.

Every aircraft can be equipped with an IFF transponder, they are similar to civilian transponder and are often compatible with civilian identification systems. The transponder listens to IFF interrogations sent by other systems. Once it receives one, the transponder decodes it and if the code corresponds to the IFF code set on the transponder it sends an encoded reply.

Once the transponder has received and decoded an interrogation, it will wait a set time before sending a reply. This set time is known by the interrogator and can be used to determine the range to the replying aircraft.

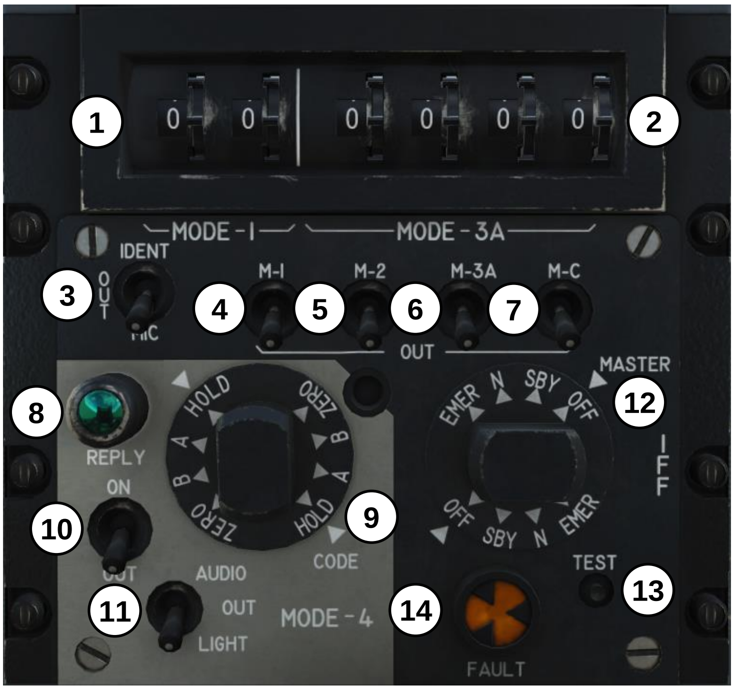
IFF can only be used to determine that an aircraft is friendly, not that it is hostile or unfriendly.

19 – 1 - IFF TRANSPONDER

The IFF transponder (*répondeur IFF*) is located behind the stick, below the VTB. It is the NRAI-7C IFF transponder that is used on multiple aircraft in the French air force.

The transponder panel allow the selection of the transponder master mode, the MODE 1 and 3/A codes, the selection of which interrogation mode to reply to and the MODE 4 settings.

NOTE	In DCS, IFF and transponder simulation is limited, none of the transponder functions are simulated. The external software SimpleRadio and LotAtc allows limited simulation of the transponder with the GCI interface.



1. MODE 1 CODE SELECTOR (*Molette d'affichage du code MODE-1*): Sets the mode 1 transponder code. Used to set the mission type code. From 00 to 73. NOT FUNCTIONAL
2. MODE 3A CODE SELECTOR (*Molette d'affichage du code MODE-3/A*): Sets the mode 3 transponder code. Used to set the flight and flight member code. From 0000 to 7777. NOT FUNCTIONAL
3. IDENT-MIC SWITCH (*Sélecteur d'identifiaction de position*): Selects the IFF identification function: NOT FUNCTIONAL
   - **IDENT** (Identification): Momentary, activates the transponder identification feature.
   - **OUT**: Stable, no function.
   - **MIC** (Microphone): Stable, enables the emission of the identification reply for 30 seconds each time the microphone is keyed for UHF or V/UHF.

4. M-1 SWITCH (*Interrupteur de mise en service MODE-1*): Allows the transponder to reply to military MODE 1 identification interrogations. NOT FUNCTIONAL
5. M-2 SWITCH (*Interrupteur de mise en service MODE-2*): Allows the transponder to reply to military MODE 2 identification interrogations. NOT FUNCTIONAL
6. M-3/A SWITCH (*Interrupteur de mise en service MODE-3/A*): Allows the transponder to reply to civilian MODE 3/A identification interrogations. NOT FUNCTIONAL
7. M-C SWITCH (*Interrupteur de mise en service MODE-3/C*): Allows the transponder to reply to civilian MODE 3/C altitude reporting interrogations. NOT FUNCTIONAL
8. REPLY LIGHT (*Voyant REPLY*): Indicates a valid mode 4 interrogation and reply when the MODE 4 AUDIO-LIGHT switch is set to the AUDIO or LIGHT position. NOT FUNCTIONAL
9. CODE CONTROL KNOB (*Commutateur code*): Selects the MODE 4 code of the day: NOT FUNCTIONAL
    - **HOLD**: Momentary, prevents the zeroizing of the MODE 4 IFF codes when the IFF transponder is turned off. To be used after the plane has weight on wheels.
    - **A**: Stable, selects the A MODE 4 IFF code set.
    - **B**: Stable, selects the B MODE 4 IFF code set.
    - **ZERO**: Momentary, starts the zeroizing procedure to erase the MODE 4 IFF codes.
10. OUT-ON SWITCH (*Interrupteur OUT-ON*): The ON position allows the transponder to decode a MODE 4 interrogation. NOT FUNCTIONAL
11. AUDIO-OUT-LIGHT SWITCH (*Sélecteur AUDIO-OUT-LIGHT*): Sets the MODE 4 monitoring mean: NOT FUNCTIONAL
    - **AUDIO**: Valid MODE 4 interrogation and replies are signaled by an audio warning and the REPLY light.
    - **OUT**: No audio or light signal for a valid MODE 4 interrogation.
    - **LIGHT**: Valid MODE 4 interrogation and replies are signaled by the REPLY light.
12. MASTER MODE KNOB (*Commutateur de fonction MASTER*): Sets the transponder master mode: NOT FUNCTIONAL
    - **OFF**: The transponder is powered off.
    - **SBY** (Standby): Sets the transponder to standby/warmup mode.
    - **N** (Normal): Sets the transponder to normal operating mode where it can reply to MODE 1, 2, 3/A, 3/C and 4 identification interrogations.
    - **EMER** (Emergency): Sets the transponder to emergency mode where it will transmit an emergency reply in MODE 1, 2 and 3/A.
13. TEST BUTTON (*Bouton poussoir test*): Initiates the IFF transponder self-test. NOT FUNCTIONAL

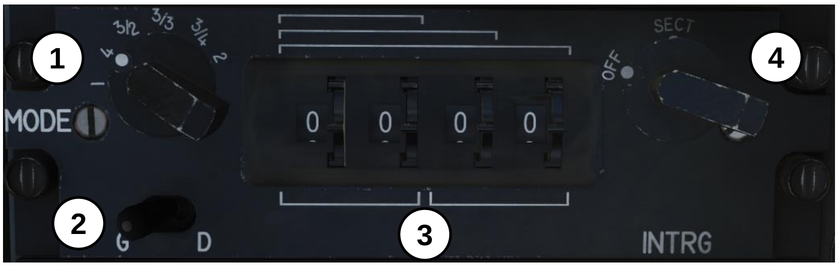
14. FAULT LIGHT (*Voyant de panne magnétique*): Indicates that the transponder self-test has failed or that it failed to reply to an identification interrogation. **NOT FUNCTIONAL**

19 – 2 - IFF INTERROGATOR PANEL

The IFF interrogator panel (*poste de commande interrogateur décodeur IFF*) is located on the right console, just below the PCN.

The interrogator panel allow the configuration of the radar IFF interrogation.

NOTE	In DCS, IFF and transponder simulation is limited, only the radar IFF interrogation mode selector is simulated.



1. MODE SELECTOR (*Commutateur de mode*): Selects the IFF mode that will be used by the radar for interrogation: NOT FUNCTIONAL
    - **1**: The interrogation will be done in MODE 1 on 2 digits of the selected IFF code depending on the position of the IFF code selection switch.
    - **4**: The interrogation will be done in MODE 4 irrelevant of the selected IFF code.
    - **3/2**: The interrogation will be done in MODE 3/A on the first 2 digits of the selected IFF code.
    - **3/3**: The interrogation will be done in MODE 3/A on the first 3 digits of the selected IFF code.
    - **3/4**: The interrogation will be done in MODE 3/A on the totality of the selected IFF code.
    - **2**: The interrogation will be done in MODE 2 on the selected IFF code.
2. IFF CODE SELECTION SWITCH (*Interupteur de sélection du code IFF*): Selects which digits to use for MODE 1 interrogation: NOT FUNCTIONAL
    - **G** (*Gauche* – Left): Selects the 2 leftmost digits.
    - **D** (*Droite* – Right) Selects the 2 rightmost digits.
3. IFF CODE SELECTOR (*Roues de sélection du code IFF*): Selects the IFF code for the MODE 1, 2 and 3/A. NOT FUNCTIONAL
4. IFF INTERROGATION MODE SELECTOR (*Sélecteur de mode d'intérrogation INTRG*): Selects the radar IFF antenna interrogation mode:
    - **OFF**: The radar IFF interrogation system is powered off.
    - **SECT** (*Sectorié* – Sectored): The radar IFF antenna will interrogate a 20° arc around the TDC.
    - **CONT** (*Continue* – Full): The radar IFF antenna will interrogate the full radar search pattern.

20 - Radar


POL TAF ARR
ALT
0.8
RB 310
869 VR
256
29/110
345
0.9
300
DEB
FIN
N
C
Z
M
T
MRQ
LUM GEN
LUM CAV
AV
AR
ALLEG
CADR
AUTO
TEST
MIS
MAG
TOT
INST
DIST x 10M
CAN ROQ
S 530
Kg x 100
JAUG
TRAN
INTER

20 – 1 - RDI

INTRODUCTION

The Mirage 2000C is equipped with the RDI (*radar doppler à impulsions*) radar, located in front of the cockpit inside the nosecone. The RDI has been developed in parallel to the RDM (*radar doppler multimodes*) to provide the Armée de l'Air with a dedicated high-performance air-to-air fire control radar.

CHARACTERISTICS:

- Waveband: I/J band
- Pulse repetition frequency: High PRF (100 kHz+)
- Transmitter output: 4 kW
- Range: Maximum detection range of 80 nm and ~65 nm against a fighter sized target (5 m^2 equivalent RCS) in HPRF
- Range ambiguity error: 20 m in PSIC and 1 nm in bar search
- Angle resolution: 0,1°
- Velocity interval: -600 knots to +3600 knots
- Radar beam: 3°
- Gimbal limits: 60° in azimuth and 55° in elevation
- Antenna maximum speed: 120 °/sec
- Antenna bar search speed: 100 °/sec or 50 °/sec

OPERATIONAL MODES

The RDI primary mission is to detect and track air targets at long range in clear sky as well as in look down against targets flying as low as 30m. It has a secondary capability to carry out ranging for air-to-ground weapon delivery as well as low altitude navigation with ground mapping and terrain avoidance modes.

AIR-TO-AIR MODES

- RECH (*Recherche en lignes* – Bar search)
- PSID (*Poursuite sur information discontinue* – Track while scan)
- PSIC (*Poursuite sur information continue* – Single target track)
- PSIC Super 530 (*Poursuite sur information continue Super 530D* – Single target track Super 530D)
- SHB (*Sécurité haut-bas* – Terrain avoidance while track)
- P. Axe (*Pointage axe* – Boresight auto-acquisition)
- CH. Viseur (*Champ viseur* – VTH auto-acquisition)
- PDS (*Plan de symétrie* – Vertical auto-acquisition)
- BAG (*Balayage acquisition en gisement* – Horizontal auto-acquisition)
- RRAS (*Ralliement radar sur alidade/site* – Radar slave to TDC/elevation auto-acquisition)

AIR-TO-GROUND MODES

- TAS (*Télémétrie air/sol* – Air-to-ground ranging)
- VISU (*Visualisation du sol* – Ground mapping)
- DEC (*Découpe terrain* – Ground avoidance)

RADAR THEORY

PRINCIPLE

A radar detects objects by emitting electromagnetic pulses at a given carrier frequency in the X band (approximately 10GHz). These pulses travel at the speed of light, and are reflected in all directions by the environment (terrain, aircraft, rainfall…). A fraction of these reflections returns back to the antenna and are detected by the radar electronics.

RANGE DETERMINATION

As the electromagnetic waves travel at the speed of light, they come back at the antenna after a delay corresponding to twice the object distance. Measuring that delay thus provides range estimation.

CLOSING VELOCITY DETERMINATION

If the radar and/or the observed object are moving, the frequency of the pulse return may differ from the initial emitted frequency; this effect is commonly known as Doppler shift. This means that by measuring this frequency shift, the radar can measure the closing velocity of the observed objects. This has 3 main applications:

- Measuring the radial velocity of objects.
- Reducing confusion between multiple objects if they have different closing velocities.
- Removing ground clutter.

ANGULAR RESOLUTION AND LOBES

Circular antennas emit a conical shaped primary beam, or primary lobe. Its angular radius is mostly governed by the laws of diffraction and a direct function of wavelength and dish radius.

The same laws of diffraction also tell us that the antenna will not emit only inside that lobe. A fraction of the energy is radiated in various directions, distributed at wider angles around the antenna axis. These secondary lobes are undesired, as they will tend to detect more objects and ground clutter which interfere with the signal of interest.

LOOK DOWN AND MAIN GROUND CLUTTER REMOVAL

Removing ground clutter is the most important feature of Doppler radars in aircraft, as it allows detecting and tracking objects that are below the horizon (“look-down”). In that case, returns from the ground are much stronger than returns from the object itself: without Doppler filtering, the signal to noise ratio of the object would be near zero. But if the object is either moving towards the radar (“hot”) or away (“cold”), returns from ground and object come back at a different frequency, allowing to filter out the ground.

This is commonly done using a notch rejector, centered on the ground return Doppler frequency. This also implies that an object moving tangent to the radar will be hidden, as its return frequency will be the same as the ground. When done on purpose, this is known as the notch or beam escape maneuver.

PULSE REPETITION FREQUENCY

Signal theory gives us the limits of what we can measure when looking at signal frequency. If doppler closing velocity was measured on a single pulse, a typical pulse length of 0.1 µs (30 m range resolution) would not allow measuring velocities with a precision lower than about 10 000 m/s, which would make the system useless as a fire control radar. In order to measure speed with a precision of 10 m/s or better, a 1 ms pulse length is necessary, but then, the range resolution becomes 300 km which would also make the system useless.

For this reason, air-to-air doppler radars measure the Doppler frequency over several consecutive pulses. This allows combining short pulses (typically under 1 microsecond) with high precision on velocity. It also introduces Doppler ambiguity: for a given pulse repetition frequency (PRF), there is a velocity ambiguity. As an example, for a 50 kHz PRF, corresponding to a 20 µs period, the velocity ambiguity is 750 m/s. This means, that when measuring an object velocity of 450 m/s, the actual object velocity could be 450m/s, but also:

- 450 + 750 = 1200 m/s
- 450 + 750 + 750 = 1950 m/s
- etc..
- 450 – 750 = -300 m/s
- 450 - 750- 750 = -1050 m/s
- etc...

So, the radar is only able to measure velocity in a 750 m/s interval that can be freely chosen by design, for instance -200 m/s to 550 m/s. Any velocity outside this interval will be measured inside, with an error equal to a multiple of 750 m/s.

A higher PRF will increase this interval, allowing to measure a broader velocity range. For instance, doubling PRF to 100 kHz gives a 1500 m/s velocity interval. This is the typical HPRF (High PRF) value used by fire control radars.

For range measurement, with a 50 kHz PRF, the pulses are emitted every 20 µs, so they are spaced by 6 km at the speed of light. This means that when observing distances larger than 6000 m, several pulses are travelling at the same time between the radar and the object. As these pulses can't be individually identified by the receptor, meaning that the absolute range can't be measured directly; as for the velocity, it's only known modulo the 6 km range ambiguity. In other words, it can't make the difference between an object at 5 km, 11 km, 17 km, etc...

Improving the range measurement requires lowering the PRF, ideally to have a range ambiguity higher than the typical distance of measured objects. For instance, a 5 kHz PRF (typical LPRF) provides a range ambiguity of 60 km. This is generally favored for terrain mapping.

For an air-to-air fire control radar, we generally want to detect objects from negative closing velocities up to a few Mach closing velocities (typically -1M to +4M), this requires about 1500 m/s of velocity ambiguity, or a PRF of at least 100 kHz. On the other hand, we want to measure non-ambiguous ranges up to 100 km or more. This requires a PRF of at most 3 kHz which is basically impossible without additional techniques.

RANGE DISAMBIGUATION

There are several ways to solve the range ambiguity problem. This topic is too vast to be fully covered here, we will only describe the simplest one: dual PRF disambiguation.

The radar uses 2 PRFs at the same time, either by using dual carriers or fast PRF switching. These PRFs are close but different meaning that they have different range ambiguity.

For example, let's consider a dual PRF system with 100 kHz and 93.75 kHz PRFs. They have respectively a 3000 m and 3200 m range ambiguity:

We observe a target located at 10900 m.

The first PRF ranging gives us a measurement of 1900 m modulo 3000 m. This means the actual distance can be: 1900 m, 4900 m, 7900 m, 10900 m, 13900 m, etc...

The second PRF ranging gives us a measurement of 1300 m modulo 3200 m. This means the actual distance can be: 1300 m, 4500 m, 7700 m, 10900 m, 14100 m, etc...

The only possible distance matching both measurements is 10900 m, the actual target distance.

There are actually other solutions used at longer range: 16900 m, 58900 m, etc... every 48000 m. Using a dual PRF technique can increase the range ambiguity from 3000 m to 48000 m, and, by using closer PRFs, this absolute ambiguity can easily be increased to be over our 100 km goal.

The limits of multiple PRF disambiguation techniques are:

- They can only simultaneously deal with a small number of objects, when the number of returns is too large (many aircraft, jamming pulses, etc...), the system may fail to correlate the returns for one PRF with the returns of the other PRFs, leading to random object distance after disambiguation. Using more simultaneous PRFs can increase this limit.
  Disambiguating objects after separating them by doppler frequency also increase this limit by a lot, as only objects with the same closing velocity may interfere in the disambiguation process.
- A very small error on a PRF return delay will cause a large error in the disambiguated range. In our case, we can see that a 200 m error on one measure will cause a 3000 m error on the final result. The closer the PRFs, the more often this issue will arise.
  Typical HPRF radars thus have a ranging error in search mode of a few thousand meters that is a consequence of these small errors.

When tracking a target, the problem is simpler as the systems knows a good estimation of the target distance from the previous measurement. So, amongst all the possible ambiguous ranges, the closest to the previous measurement will be chosen. Jammers or disturbances may cause large errors in range estimation, causing the tracking to look at the wrong interval.

Also, if the tracked target closing velocity is small enough, a radar can adapt its PRF to a lower value, allowing easier range extraction.

MONOPULSE RADAR

The Mirage’s RDI radar is in the monopulse radar family. This means that it is able to locate the angular position of an object within the main lobe instantly, without any scanning or temporal modulation. There are various monopulse techniques, all involve splitting the beam into several (typically 4), off-axis lobes.

When receiving, the antenna does not produce a single signal but 4, in a up/down, left/right pattern. By comparing the relative powers of the 4 signals, it is possible to know the angular position of the object with a significantly higher precision than the lobe angle itself.

AIR-TO-AIR MODES

BAR SEARCH

The bar search (*Recherche en lignes* – Range while scan) mode is the main air search mode. It is most useful when searching for aircrafts at long range in clean air or in look down. In this mode the radar is gyro stabilized to the horizon in pitch and roll.

In bar search the total number of contacts that the radar can display is dependent on the selected bar number and persistence setting:

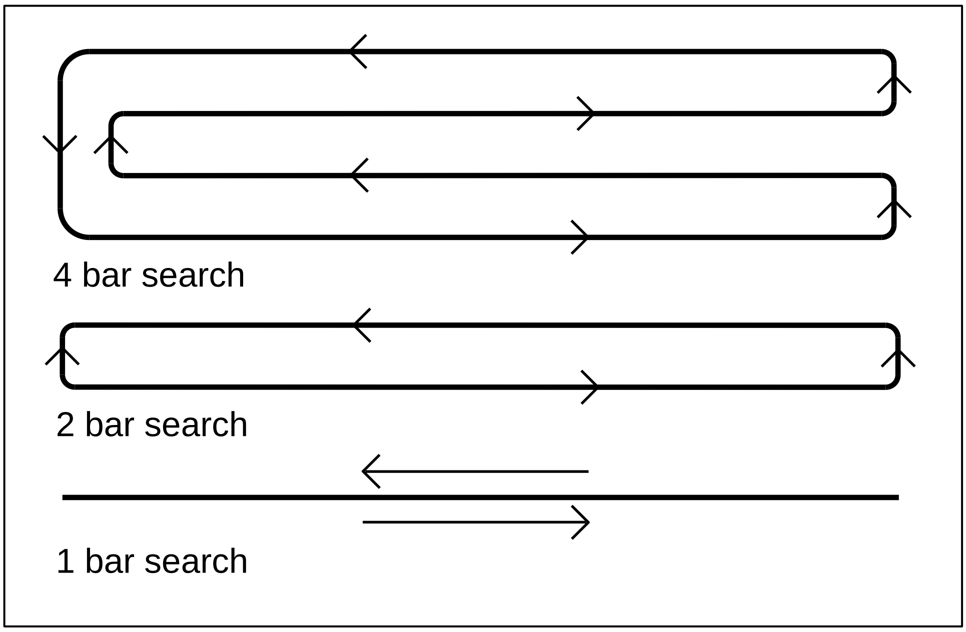
- 64 in 4 bars (16 per bar)
- 64 in 2 bars (32 per bar)
- 40 in 1 bar without persistence
- 20 in 1 bar with persistence

The displayed contacts provide the following information:

- Azimuth
- Distance
- Closing speed

The displayed contacts are not tracked, meaning that their position is not updated with time, they are erased after being displayed for precisely 1 search pattern and a new contact is displayed at the new position.

In order to scan the airspace, the radar follows a search pattern that is decomposed in horizontal bars that are the width of the azimuth aperture. The bars are scanned from top to bottom.



The search pattern depends on 2 parameters:

- The bar number (*Nombre de lignes balayées*)
- The azimuth aperture (*Amplitude de gisement*)

Both can be set from the PCR (*poste de commande radar* – radar control panel).

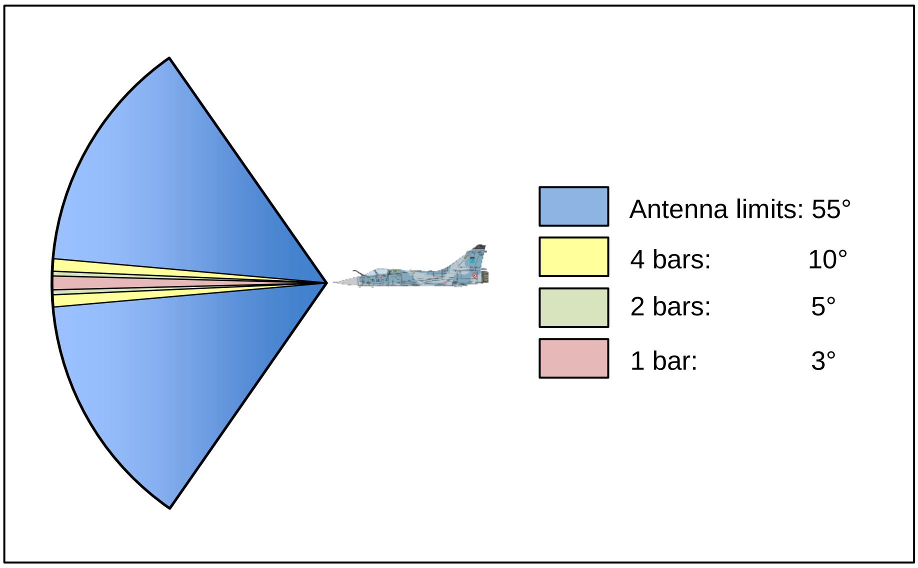
This search pattern can be panned up and down as well as left and right if the azimuth aperture is lower than 60°.

A smaller search pattern means that the scanned airspace is smaller, but this airspace is scanned faster. A fast scan pattern allows for quicker detection and faster contact refresh rate.

The bar search mode pattern size can be set the PCR as well as the display range, PRF setting, the contact persistence setting and elevation control type. The search pattern orientation in elevation and azimuth is set using the HOTAS joystick and elevation commands.

BAR NUMBER

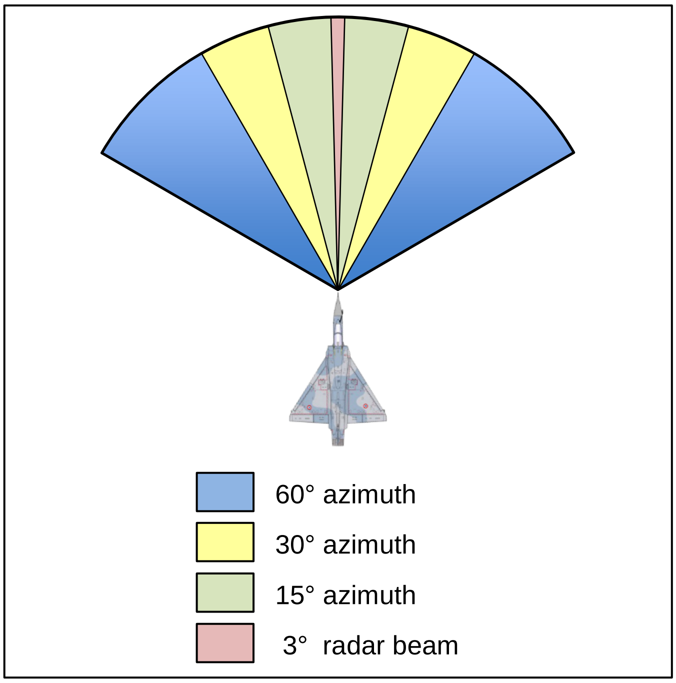
The bar number is the number of horizontal lines that the radar will execute during a search pattern:



In 2 and 4 bars search the bars are overlapping each other, resulting in a 5° and 10° vertical coverage. This overlap can lead to duplicated contacts.

AZIMUTH APERTURE

The azimuth aperture is the width of the search pattern:



DISPLAY RANGE

The radar display range represents the range scale presented on the VTB. It is changeable using the radar range switch on the PCR or “hitting” the top and bottom of the VTB screen with the TDC.

Selectable range are 10, 20, 40, 80, 160 and 320 nm. In the 320 nm setting, no radar image (HFR contacts/BFR returns) is displayed as this range is intended to be used with a DO track.

PRF SETTING

The PRF (pulse repetition frequency) setting sets the PRF used by the radar while performing the search pattern:

- **HFR** (*Haute fréquence de récurrence* – High PRF): The radar will display HFR contacts and no raw returns. The HFR contacts can then be locked in PSIC or PSID using the TDC.
- **ENT** (*Entrelacé* – Interleaved): The radar will alternate between HFR and BFR in the following pattern starting from to top bar and to the right side:
    - 4 bars: HFR > HFR > BFR > HFR, restart to the top right bar, BFR > BFR > HFR > BFR, restart to the top right bar and back to the beginning.
    - 2 bars: HFR > HFR, restart to the top right bar, BFR > BFR, restart to the top right bar and back to the beginning.
    - 1 bar: The leftward scans are in HFR and the rightward scans are in BFR.

  The BFR raw returns and HFR contacts are displayed simultaneously. The HFR contacts can then be locked in PSIC or PSID using the TDC.
- **BFR** (*Basse fréquence de récurrence* – Low PRF): The radar will display the raw returns. The radar gain can be adjusted using the BFR radar gain command on the PCR. Since no HFR contacts are display, the only way to lock a contact is from this mode it to enter RRAS auto-acquisition mode.

CONTACT PERSISTENCE

The contact persistence is only effective in 1 bar modes with HFR:

- **N** (Non – No): No contact persistence.
- **R** (Rémanence – Persistence): In 1 bar mode (bar search, PSID, SHB), HFR contacts remain displayed for 2 search pattern after they are first displayed.

ELEVATION CONTROL TYPE

The elevation control type sets the way the HOTAS antenna elevation command controls the antenna elevation position:

- **S** (*SITE*): The HOTAS elevation command directly moves the antenna elevation.
- **Z** (*ZBUT*): The HOTAS elevation command sets the center of the searched altitude slice and the radar moves the antenna to match this elevation at the TDC position.

ELEVATION

The search pattern orientation in elevation is controlled using the HOTAS radar elevation controls according to the elevation control type setting.

AZIMUTH

When the azimuth aperture setting is under 60°, the search pattern is centered around the TDC position.

PSID

The PSID or PID (*poursuite sur information discontinue* – track while scan) mode allows the radar to focus on a single contact and provide additional information while still scanning the airspace around the contact.

The radar will provide additional information on the focused or locked contact:

- Direction
- Speed
- Altitude

The radar will keep a 1 bar search pattern centered on the locked contact in azimuth and elevation and be able to display 16 other contacts with the same info as in bar search.

The bar setting is forced to 1 bar and the azimuth setting is free to be set at 60°, 30° or 15°.

The radar will build a track of the locked contact, this means that the contact position is updated in real time according to its movement and adjusted each time the contact is scanned by the radar.

This mode allows to track a contact position but is not perfect, lock can be lost due to erratic maneuvers. It also cannot be used to guide the Super 530D missile.

PSIC

The PSIC or PIC (*poursuite sur information continue* – single target track) mode physically locks the radar on a single contact to provide additional information and maintain maximum lock reliability.

The radar will provide the same additional information than in PSID mode, but the update rate is almost instantaneous:

- Direction
- Speed
- Altitude

As the radar is physically locked on the target, the information provided has a greater accuracy and is updated in real time. This lock is almost impossible to evade using erratic maneuvers.

If the target is lost, the radar keeps illuminating the target trajectory and try to re-acquire it for 5 seconds after which the radar will return to bar search.

Locked aircraft can also be made aware that they are targeted if they are equipped with an RWR.

From this mode, the Super 530D missiles can be fired and guided on the radar target. When a 530 is fired, the radar enters to a PSIC sub-mode: PSIC Super 530.

PSIC SUPER 530

The PSIC Super 530 (*poursuite sur information continue Super 530D* – single target track Super 530D) is a sub-mode of PSIC that is switched to automatically once a Super 530D missile has been fired.

The radar stays in PSIC Super 530 for 50 seconds after the last missile fired. During this time, if the target is lost, the radar will keep illuminating the target trajectory and try to re-acquire it just like PSIC mode but for 8 seconds instead of 5. After those 8 seconds, the radar will continue to illuminate the target trajectory but won't try to re-acquire the lock. This forced illumination mode lasts as long as the radar is in PSIC Super 530.

If the radar is unable to continue to illuminate the target, the PSIC Super 530 pointé mode can be used to manually illuminate the target. This mode is only selectable while the radar is in PSIC Super 530 and fixes the radar antenna to the aircraft axis, allowing the radar to be aimed at the target by flying the aircraft.

SHB

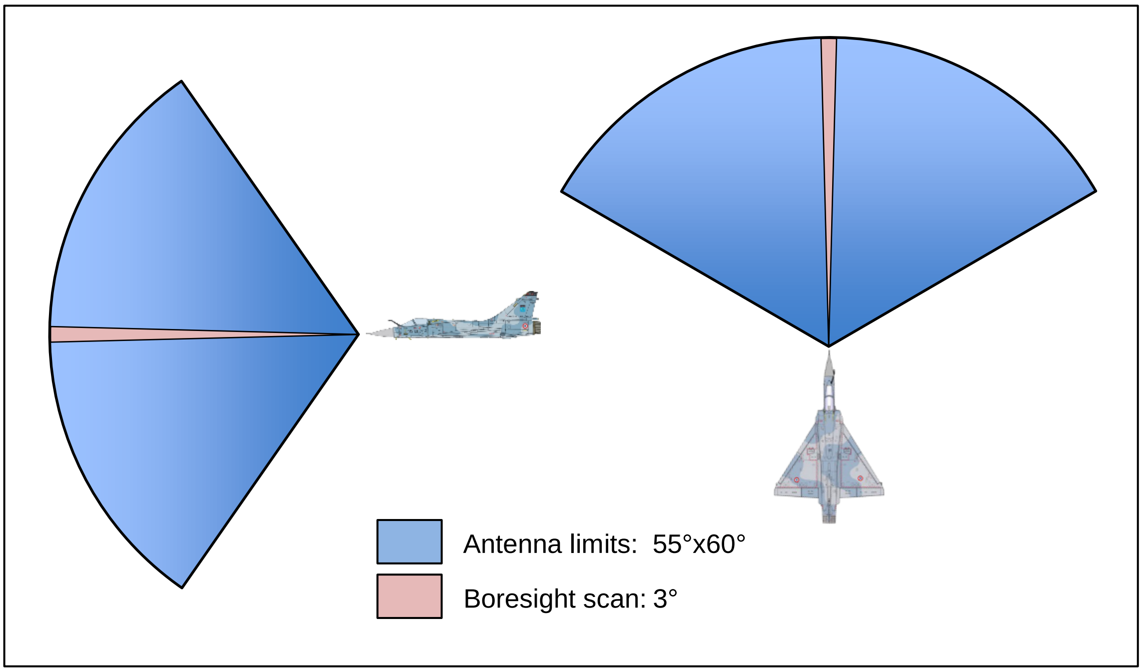
The SHB (*sécurité haut-bas* – terrain avoidance while track) mode combine the DEC and PSID mode. The radar performs a 2 bar search pattern alternates between the 2 modes, leftward scans for the DEC, rightward scans for the PSID.

The DEC radar image is displayed up to 10 nm and the display range setting can be set to 10 or 20 nm. The PSID lock range is not more limited than in PSID.

In SHB, there is 20° limit in elevation difference between the tracked target and the clearance height. If this limit is exceeded, the radar will drop the lock and switch to DEC mode. There is a similar limit in azimuth if the azimuth aperture setting is under 60°, the radar needs to keep scanning 5° on each side of the aircraft axis line.

BORESIGHT AUTO-ACQUISITION

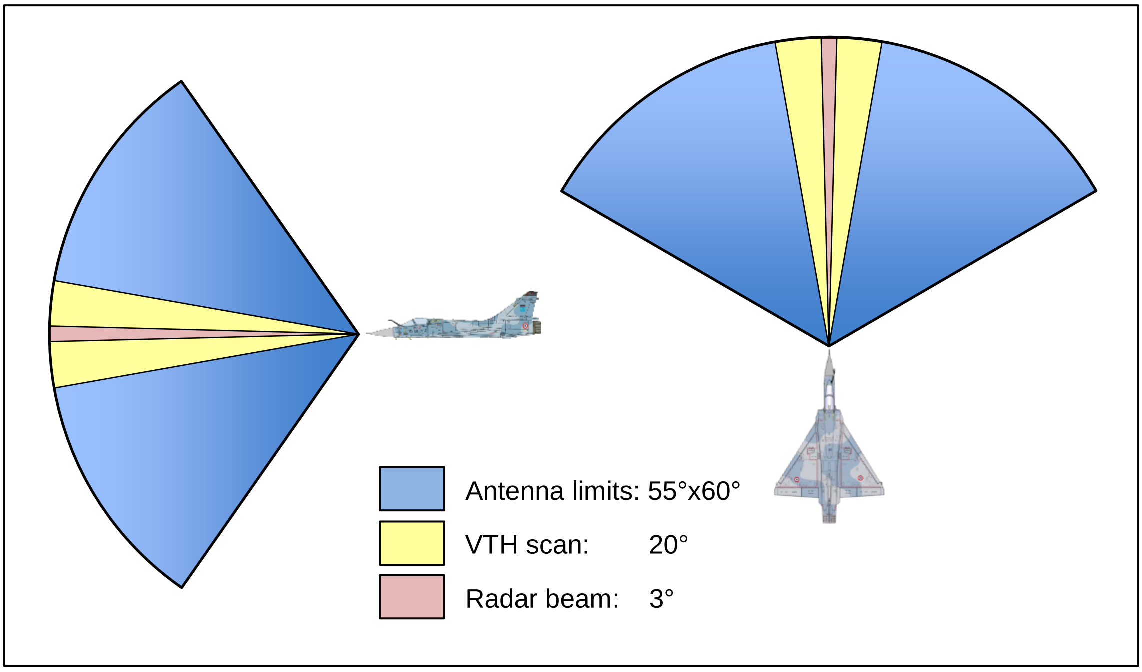
The boresight auto-acquisition (P.axe – *pointage axe*) mode is a close combat mode for the radar. The radar is slaved to the aircraft boresight and will try to lock in PSIC any contact within 10nm. The scanned area is equal to the antenna aperture, a 3° cone.



This mode is most useful to lock a visual contact.

VTH AUTO-ACQUISITION

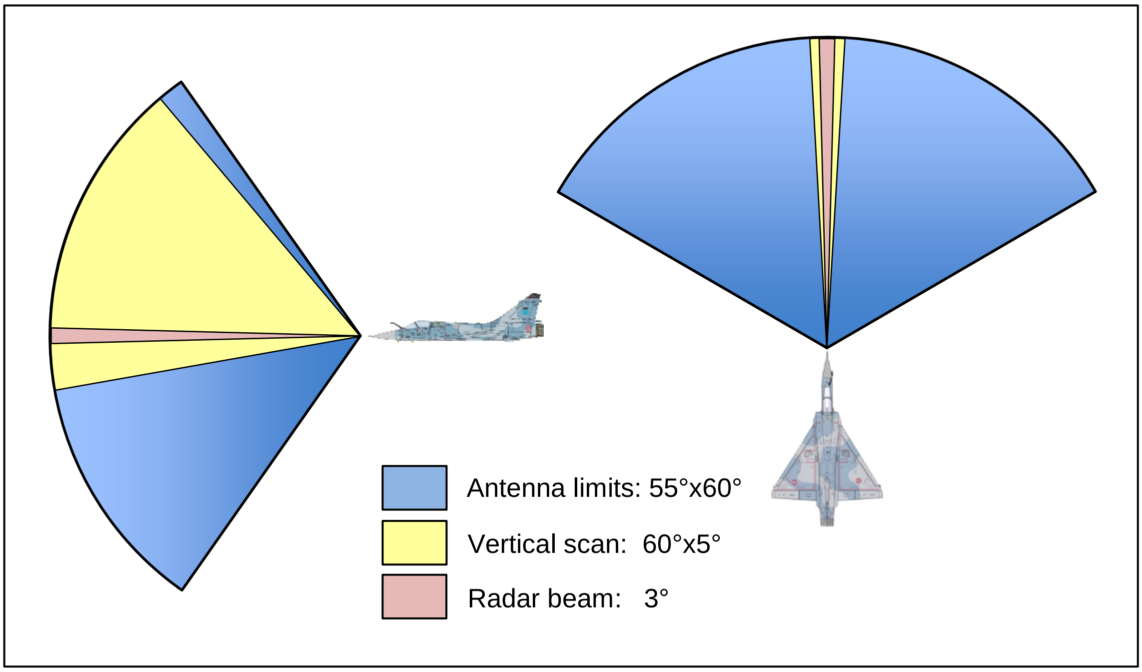
The VTH auto-acquisition (CH. viseur – *champ viseur*) mode is a close combat mode for the radar. The radar executes a spiral pattern that is roughly the size of the VTH and will try to lock in PSIC any contact within 10nm. The scanned area is equal to a 20° cone.



This mode is most useful to re-acquire a lost contact whose approximate position is known.

VERTICAL AUTO-ACQUISITION

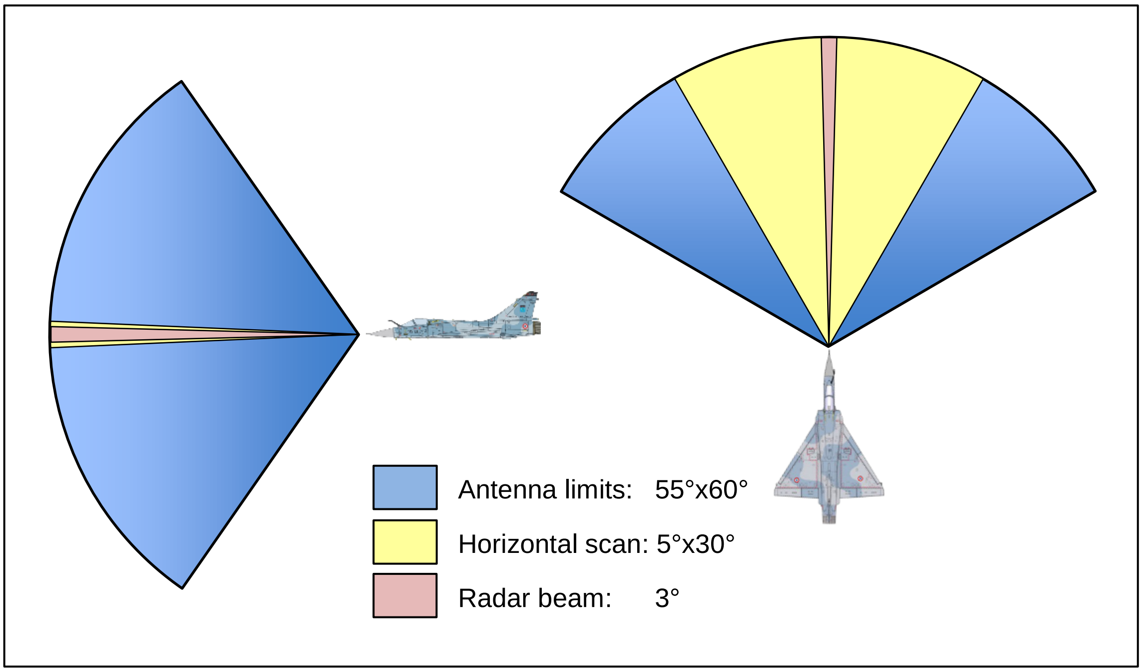
The vertical auto-acquisition (PDS – *plan de symétrie*) mode is a close combat mode for the radar. The radar executes a pattern composed of 2 vertical lines relative to the aircraft. The vertical lines are just left and right of the aircraft vertical axis and goes from 10° under the nose to 50° above. The radar will try to lock any contact in PSIC within 10nm.



This mode is useful in dogfights, when the hostile aircraft is in front and above.

HORIZONTAL AUTO-ACQUISITION

The horizontal auto-acquisition (BAG – *balayage acquisition en gisement*) mode is a close combat mode for the radar. The radar executes the same search pattern as the 2 bar/30° bar search pattern and will lock in PSIC any contact within 10nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command and by moving the TDC in the same way than in bar search.



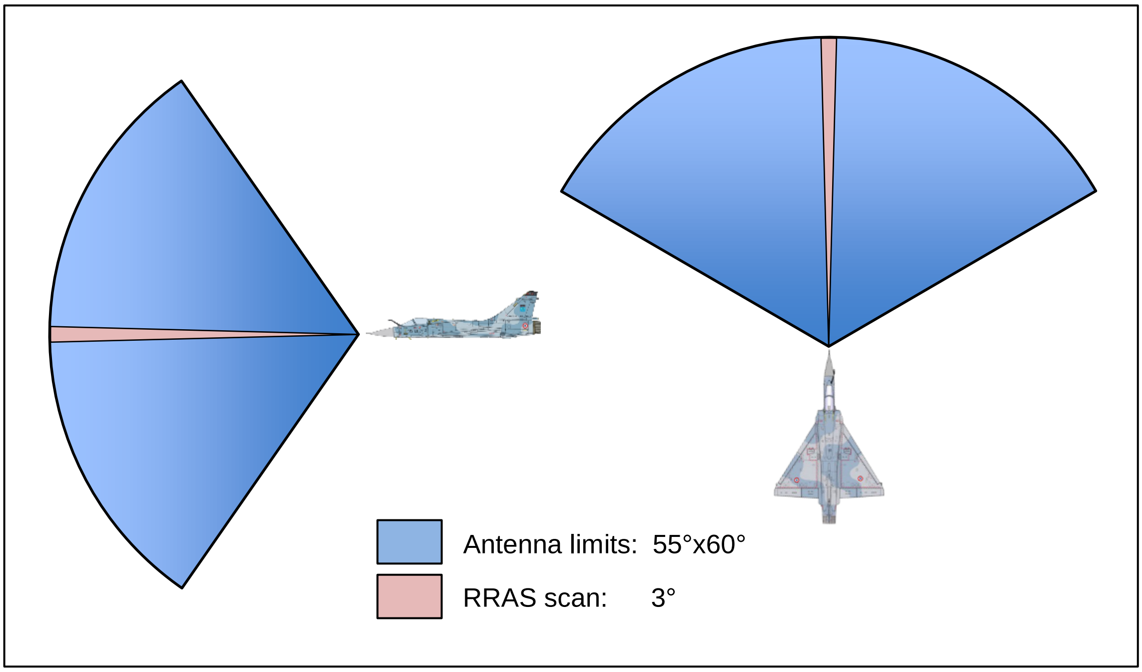
This mode is most useful to lock a close contact as is offers the biggest scan zone of all auto-acquisition modes.

2 modes are available for horizontal auto-acquisition:

- BAH: The radar uses HFR (high PRF)
- BA2: The radar uses MRF2 (medium PRF)

RADAR SLAVE TO TDC/ELEVATION

The radar slave to TDC/elevation (RRAS - *Ralliement radar sur alidade/site*) mode is a close combat mode for the radar. The radar executes the same search pattern as in boresight mode and will lock in PSIC any contact within 10nm. The scanned area can be panned up, down, left and right using the HOTAS antenna elevation command and by moving the TDC in the same way than in bar search.



This mode is most useful to achieve a HFR lock on a BFR contact.

AIR-TO-GROUND MODES

TAS

The TAS (*télémétrie air/sol* – air-to-ground ranging) mode is the main ranging method for air-to-ground weapon delivery. The radar is slaved to the weapon delivery point or the designation diamond to provide slant range to the ground target.

Using a radar to range ground targets is not perfect due to the size of the radar beam. In order to determine the center of the beam, the radar averages all the ground returns it gets. This process is always occurring as long as the radar has a solid lock on the ground, meaning that this average will most likely be incorrect if the terrain is moving under the radar beam.

In order to achieve the most accurate ranging possible, a few precautions need to be taken:

- Stabilize the weapon delivery point or designation diamond on the target for at least 1 second before weapon release or designation to allow the radar to determine the center of the beam.
- Avoid uneven terrain or targets on top of ridges, the radar will have a hard time finding the center of the beam if it sees multiple planes of terrain.
- Since the radar beam is a cone, a close and steep dive angle reduce the size the area illuminated by the radar, allowing for a greater accuracy.
- Water absorbs radar waves a lot, radar ranging might be unpracticable on or near water unless using a very steep angle.

VISU

The VISU (*visualisation du sol* – ground mapping) mode is a terrain visualization mode. The radar displays the raw ground return to provide a radar map of the ground. The radar gain can be adjusted using the BFR radar gain command on the PCR, this command can be used to adjust intensity of the radar image. The antenna attitude is set by the pilot.

In this mode the bar number can be set to 2 or 1 bars, the 4 bars position sets it to 2 bars, and the azimuth aperture to 60°, 30° or 15°. The display range can be set to 10, 20 and 40 nm.

DEC

The DEC (*découpe* – ground avoidance) mode is a terrain avoidance and visualization mode. The radar displays the raw ground return in 2 colors depending on the terrain altitude relative to the set clearance height. The antenna attitude is set by the radar according to the clearance height which is set by the pilot.

In this mode the bar number can be set to 2 or 1 bars, the 4 bars position sets it to 2 bars, and the azimuth aperture to 60°, 30° or 15°.

20 – 2 - RADAR CONTROL PANEL

The radar control panel (PCR – *poste de commande radar*) provides control over the radar operational mode, options and configuration.

1. RADAR CHANNEL SELECTOR: Changes the radar emission channel. NOT FUNCTIONAL
2. RADAR CHANNEL SAVE BUTTON: Saves the selected emission channel. NOT FUNCTIONAL
3. RADAR CHANNEL SELECTOR: Changes the radar emission channel. NOT FUNCTIONAL
4. REAM BUTTON (*Poussoir de réarmement*): Resets the radar in case of malfunction. NOT FUNCTIONAL

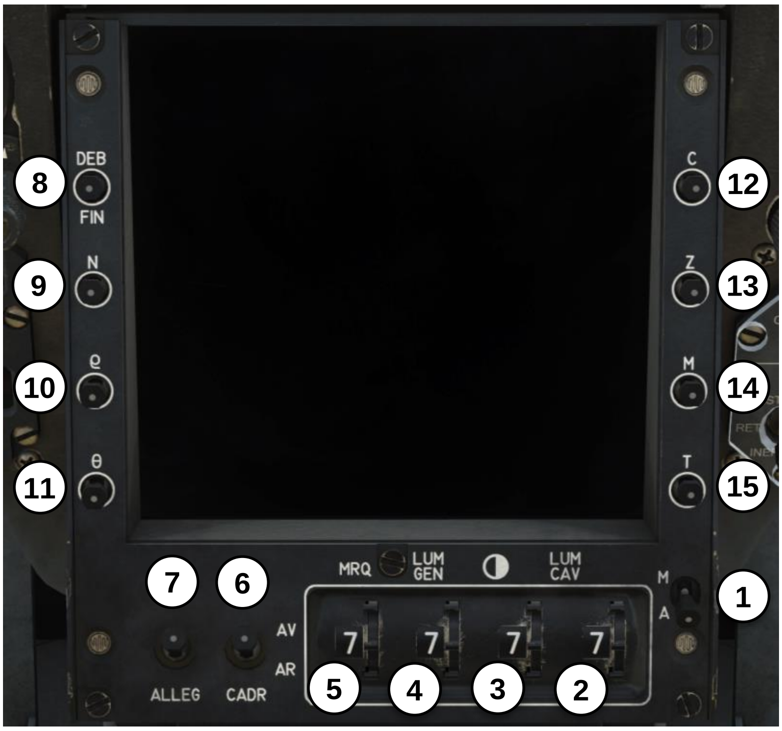
5. DOPPLER FILTER SWITCH (*Sélecteur de rejection*): Selects the doppler filter operation mode for HFR:
   - **Avec** (With): The radar main lobe filter is always activated. Will reduce the spurious contact quantity and reduce the probability of the radar to track a chaff but will increase the chance of losing lock due to notching.
   - **Auto**: The radar main lobe filter is activated when the main lobe ground return is too high. Will improve notching resistance but increase the chance of spurious contact and the probability of the radar to track a chaff.
   - **Sans** (Without): The radar main lobe filter is never activated. Result in a lot of spurious contact but can decrease the chance of losing lock due to notching.
6. BFR RADAR GAIN (*Gain radar BFR*): Sets the radar BFR return gain in ENT, BFR and VISU modes.
7. RADAR POWER MODE KNOB (*Rotacteur d'état radar*): Selects the radar power mode:
   - **A** (*Arrêt* – OFF): The radar is not powered.
   - **P CH** (*Préchauffage* – Pre-heating): The radar is in preparation mode, it pre-heats to operational temperature.
   - **SIL** (*Silence* – Standby): The radar executes the selected search pattern but it not emitting. In this mode, the radar can be forced to emit by selecting a close combat or TAS mode.
   - **EM** (*Emission* – Emitting): The radar is emitting.
8. RADAR TEST BUTTON (*Poussoir de test radar*): Starts the radar test sequence. NOT FUNCTIONAL
9. DEC MODE SELECTION BUTTON (*Boutton de sélection DEC*): Selects and deselect the DEC mode for the radar. The button is lit up red when the DEC mode is selected.

   If the radar is in PSID, pressing the DEC button will select the SHB mode.
10. VISU MODE SELECTION BUTTON (*Boutton de sélection VISU*): Selects and deselects the VISU mode for the radar. The button is lit up red when the VISU mode is selected.
11. RADAR PRESENTATION SWITCH (*Sélecteur de visualisation*): Selects between the 2 available radar presentation modes:
    - **PPI** (Plan position indicator): The emitter is at the bottom center of the screen and the contacts are displayed inside the radar cone coming from the emitter.
    - **B** (B scope): The emitter is at the bottom of the screen but stretched to take all the width. This way the vertical axis represents the distance and the horizontal axis the azimuth. This presentation is distorted to allow easier readings of contacts at close distance.
12. RADAR HARDENED NOISE GATE SELECTION BUTTON (*Bouton de réduction du bruit*): Increases the background noise filter for the radar. Removes most of the spurious contacts but reduces the maximum detection range. The button is lit up red when the hardened noise gate is selected.

13. ANTENNA ELEVATION TYPE SWITCH (*Inverseur de mode site moyen*): Selects the antenna elevation movement type for bar search:
    - **S** (*SITE*): The HOTAS elevation command moves the antenna elevation and the searched altitude range will be displayed in thousands of feet right of the TDC for the current TDC position.
    - **Z** (*ZBUT*): The HOTAS elevation command sets the center of the searched altitude slice as displayed right of the TDC and the radar moves the antenna to match this elevation at the TDC position.
14. PERSISTENCE KNOB (*Rotacteur de rémanence*): Selects the contact persistence mode in bar search:
    - **N** (Non – No): No persistence.
    - **R** (*Rémanence* – Persistence): In 1 bar mode (bar search, PSID, SHB), HFR contacts remain displayed for 2 search patterns after they are first displayed.
15. PRF SELECTION SWITCH (*Sélecteur de fréquence de récurrence*): Selects the radar pulse repetition frequency in bar search:
    - **HFR** (*Haute fréquence de récurrence* – High PRF): Used to detect contacts with a high radial (closing or opening) speed.
    - **ENT** (*Entrelacé* – Interleaved): The radar alternates between HFR and BFR to maximize the detection chance.
    - **BFR** (Basse fréquence de récurrence – Low PRF): Used to detect contacts with low radial speed without using doppler effects.
16. BAR NUMBER SELECTOR (*Sélecteur du nombre de lignes*): Selects the number of horizontal bars for bar search, DEC and VISU modes. Possible number of bars is 1, 2 and 4.
17. RADAR RANGE SWITCH (*Commande d'échelle radar*): Increases or decreases the displayed radar range.
18. PSIC BUTTON (*Boutton PSIC*): Toggles the PSID or PSIC pre-selection:
    - Radar in PSID or PSIC: Commands the radar to switch between PSID and PSIC mode unless the radar is in PSIC Super 530.
    - Radar in bar search: Toggles the PSID/PSIC preselection.
19. AZIMUTH APERTURE SELECTOR (*Sélecteur de l'amplitude de gisement*): Selects the azimuth aperture for the radar in bar search. Possible azimuth aperture are 15°, 30° and 60°.

20 – 3 - VTB COMMANDS

The radar display (VTB – *visualisation tête basse*) commands main purpose is to turn on and off the display, to select the symbology luminosity, to declutter the display and to chose the display type. It's also used to set the parameter for a target designation (*désignation d'objectif*).



1. POWER SWITCH (*Interrupteur marche/arrêt*): Turns ON (M – *Marche*) or OFF (A – *Arrêt*) the VTB display.
2. TDC BRIGHTNESS (*Luminosité alidade*): From 0 to 7, sets the TDC brightness.
3. RADAR VIDEO CONTRAST (*Contraste vidéo radar*): From 0 to 7, sets the contrast of the video coming from the radar.
4. SYMBOLOGY BRIGHTNESS (*Luminosité symbologie*): From 0 to 7, sets the symbology brightness.
5. MARKS BRIGHTNESS (*Luminosité marqueurs*): From 0 to 7, sets the marks brightness.
6. PRESENTATION SELECTION SWITCH (*Inverseur CADR AV/AR*): Selects the radar display type:
    - AV (*Avant* – Front): The VTB displays the standard PPI or B scope with all the radar informations.
    - AR (*Arrière* – Rear): The VTB displays the *DO centrée* mode where the aircraft is placed at the center of the screen and no radar information is displayed.
7. DECLUTTER SWITCH (*Poussoir ALLEG*): Momentary switch, toggles the display of the DO symbology present on the VTB and removes all the displayed tactical BUTs.

8. START/FINISH SWITCH (Commande *DEB/FIN*): Used to visualize, edit and save target designation:
    - DEB (Début – Start): Displays the target designation parameter insertion/visualization bands.
    - FIN (Fin – End): Insert the target designation parameters.
9. N SWITCH (*Commande* N): Selects the reference BUT for the target designation. Also selects the reference BUT for the TDC distance/azimuth symbology.
10. RHO SWITCH (*Commande ρ*): Sets the target designation horizontal distance from the reference BUT in nm.
11. THETA SWITCH (*Commande θ*): Sets the target designation azimuth from the reference BUT in true north. Also resets the target designation when RAZ (*remise à zéro* – reset) is displayed next to it.
12. C SWITCH (*Commande C*): Sets the target designation bearing in true north.
13. Z SWITCH (*Commande Z*): Sets the target designation altitude barometric altitude.
14. M SWITCH (*Commande M*): Sets the target designation speed in Mach.
15. T SWITCH (*Commande T*): Sets the target designation age, the time since it was at the inserted position.

20 – 4 - VTB SYMBOLOGY

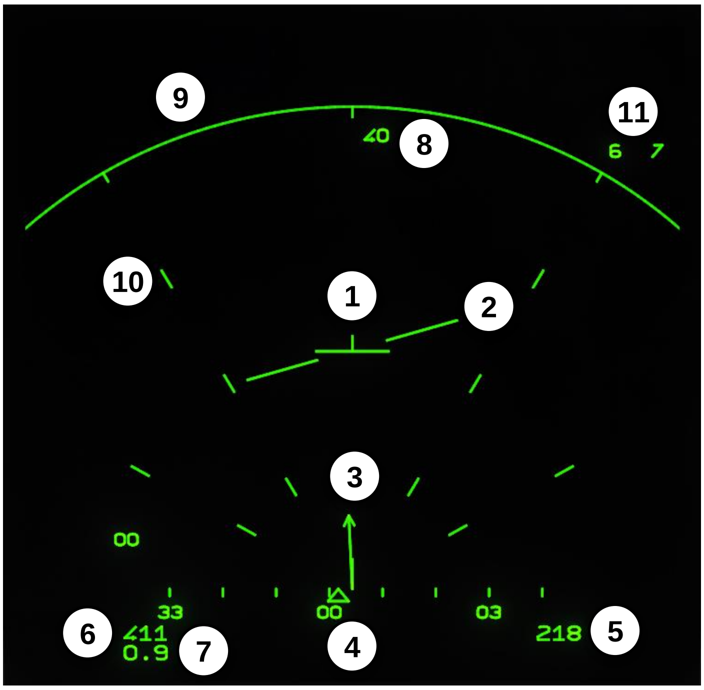
INTRODUCTION

Once the VTB ON/OFF switch is set to M (*marche* – ON), the VTB screen will display symbology coming from the radar.

In this section the symbology will be explained and presented in PPI display mode, most of the symbology works the same between PPI and B display mode and differences will be explained in a dedicated B mode section.

COMMON SYMBOLOGY

In all radar modes, except in PRES (*visualisation des présences* – ordinance display) mode, the VTB screen will display the following symbology:



1. AIRCRAFT MODEL (*Maquette avion*): Fixed, used as a reference for the horizon symbol.
2. HORIZON (*Horizon*): Indicates the aircraft pitch and roll relative to the aircraft model symbol. Pitch is limited to ±30°.
3. AIRCRAFT VECTOR (*Vecteur vitesse chasseur*): Represents the ground speed of the aircraft (1 cm = 200 m/s) and its bearing.
4. HEADING SCALE (*Echelle de cap*): The Heading Scale moves horizontally against the base of the aircraft vector indicating aircraft heading from 0º to 360º. The scale is numbered tens of degrees, with a short line every 10° and the azimuth in tens of degrees every 30°.

   The triangle Δ represents the aircraft bearing (*route*), meaning the direction where the aircraft is flying. There might be a difference between the aircraft heading and bearing due to the wind.

5. AIRCRAFT ALTITUDE (*Altitude chasseur*): Indicates the aircraft's corrected barometric altitude in hundreds of feet.
6. AIRCRAFT AIR SPEED (*Vitesse conventionnelle chasseur*): Indicates the current aircraft's airspeed in knots.
7. AIRCRAFT MACH (*Mach chasseur*): Indicates the aircraft's Mach speed.
8. RANGE INDICATION (*Repère de distance*): Indicates the selected radar display range scale at the range marker.
9. RANGE MARKER (*Marqueur de distance*): Represents the scale of the radar display relative to the range indication.
10. AZIMUTH MARKERS (*Marqueurs de gisement*): Represents the 30° and 60° azimuth relative to the aircraft heading.
11. RADAR FREQUENCY CHANNELS (*Pinceaux de fréquence radar*): Displays the selected radar frequency channels.

RADAR OFF

With the radar power mode knob in the A (*arrêt* – off) position, the VTB will only display the common symbology.

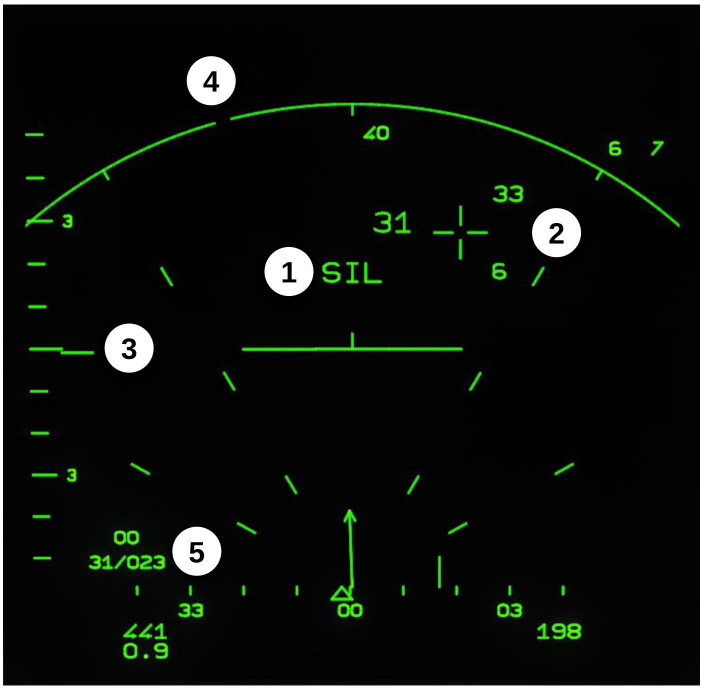
RADAR IN PRE-HEATING

With the radar power mode knob in the P CH (*préchauffage* – pre-heating) position, the VTB will only display the fixed symbology as well as a flashing or steady pre-heating indication.

1. RADAR PRE-HEATING INDICATION (*Radar en préchauffage*): Indicates the condition of the radar depending on the selected radar mode:
   - **P CH**:
     - Fixed, indicates that the pre-heating sequence is finished.
     - Flashing, indicates that the pre-heating sequence is ongoing.
       The indicator also flashes as long as the aircraft has weight on wheels, even if the sequence is finished.
   - **SIL** or **EM**:
     - Flashing, indicates that the pre-heating sequence is ongoing, only displayed for 10 seconds after the radar is set to SIL or EM mode.

RADAR IN STANDBY

With the radar power mode knob in the SIL (*silence* – standby) position, the VTB will display the common symbology with the addition of the TDC, antenna elevation scale and antenna azimuth indicator.



1. RADAR IN STANDBY INDICATION (*Radar en silence*): Indicates that the radar is in standby mode and not emitting.
2. TDC (*Alidade* – Target designation caret): Moved using the HOTAS radar designator joystick, used to designate target for the radar.
3. ANTENNA ELEVATION SYMBOLOGY (*Echelle de site*): Indicates the position of the antenna in elevation.
4. ANTENNA AZIMUTH INDICATOR (*Gisement instantané de l'antenne*): Indicates the position on the antenna in azimuth.
5. TDC RANGE/AZIMUTH (*Distance/relèvement alidate*): Indicates the TDC range and bearing relative to a reference point.

   In this mode the radar is not emitting and will not display contacts, but IFF interrogation and reply display is still possible.

BAR SEARCH

Bar search is the radar default air-to-air mode when the radar power mode knob is set to the EM (*émission* – emit) position, the VTB will display the standby symbology with the addition of the radar mode and PSIC/PSID preselection symbology without the standby mode indication.

1. RADAR MODE (*Mode radar*): In bar search the radar mode indicates the PRF mode as selected by PRF selection switch on the PCR. Possible modes are HFR, ENT and BFR.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

2. PSID/PSIC PRESELECTION (*Présélection PSID/PSIC*): Indicates what tracking type will be selected when a manual lock is achieved. It is set to PID or PIC using the PCR PSIC button or the HOTAS PSIC toggle command.

AZIMUTH MARKERS

The VTB azimuth marker are located at 30° and 60° from the aircraft centerline. They are spaced evenly to also represent range.

When the radar range setting is at 320, 160, 80, 40 or 20 nm, 4 azimuth markers are displayed per line while with the range setting at 10 nm, only 2 azimuth markers are displayed.

RANGE MARKER

The range marker represents the scale of the radar display relative to the range indication, it also indicates the search pattern size and position as well as the instantaneous antenna azimuth.

The instantaneous antenna azimuth (*gisement instantané de l'antenne*) is indicated by the hole in the range marker arc. It is only displayed when the radar power setting knob is in the SIL or EM position with the radar in bar search, PSID, SHB, DEC or VISU mode.

The search pattern size and position (*amplitude et position du gisement moyen de balayage*) is indicated by the size and position of the range marker arc.

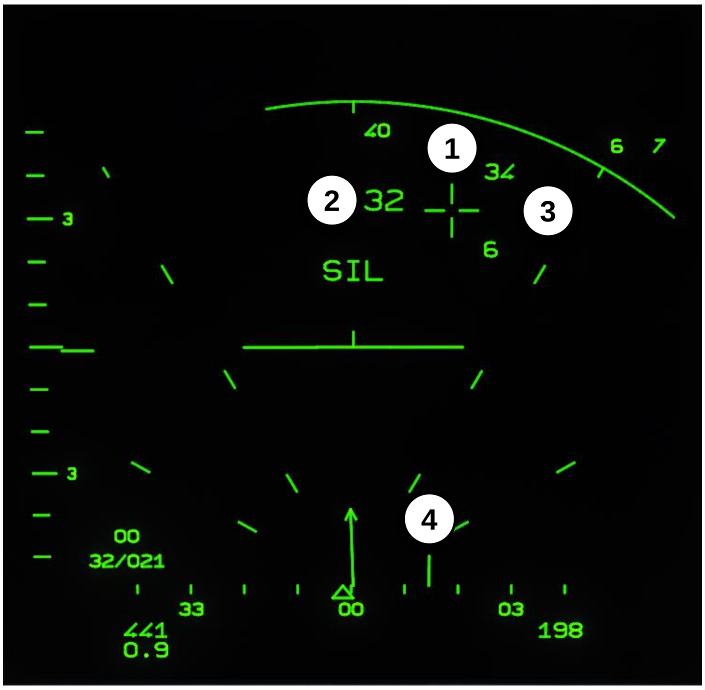
ANTENNA ELEVATION SYMBOLOGY

The antenna elevation is composed of the antenna elevation scale, the antenna elevation indicator and the bar number.

1. ELEVATION SCALE (*Echelle de site*): Provides a reference for the antenna elevation indicator relative to the horizon. Each dash is 10°, longer dashes at -30°, 0 and +30° with a 3 next to the - 30° and +30°. The ±55° radar gimbal limit is not indicated.
2. ANTENNA ELEVATION INDICATOR (*Repère de site*): Indicates the instantaneous position of the antenna in elevation relative to the elevation scale.
3. BAR NUMBER (*Nombre de lignes*): Indicates the number of horizontal bars for the current search pattern as set with the bar number selector on the PCR. Its position, relative to the elevation scale, indicates radar search pattern elevation. Only displayed when the radar power setting knob is in the EM position with the radar in bar search mode.

TDC

The TDC (*alidade* – target designation caret) is represented by a hollow plus and is moved using the HOTAS radar designator joystick everywhere inside the VTB. It is only displayed when the radar power mode knob is in the SIL or EM position and the radar mode is bar search, PSID, PSIC, SHB, BAG or RRAS. It is used to orient the antenna or antenna search pattern in azimuth and elevation as well as designate a target for the radar.



1. TDC (*Alidade* – Target designation caret): Moved using the HOTAS radar designator joystick, it is used to direct the antenna position in azimuth and designate contacts for radar lock.
2. TDC RANGE (*Distance alidade*): Indicates the range of the TDC at its position. Only displayed in bar search, BAG or RRAS radar mode.
3. TDC ALTITUDE RANGE (*Tranche d'altitude*): Indicates the searched altitude range at the TDC position. Only displayed when the antenna elevation type switch is in the S position on the PCR and the radar is in bar search, PSID, SHB, BAG or RRAS mode.
4. TDC AZIMUTH (*Relèvement alidade*): Indicates the azimuth of the TDC at its position relative to the heading scale.

5. TDC MEAN ALTITUDE (*Altitude ZBUT*): Indicate the center of the searched altitude slice. Only displayed when the antenna elevation type switch is in the Z position on the PCR and the radar is in bar search, PSID, SHB, BAG or RRAS mode.

NAVIGATION SYMBOLOGY

The VTB can also display navigation information with the radar power mode knob in any mode.

1. NAVIGATION BUT (*BUT de navigation*): Displayed in any SNA mode except air-to-air mode, it displays the position of the currently selected DEST BUT, BAD or MRQ.
2. DESIRED HEADING (*Route désirée d'arrivée*): Displayed when the navigation BUT is displayed, the PCA RD option is selected and the radar is in PPI mode. It displays the desired heading arrival heading relative to the navigation BUT.
3. TACTICAL BUT (BUT tactique): Displayed in any mode except when the SNA is in air-to-ground selected sub-mode, it displays the position of up to 5 BUTs with their number.

For more information about the navigation BUT and tactical BUTs, see the **INS USING THE PCN SUB-SECTION.**

HFR SYMBOLOGY

In bar search, PSID and SHB mode, contacts detected in HFR are displayed on the VTB screen. In Bar search, HFR contact are displayed if the PRF selection switch on the PCR is set to the HFR or ENT position.

1. RADAR MODE (*Mode radar*): In bar search the radar mode indicates the currently selected PRF mode.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

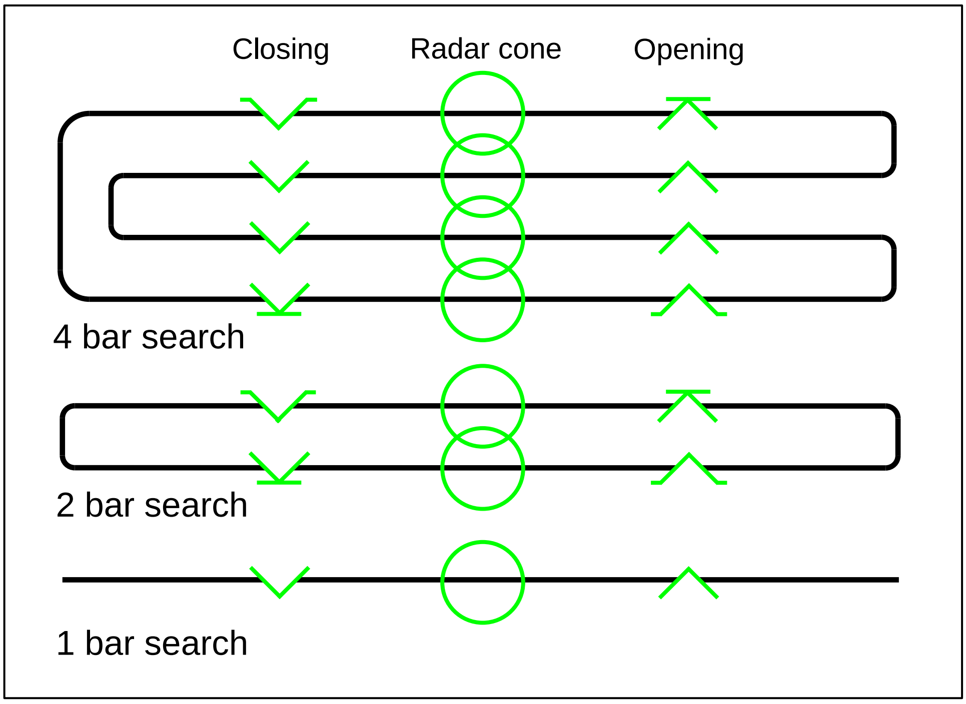
2. HFR RADAR CONTACT (*Plot HFR*): Indicates the position and closing speed in Mach of the contact as well as the bar that detected the contact.

   The tip of the V or inverted V shape is the position of the contact, not the center of the shape.

HFR radar contacts symbology gives 2 information:

- The contact range is closing or opening, indicated by the contact V direction.
- Which bar scanned the contact, indicated by the horizontal bars at the top or bottom of the contact symbol or lack thereof.

A single aircraft can be displayed multiple times on the VTB screen due to the bars overlapping.



BFR SYMBOLOGY

In bar search, SHB, DEC and VISU mode the raw radar image is displayed on the VTB screen. In Bar search, the raw radar image is displayed if the PRF selection switch on the PCR is set to the BFR or ENT position.

The BFR radar image is only displayed up to 40 nm.

The raw radar image needs to be interpreted by the pilot to find contacts in the clutter.

1. RADAR MODE (*Mode radar*): In bar search the radar mode indicates the currently selected PRF mode.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

2. BFR CONTACT (*Plot BFR*): In BFR, aircraft are represented as arcs, its width dependent on the closeness and size of the target.

3. BFR GROUND CLUTTER (*Retours sol*): In BFR, the radar displays the raw return without any filter, if the radar search pattern is oriented toward the ground, a radar image from the ground will be displayed on the VTB. The BFR radar image is all green, the brighter the green the stronger the return.

   The BFR radar gain knob can be used to adjust the intensity of the radar image.

4. ALTITUDE SIDE LOBE RETURN (*Retour d'altitude du lobe secondaire*): As the raw returns are not filtered, the side lobe return coming from the ground directly below the aircraft is displayed.

   Its position in range correspond to the altitude of the aircraft over the ground.

TRACKED TARGET SYMBOLOGY

In PSID, PSIC and SHB the tracked target is represented by a separate symbology.

This symbology is composed of 4 elements:

- 2 vertical bars indicating the position of the tracked target.
- Left of the 2 vertical bars, the target range.
- Originating from the center of the 2 vertical bars, the arrow indicates the tracked target ground velocity vector. The length of the velocity vector represents the target speed where 1 cm equals 200 m/s.
- Right of the tip of the velocity vector, the B angle. It indicates the tracked target reverse heading relative to the aircraft, 180 indicating that the tracked target is flying at the same heading than the aircraft and 0 indicating that it's flying the opposite heading. From 0° to 180° and by 5° increments.

The tracked target is crossed by the aircraft target line that indicates the direction of the tracked target.

In PSID and SHB, the contact quantity is displayed under the B angle. It represents the number of HFR contacts detected around the tracked target. This number can be as high as 7 and is displayed when above 1.

IFF SYMBOLOGY

The execution of an IFF interrogation and the display the IFF replies is represented by a specific symbology depending on the radar mode.

The IFF antenna is placed on the radar antenna and thus follow its azimuth and elevation. It’s field of interrogation is 10° wide.

With the radar in bar search (only with the PRF set to HFR or ENT) or PSID, the execution of an interrogation is represented by a doubling of the radar range marker arc. The size of the interrogation arc is dependent on the position of IFF interrogation mode on the IFF interrogator panel:

- **SECT** (*Sectorié* – Sectored): The interrogation is sent in a 20° arc around the TDC.
- **CONT** (*Continue* – Full): The interrogation is sent in the full search pattern, within the limits of its azimuth setting and orientation.

When an IFF interrogation is requested, the arc is dashed until the interrogation is effective, when it is displayed full. With IFF interrogation mode in CONT, it lasts only 0,5 sec while in SECT, the interrogation is effective is only when the radar antenna is oriented in the requested interrogation azimuth.

In bar search and PSID, the IFF replies are represented by a full diamond located at the rough location of the IFF replying aircraft. The IFF diamonds are not correlated to HFR contacts and are displayed for a full search pattern. The maximum number of IFF diamonds that can be displayed is 64.

In PSIC, the interrogation arc is 20° wide, centered on the tracked target. The IFF diamonds are no longer displayed, the 2 vertical bars indicating the position of the tracked target are doubled if it replies the IFF interrogation. A diagonal line indicates that the received reply is doubtful, meaning that the position of the IFF replying aircraft does not totally correspond to the position of the tracked target.

PERSISTENCE MODE

The persistence mode (*mode remanence*) is selected by placing the persistence knob in the R position. This mode in only effective when the radar is in searching 1 bar in HFR:

- Bar search with the bar number selector set to 1 and the PRF selection switch set to HFR or ENT.
- PSID.
- SHB.

In persistence mode, HFR contacts remain displayed for 3 search patterns instead of 1. During the first search pattern after the contact is detected, it is represented by the normal HFR symbol. During the second search pattern, the normal HFR symbol is replaced by an horizonal line, this same line is used during the third search pattern but dimed. The contact disappear once the third search pattern is finished.

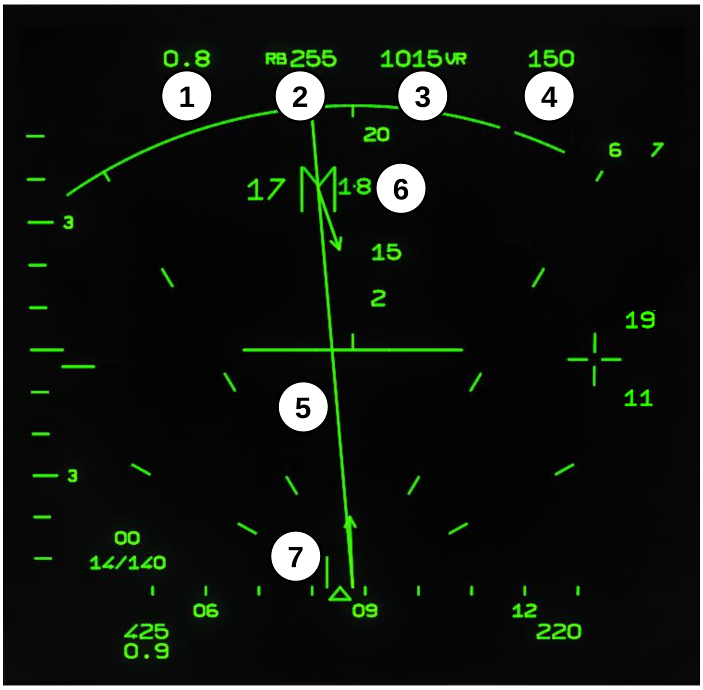
This mode is useful to spot spurious contacts and estimate the trajectory of detected aircraft.

PSID

In PSID (*poursuite sur information discontinue* – TWS) mode, the radar will display additional information relative to the tracked contact as well as specific symbology.

The radar will set itself in 1 bar search and center the searched pattern on the tracked contact in azimuth an elevation

In addition to the PSID symbology, the radar will continue to display the bar search symbology and HFR contacts, except the TDC range and preselection PSID/PSIC symbology.

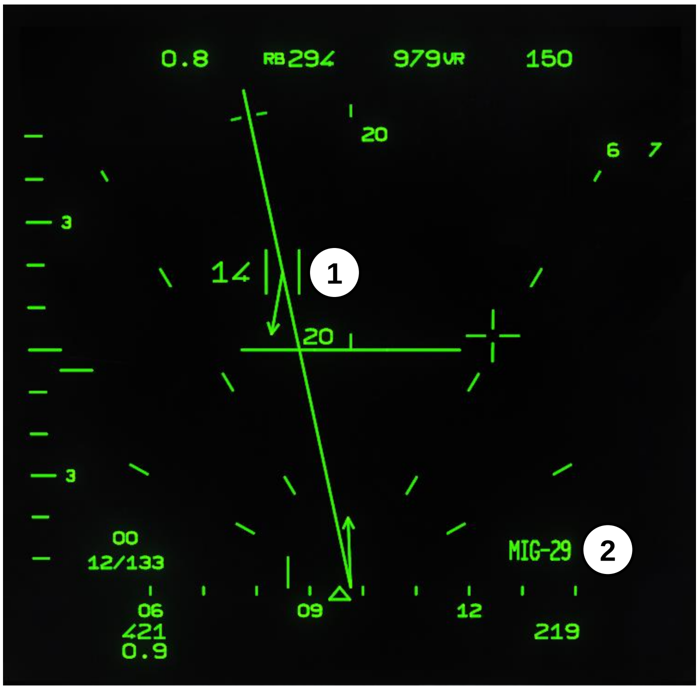


1. TARGET MACH (*Mach cible*): Indicates the tracked target speed in mach.
2. TARGET BEARING (*Route cible*): Indicates the tracked target bearing.
3. TARGET CLOSING SPEED (*Vitesse de rapprochement cible*): Indicates the tracked target closing speed in knots. Can be positive (closing) or negative (opening).
4. TARGET ALTITUDE (*Altitude cible*): Indicates the tracked target altitude in flight level or hundreds of feets. Always positive or null.
5. AIRCRAFT TARGET LINE (*Droite chasseur cible*): The line indicates the direction of the tracked target. It starts from the bottom center of the display, where the aircraft is positioned, passes by the tracked target and ends just above the range marker. It flashes when the antenna is at less than 5° from its gimbal limits.
6. TRACKED TARGET (*Plot poursuivi*): Indicates the tracked target position, range, velocity vector, B angle and contact quantity.
7. TARGET AZIMUTH (*Relèvement cible*): Replaces the TDC azimuth and indicates the tracked target azimuth relative to the heading scale.

PSIC

In PSIC (*poursuite sur information continue* – STT) mode, the radar will display the same additional information relative to the tracked contact than in PSID.

The radar will stop its search pattern and lock its azimuth and elevation on the tracked contact. No bar search contact symbology is displayed.



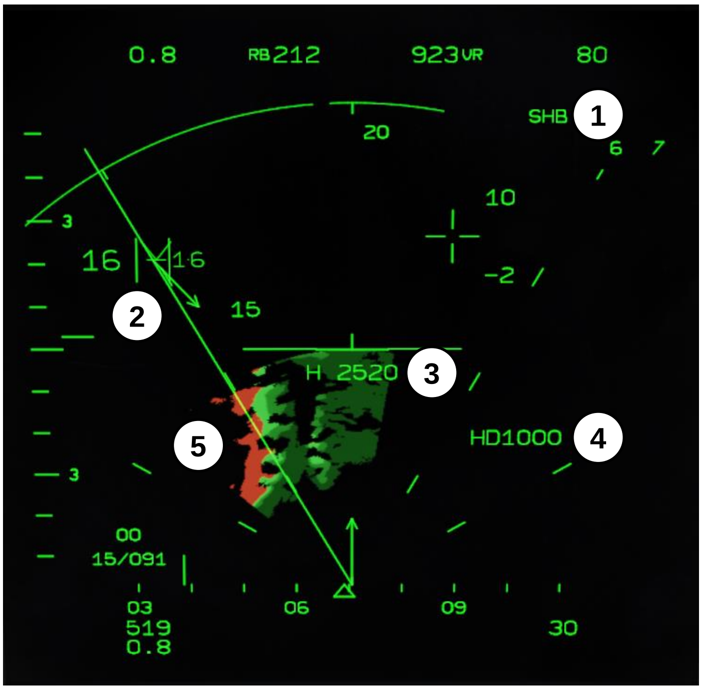
1. TRACKED TARGET (*Plot poursuivi*): Indicates the tracked contact position just like in PSID mode.
2. NCTR TYPE (RCNC – *Reconnaissance de cibles non coopératives*): Indicates the tracked contact type as determined by the radar NCTR system. Replaced by asterisks when the type cannot be determined.

SHB

In SHB (*sécurité haut-bas* – terrain avoidance while track) mode, the radar combines the symbology from the PSID and DEC modes.

The radar will set itself in 2 bar search and center the searched zone on the tracked contact in azimuth. In elevation the radar will alternatively scan the target and the ground.

The range can only be set to 10 or 20 nm and the DEC ground returns are only shown up to 10 nm.



1. RADAR MODE (*Mode radar*): Indicates the current radar mode.
2. TRACKED TARGET (*Plot poursuivi*): Indicates the tracked target position, range, velocity vector and B angle.
3. RADAR ALTIMETER (*Hauteur radio-sonde*): Indicates the radar altitude of the aircraft.

   Displayed in green when the radar altitude is above the minimum altitude as set on the PCTH and red when below
4. CLEARANCE HEIGHT DEPRESSION (*Dénivelé plan de garde*): Indicates the altitude difference bellow the aircraft at which the clearance height is set.
5. DEC GROUND RETURN (*Retour sol DEC*): The raw radar returns from the ground.

   Displayed in green is the terrain that is bellow the clearance height, in red, the terrain that is at or above the clearance height.

CLOSE COMBAT MODES

In close combat (*recherche avec accrochage automatique*) modes, the displayed symbology is close to the bar search mode, but each mode has its differences. The selection of a close combat mode force radar emission.

No contacts are displayed during close combat search and a PSIC lock will automatically be attempted once a target is found.

BORESIGHT AUTO-ACQUISITION

The TDC is not displayed and the azimuth aperture setting and elevation symbology indicate the position of the antenna.

VTH AUTO-ACQUISITION

The TDC is not displayed and the azimuth aperture setting and elevation symbology represents the search area as well as the position of the antenna.

VERTICAL AUTO-ACQUISITION

The TDC is not displayed and the azimuth aperture setting and elevation symbology represents the search area as well as the position of the antenna.

HORIZONTAL AUTO-ACQUISITION

The TDC is displayed flashing and the azimuth aperture setting and elevation symbology represent the search area as well as the position of the antenna. The search pattern can be moved using the TDC and antenna elevation commands.

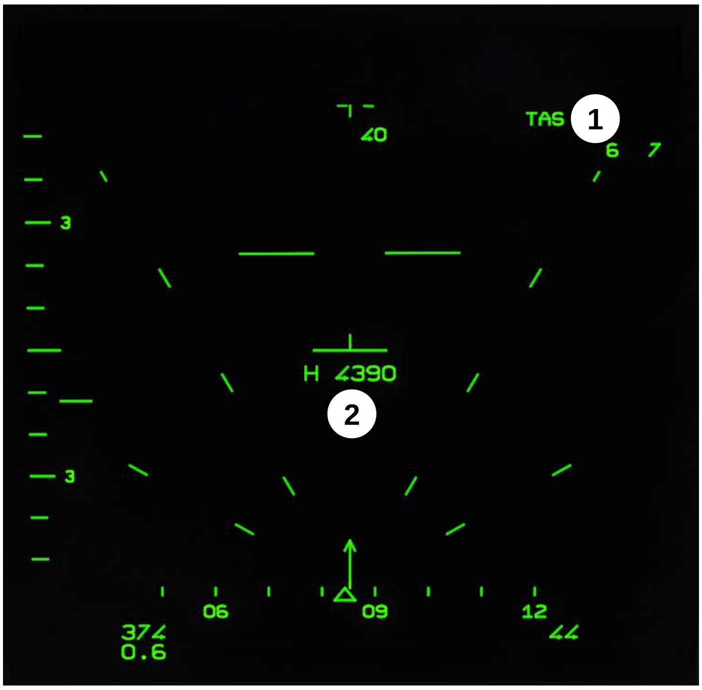
The radar mode symbol indicates the horizontal search type, BAH for high PRF (HFR) and BA2 for medium PRF (MFR2).

RADAR SLAVE TO TDC/ELEVATION AUTO-ACQUISITION

The TDC is displayed flashing and the azimuth aperture setting and elevation symbology represent the position of the antenna. The antenna can be moved using the TDC and antenna elevation commands.

AIR-TO-GROUND RANGING

In air-to-ground ranging (TAS – *télémétrie air/sol*) mode the radar displays minimal symbology. In addition to the common symbology, only the azimuth aperture setting and position as well as the elevation scale is displayed.



1. RADAR MODE (*Mode radar*): When displaying TAS, indicates that the radar is in air-to-ground ranging mode.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

2. RADAR ALTIMETER (*Hauteur radio-sonde*): Indicate the radar altitude of the aircraft.

   Displayed in green when the radar altitude is above the minimum altitude as set on the PCTH and red when below.

GROUND AVOIDANCE

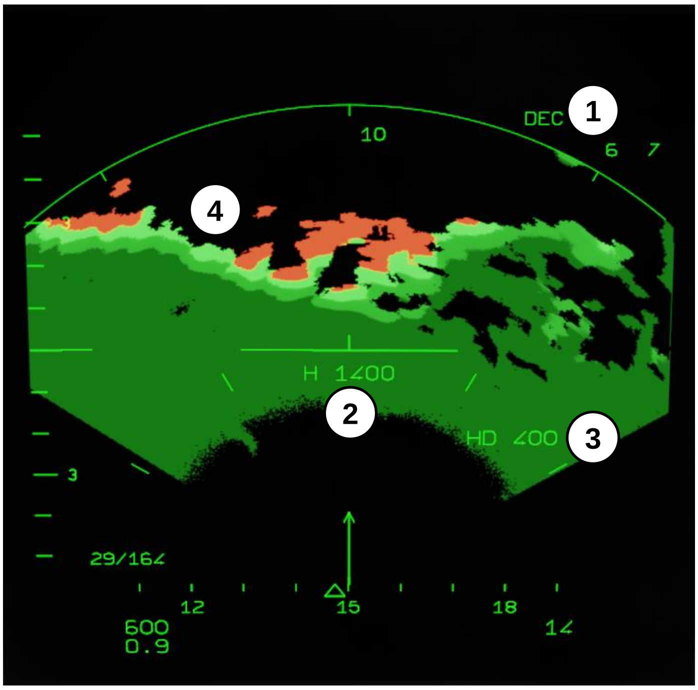
In ground avoidance (DEC – *découpe terrain*) mode the radar displays minimal symbology. In addition to the common symbology, only the azimuth aperture setting and position, elevation scale and antenna elevation are displayed. A specific clearance height symbology is displayed.

In this mode the radar operates in BFR and the TDC is not available. The range is locked to 10 nm, the bar number to 2 or 1 and the azimuth aperture is free. The radar BFR gain command has no effect and the gain is set to its maximum.

The radar displays return from the ground in 2 colors depending on the terrain altitude relative to the clearance height:

- Green below the clearance height
- Red at and above the clearance height.

In this mode, the radar display is oriented to follow the aircraft bearing. This means that the display is not oriented to where the aircraft is pointed to but where it's going.



1. RADAR MODE (*Mode radar*): When displaying DEC, indicates that the radar is in ground avoidance mode.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

2. RADAR ALTIMETER (*Hauteur radio-sonde*): Indicates the radar altitude of the aircraft.

   Displayed in green when the radar altitude is above the minimum altitude as set on the PCTH and red when below.

3. CLEARANCE HEIGHT DEPRESSION (*Dénivelé plan de garde*): Indicates the altitude difference bellow the aircraft at which the clearance height is set. Ranges from 0 to 5000 ft in 100 ft increments.

4. DEC GROUND RETURN (*Retour sol DEC*): The raw radar returns from the ground, colored depending on its altitude relative to the clearance height.

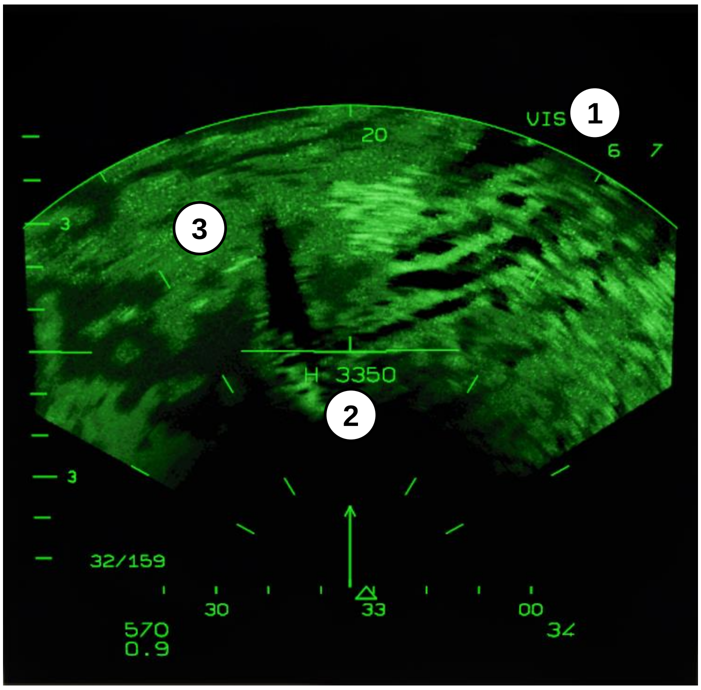
GROUND MAPPING

In ground mapping (VISU – *visualisation terrain*) mode the radar displays minimal symbology. In addition to the common symbology, only the azimuth aperture setting and position, elevation scale and antenna elevation are displayed.

In this mode the radar operates in BFR and the TDC is not available. The range can only be set to 10, 20 or 40 nm, the bar number to 2 or 1 and the azimuth aperture to 60° or 30°. The radar BFR gain command can be used to adjust the intensity of the radar image.

The radar displays return from the ground in shades of green depending on the return strength, the brighter the green the stronger the return.

In this mode, the radar display is oriented to follow the aircraft bearing. This means that the display is not oriented to where the aircraft is pointed to but where it's going. As a consequence, the aircraft vector is always pointing strait up.



1. RADAR MODE (*Mode radar*): When displaying VIS, indicates that the radar is in ground mapping mode.

   Flashes to indicate that the radar pre-heating sequence is still ongoing.

2. RADAR ALTIMETER (*Hauteur radio-sonde*): Indicates the radar altitude of the aircraft.

   Displayed in green when the radar altitude is above the minimum altitude as set on the PCTH and red when below.

3. VISU GROUND MAPPING (*Cartographie radar*): The raw radar returns from the ground, the brighter the green the stronger the return.

   The BFR radar gain knob can be used to adjust the intensity of the radar image.

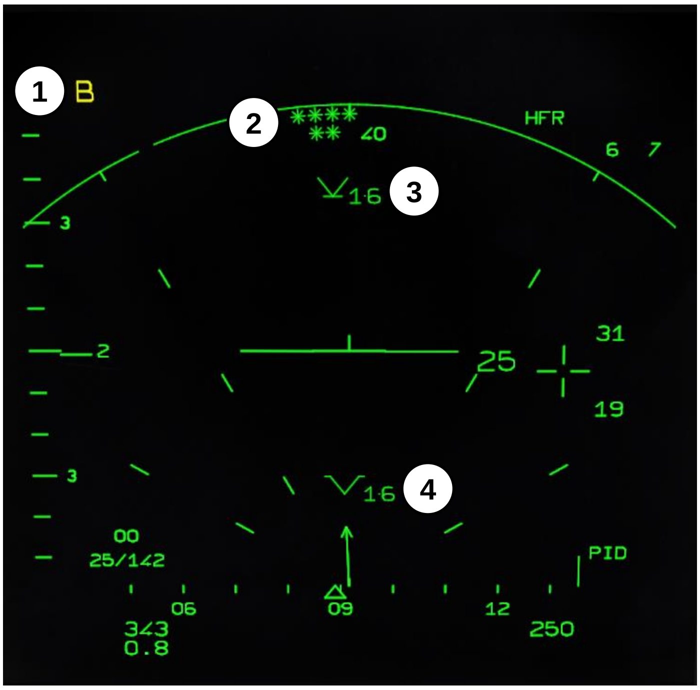
JAMMING SYMBOLOGY

While in bar search, the radar can encounter noise jammer that will try to confuse it by providing it with false contacts.

In HFR, the radar will detect that it is being jammed and reduce its sensitivity to lower its chance to display a false target from the jammer. It will also display the direction of the jamming signal as well as its strength.

Against the RDI radar, noise jamming is only effective until around 20-25 nm, at this range, the radar will burn-through the jam and will be able to detect the target. The radar might still display jam contacts and will still have its sensitivity reduced.

When the radar is in PSID the jamming behavior is the same as the jammer technique doesn't change.



1. JAM INDICATION (*Ambiance brouillié*): Indicates that the radar is detecting a jammer.
2. JAMMING AZIMUTH AND STRENGTH (*Gisement et force du brouillage*): The astrisks are positioned just bellow the range marker in the direction of the jammer.

   Up to 3 asterisks can be stacked vertically to indicate the strength of the jamming signal. Since the jamming signal is not a perfect beam, the asterisks will often be displayed in the shape of a pyramid.
3. REAL HFR CONTACT (*Plot HFR réel*): This HFR contact is the real contact detected by the radar.
4. JAM HFR CONTACT (*Plot HFR brouillé*): This HFR contact is a result of the noise jamming. Jam contact will only be displayed along the azimuth of the jammer and with the same closing speed. They can be distinguished from the real contact because they will be displayed intermittently and at different range.

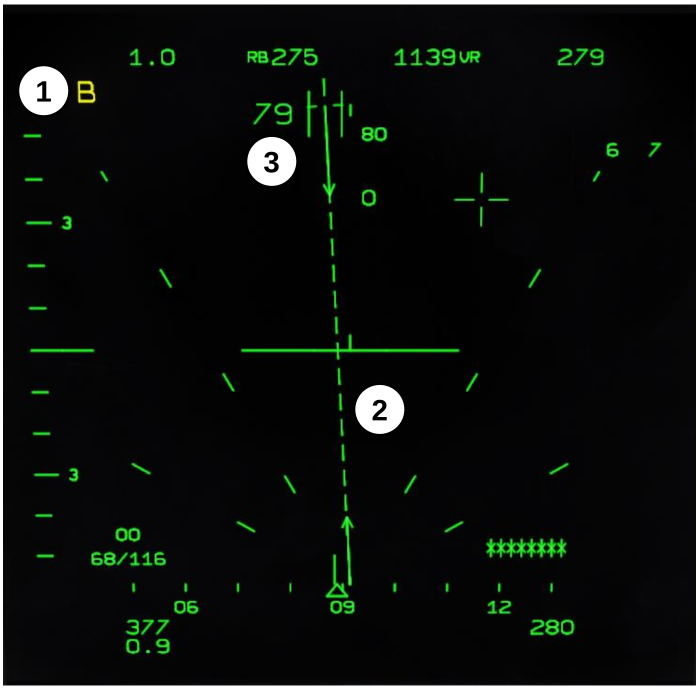
In BFR, the radar will continue to display the raw radar image including the noise coming from the jammer.

1. NOISE JAMMING (*Brouillage par bruit*): In BFR, jammers will produce noise in a small arc in the direction of the jammer. Contacts will be lost in the noise and most likely impossible to detect even at close range.

When tracking an aircraft in PSIC, its jammer will switch to range gate and velocity gate pull-off techniques. These techniques aim to confuse the radar ranging and velocity determination by sending false returns with a different closing speed or range.

When confronted to these jamming techniques, the radar will continue to track the target in azimuth and elevation but won't be able to provide a reliable range and altitude information. The tracked target symbol will move along the jammer azimuth, following the jamming signal.

This technique is also only effective until around 20-25 nm, at this range, the jammer signal is not strong enough to confuse the radar.



1. JAM INDICATION (*Ambiance brouillié*): Indicates that the radar is detecting a jammer.
2. JAMMED AIRCRAFT TARGET LINE (*Droite chasseur cible brouillée*): When the tracked target is jamming, the aircraft target line is dashed.
3. JAM TRACKED TARGET (*Plot poursuivi brouillé*): Will indicate the position of the jamming target according to the radar. If the radar is following the jamming signal, the tracked target will change its range and closing speed continuously and it will be impossible to determine the true range of the target.

B DISPLAY MODE PARTICULARITIES

WORK IN PROGRESS

REAR PRESENTATION

The rear presentation (*DO centrée*) display mode is selected by placing CADR switch (*cadrage* – presentation) located bellow the VTB screen on the AR (*arrière* – rear) position.

In this presentation mode, the aircraft is at the center of the VTB display pointing at the top of the display. The radar image and TDC and is not displayed in this mode.

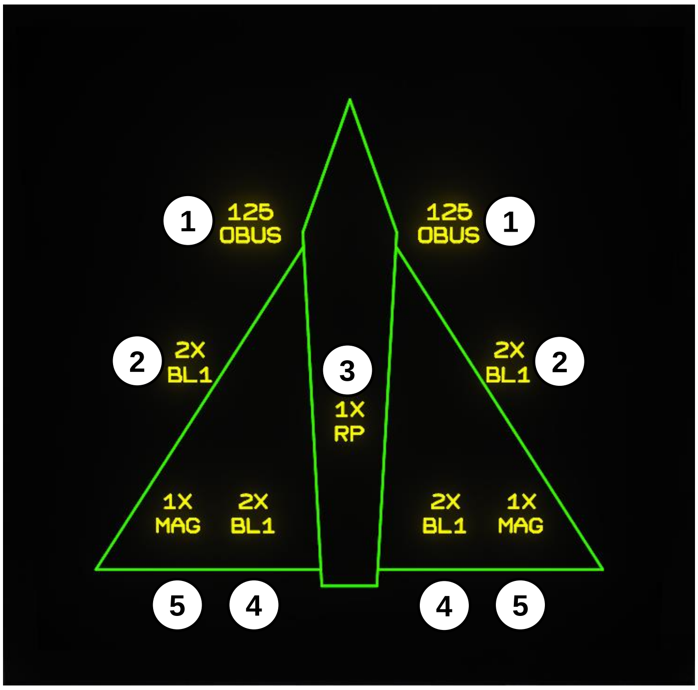
This mode main use is to visualize the position of the navigation and tactical BUT as well as the target designations when they are not in front of the aircraft.

STORES VISUALIZATION

The stores visualization screen (*visualisation des présences*) is displayed by maintaining the stores PPA light test and stores visualization switch (*Sélecteur de test touches et visualisation des présences*) in the PRES (*Présences* – Stores) position.

The VTB will then display the aircraft silhouette with the stores loaded on each hardpoint by type and quantity as well as the remaining gun ammunition. If a hardpoint is not loaded the reserved space is blank.

The stores are identified by the same code as on the PCA, for more information, see the WEAPONS LOADOUT CHART SUB-SECTION.



1. LEFT AND RIGHT GUN AMMO (*Obus restants canon gauche et droite*): The number of remaining shells or the left and right guns followed by the word *obus* (shells).
2. FRONT AND REAR SIDE HARDPOINTS (*Points d'emport latéraux avant et arrière*): Store quantity and type loaded on the front and rear side hardpoints.
3. FUSELAGE HARDPOINT (*Point d'emport fuselage*): Store quantity and type loaded on the fuselage hardpoint.
4. INTERNAL WING HARDPOINTS (*Points d'emport intérieur voilure*): Store quantity and type loaded on the internal wing hardpoints.
5. EXTERNAL WING HARDPOINTS (*Points d'emport extérieur voilure*): Store quantity and type loaded on the external wing hardpoints.

20 – 5 - HOTAS CONTROLS

INTRODUCTION

The Mirage 2000C radar is controlled through the PCR and HOTAS commands. The HOTAS commands the TDC position, antenna orientation and contact lock though the following commands:

STICK

- Weapon system command.
- PSIC toggle.
- NWS/IFF Interrogator.

THROTTLE

- Radar designator joystick.
- Antenna elevation control.

The radar allows different controls depending on the selected mode.

WEAPON SYSTEM COMMAND

The weapon system command (WSC - *commande temps réel SNA*) is a three-way switch (forward, depress and aft) that has multiple functions depending on the SNA mode.

SNA IN AIR-TO-AIR MODE

With an air-to-air weapon or police mode selected, the command set the radar into different close combat modes. The selected mode depends on the selected weapon/mode and the number of command presses:

- **Forward**:
  - Odd presses: Sets the radar in boresight auto-acquisition mode.
  - Even presses:
    - Air-to-air guns or MAGIC: Selects the vertical auto-acquisition mode.
    - 530 or Police mode: Selects the VTH auto-acquisition mode.
- **Depress**: Returns the radar to bar search mode, Active when the radar is in close combat mode, PSID, PSIC and SHB.
- **Aft**:
  - Odd presses: Sets the radar in horizontal BAH auto-acquisition mode.
  - Even presses: Sets the radar in horizontal BA2 auto-acquisition mode.

The selection of a close combat mode force radar emission.

When the radar is in PSIC Super 530, the WSC forward command is used to switch to PSIC S530 pointé mode. The command is inhibited for a few seconds after the missile is fired to prevent a manipulation error. The WSC aft command is disabled while the depress command is unchanged.

SNA IN AIR-TO-GROUND MODE

- **Forward**: Sets the SNA in air-to-ground selected mode, forces the radar to TAS mode if selected.
- **Depress**: No function.
- **Aft**: Each press will switch between the SNA pre-selected and memorized mode, returns the radar to the previous mode if it was forced in TAS mode.

For more information on the weapon system command function in air-to-ground mode, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

PSIC TOGGLE

The PSIC toggle (*fonction PSIC*) command has the same function as the PSIC button on the PCR:

- Radar in PSID or PSIC: Commands the radar to switch between PSID and PSIC mode unless the radar is in PSIC Super 530.
- Radar in bar search: Toggles the PSID/PSIC preselection.

NWS/IFF INTERROGATOR

The NWS/IFF interrogator (*DIRAV-sol/IFF-vol*) command starts the radar IFF interrogation sequence. The IFF interrogation is maintained as long as the command is pressed and last at least a complete scan pattern.

IFF interrogation is only available with the radar in standby, bar search, PSID, PSIC and SHB.

RADAR DESIGNATOR JOYSTICK

The radar designator joystick (*manipulateur alidade/accrochage radar*) is an analogue joystick with a click function.

JOYSTICK MOVEMENT

The joystick controls the movement of the radar TDC. The radar TDC is available in the following modes:

- Radar in standby mode
- Bar search
- BAH/BA2
- RRAS
- PSIC
- PSID
- SHB

While in standby mode, bar search BAH/BA2 and RRAS, the TDC also commands the radar search pattern position in azimuth. In standby and bar search, this is only possible when the selected radar azimuth setting is lower than 60°.

In standby and bar search, moving the TDC to the top or bottom of the screen and maintaining the movement for 0,2 second will change the radar range scale and move the TDC to the center of the screen.

In VISU mode, while the TDC is not present, maintaining the joystick in one direction fir 0,2 second will also change the radar range scale.

JOYSTICK DEPRESS

The joystick depress commands the radar to lock the closest contact to the TDC in the pre-selected PSIC or PSID mode.

This function is only available when the radar is in bar search.

This command is also used to switch the radar to RRAS mode. For this, the radar needs to be in bar search with the PRF selection switch in the ENT or BFR position. From there, the joystick needs to be depressed while the TDC is under 10 nm and not placed over a HFR contact.

ANTENNA ELEVATION CONTROLS

The antenna elevation controls (*manipulateur calage antenne*) is a two-way wheel with buttons on each side. It controls directly or indirectly the radar antenna elevation depending on the radar mode.

BAR SEARCH OR STANDBY MODE

The antenna elevation controls action depends on the antenna elevation type switch position on the PCR:

- **S** (*SITE*): The elevation command directly moves the antenna elevation relative to the horizon. The TDC searched altitude range symbology will display the maximum and minimum searched altitude at the position of the TDC.
  In this mode, the antenna will move up and down at 20°/s.
- **Z** (*ZBUT*): The elevation command sets the center of the searched altitude slice as displayed by the TDC mean altitude symbology. The radar sets the antenna elevation to match the selected mean altitude while the TDC is moved.
  In this mode, the center of the searched zone will move up and down at 10000 ft/s.

VISU MODE

The elevation command directly moves the antenna elevation relative to the horizon. The elevation of the antenna is represented by the antenna elevation indicator relative to the elevation scale.

In this mode, the antenna will move up and down at 5°/s.

DEC MODE

The antenna elevation controls set the clearance height for ground avoidance.

A short press of the elevation command will shift the clearance height by 100 ft, while a long press will shift the clearance height at 1000 ft/s.

BAH/BA2 MODES

In horizontal scan mode, the antenna command works the same way as in bar search S mode, the antenna elevation relative to the horizon is directly controlled by the commands.

In this mode, the antenna will move up and down at 5°/s.

RRAS MODE

In horizontal scan mode, the antenna command works the same way as in bar search S mode, the antenna elevation relative to the horizon is directly controlled by the commands.

In this mode, the antenna will move up and down at 5°/s.

21 - ELECTRONIC WARFARE

INTRODUCTION

The Mirage 2000C electronic warfare (EW) suite is highly integrated, all the systems communicate with each other to increase survivability and situational awareness.

The Mirage EW systems are:

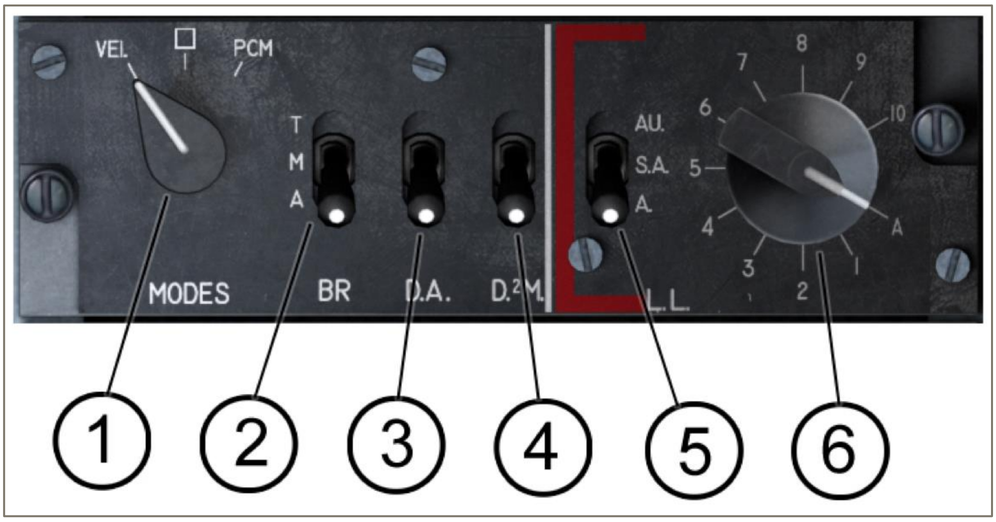
- SERVAL: Radar warning receiver.
- SPIRALE: Chaff and flare dispenser.
- SABRE: Defensive jammer.
- ÉCLAIR: Additional chaff and flare dispenser.
- D^{2}M: Missile launch warning system.

These systems are configured by a single panel, the countermeasure panel, located on the right console. The electronic, infrared and radar countermeasures employment is done via commands on the HOTAS or automatically by the aircraft.

21 – 1 - PCCM

The countermeasure panel (PCCM - *Poste de commande contre-mesure*) is divided into 2 sections:

- Left: Sensors and emitters power, status and test.
- Right: Decoy dispensers power and setup.



1. JAMMER OPERATION MODE SWITCH (*Sélecteur de mode d'opération brouilleur*):
   - **VEI.** (*Veille* – Standby): The jammer is in standby and records the radar emission.
   - **[ ]** (*Sélection HOTAS* – HOTAS command): The jammer is operated using the HOTAS jammer toggle switch.
   - **PCM** (*Priorité contre-mesures* – Countermeasure priority): The jammer operates all the time.
2. JAMMER POWER AND TEST SWITCH (BR – *Brouilleur*):
   - **A** (*Arrêt – OFF)*: The jammer system is not powered.
   - **M** (*Marche* – ON): The jammer is powered and operates in accordance with the operation mode switch position.
   - **T** (*Test*): Starts the jammer self-test. **NOT FUNCTIONAL**
3. DA POWER AND TEST SWITCH (D.A. – *Détecteur d'alerte*):
   - **A** (*Arrêt – OFF)*: The RWR is not powered.
   - **M** (*Marche* – ON): The RWR is powered and starts to display radar emitters.
   - **T** (*Test*): Starts the RWR self-test.
4. D2M POWER AND TEST SWITCH (D.^{2}M. – *Détecteur de départ missile*):
   - **A** (*Arrêt – OFF)*: The D^{2}M is not powered.
   - **M** (*Marche* – ON): The D^{2}M is powered and starts to watch for missile launches.
   - **T** (*Test*): Starts the D2M self-test.

5. DECOY DISPENSER OPERATION MODE SWITCH (L.L. – *Lance-leurres*):

- **A.** (*Arrêt* – OFF): The decoy dispenser system is not powered.
- **S.A.** (*Semi-automatique* - Semi-automatic): The decoy dispenser system is powered and the release of the selected program is done with the HOTAS countermeasure switch.
- **AU.** (*Automatique* – Automatic): The decoy dispenser system is powered and the release of the selected program is done automatically. NOT FUNCTIONAL

6. DECOY DISPENSER PROGRAM SELECTOR (*Sélecteur de programme lance-leurres*):

- **A** (*Arrêt* – OFF): No program selected, only the panic release is available if the operation mode switch is in the **S.A.** position.
- **1-10**: Manual selection of the release program.

21 – 2 - SERVAL

INTRODUCTION

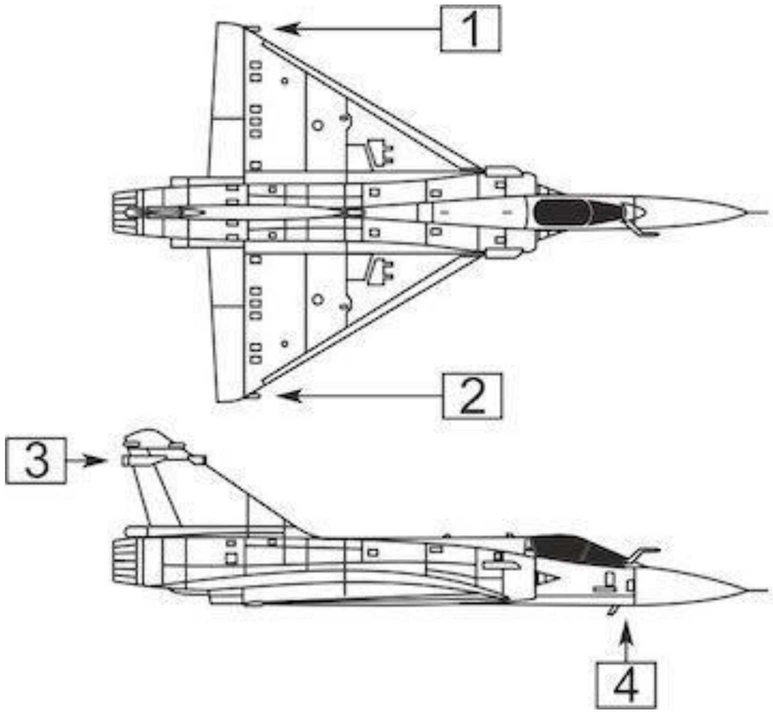
The Serval (*système d'ecoute radar et de visualisation de l'alerte*) is the name of the radar warning receiver (DA – *détecteur d'alerte*) system. The system is composed of 4 radar receiving antennas, a signal processor, and a display in the cockpit (VCM – *visualisation contre-mesure*). This detection system is passive, it uses signals emitted by other radar to classify and position air, land and sea emitters.

This system function is to detect, classify and display a picture of the electromagnetic environment of the aircraft. It will indicate the rough location of radar emitters, called threats, as well as their type. The Serval will also warn of radar locks as well as semi-active and active missile activity using audio warnings and specific symbology on the VCM.

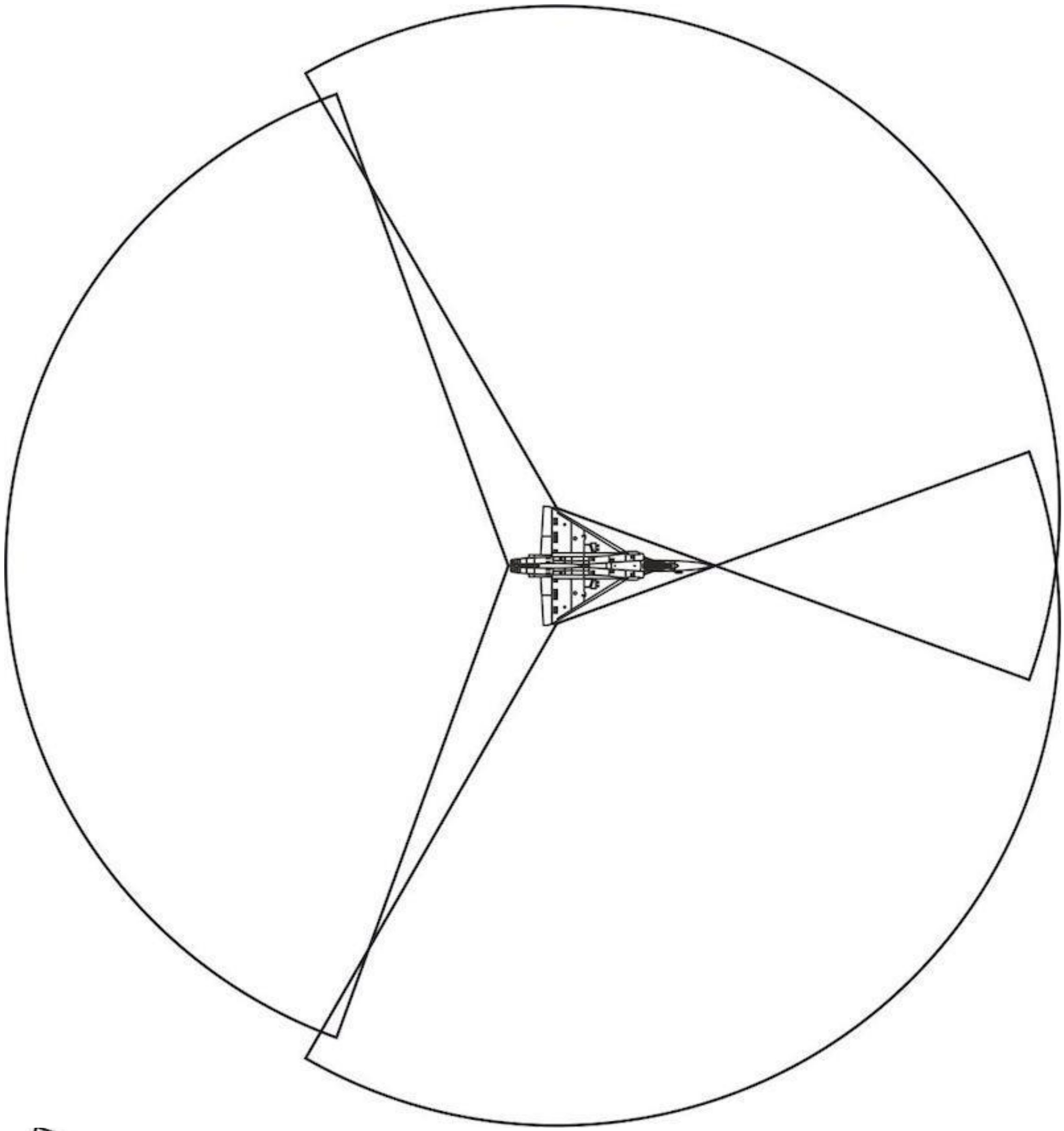
The VCM will also display the direction of the missiles launches detected by the D2M system accompanied by an audio warning.

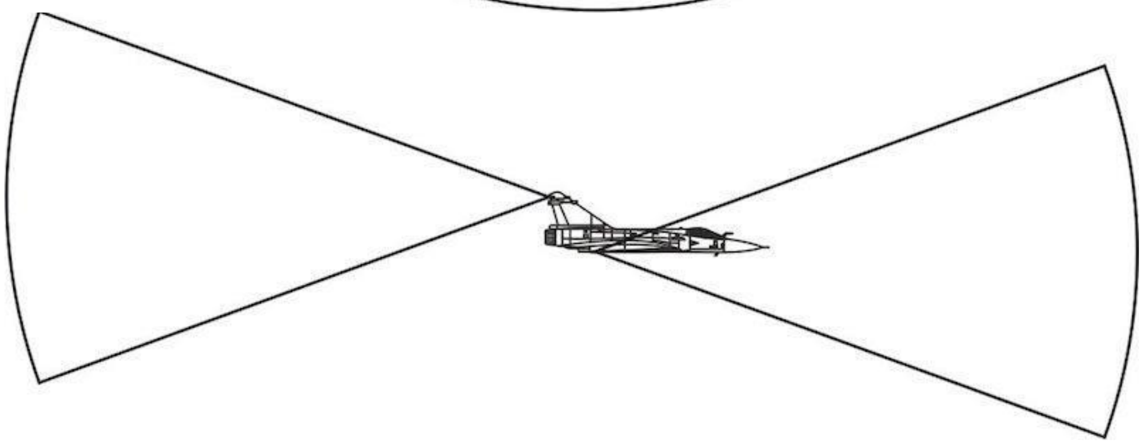
COVERAGE

The Serval system uses 4 antennas that provide a 360º horizontal and about ±20° vertical coverage.



1- Wing left sensor
2- Wing right sensor
3- Fin rear sensor
4- Onmidirectional sensor



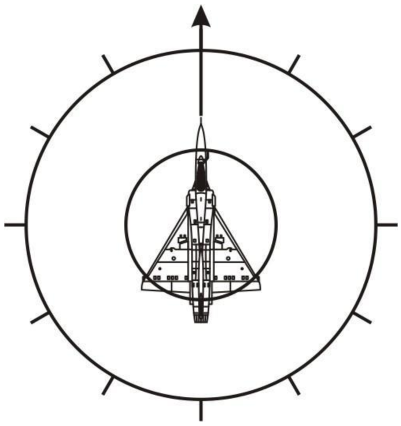


COUNTERMEASURE DISPLAY

The countermeasure display (VCM – *visualisation contre-mesure*) serves 2 purposes:

- Display the detected threats.
- Indicate the electronic warfare systems status.

The threat display is done by the circular display. The display is a top view of the aircraft's electromagnetic environment with the aircraft at its center and the top of the display representing the front of the aircraft.



Threats are displayed on the screen relative to their position in azimuth and the strength of their signal, the higher the closer to the center. This means that the display does not directly indicates the threat range, a strong emitter farther that a weaker emitter could still be displayed closer to the center of the display.

The displayed threats are classified by comparing the signal to a database and then displaying a symbol, number or letter corresponding to the classification.

New threats displayed on the VCM are accompanied by a 1 kHz signal chopped at 20 Hz for 500 ms. This sound is also used when a threat crosses into the high threat zone. NOT FUNCTIONAL

Radar locks are represented by an inverted chevron under the locking threat and are accompanied by the same sound as the new threat sound but continuously.

When the Serval detects a radar guided missile, it will display a chevron over the threat source, the firing aircraft in case of a semi-active missile and the missile in case of an active missile. This symbology is accompanied by a sound sequence composed of 2 new threats sound separated by 500 ms and repeating every 1000 ms.

1. THE LOW THREAT ZONE: Threats displayed in this zone are considered a low threat to the aircraft. This means that according to their type and signal strength, they are not able to employ weapons.
2. THE HIGH THREAT ZONE: Threats displayed in this zone are considered an immediate high threat to the aircraft. This placement can be because the threat has a radar lock, fired a missile or that according to their type and signal strength they are within weapon employment range.
3. OPERATION INDICATOR: The + indicates that the display is powered and operating normally.
4. BRIGHTNESS KNOB: Controls the VCM display brightness.

SUITE STATUS INDICATORS

1. SUIT STATUS INDICATORS: Indicates the status of the electronic warfare systems:
   - **V** (*Veille* – Intelligence gathering): Indicates that Sabre jamming system is powered and recording the aircraft's electromagnetic environment for ELINT purpose.
   - **BR** (*Brouillage* - Jamming): Indicates that the Sabre jammer is actively jamming.
   - **DA** (*Détecteur d'alerte* – Radar warning receiver): Indicates that the Serval system is powered and operating normally.
   - **D2M** (*Détecteur de dépat missile* - Missile launch warning system):
     - Steady, indicates that the D2M is powered and operating normally.
     - Blinking, indicates that the D2M is powered but that the sensors are not cooled yet. It can also indicate that the D2M system is not present, that the coolant is depleted or that the system is damaged.
   - **LL** (*Lance-leurres* – Decoy dispencer): Indicates that the Spirale and Éclair systems are powered and operating normally.

THREATS CLASSIFICATION

The Serval classification library allows the system to identify radar emitter based on the radar signal frequency, shape, PRF… and then display the threat type on the VCM.

Some threats like ships and bomber aircraft radars are regrouped under the same symbol to ease situational awareness.

SURFACE THREATS

SYMBOL	DESCRIPTION
A	Anti-aircraft artillery (AAA)
G	Flakpanzer Gepard
V	Vulcan
H	Hawk
P	Patriot
R	Roland
C	Early warning
Z	ZSU-23-4 Shilka
D	SA-13 Dog ear
K	P-19 Flate face B (SA-02/SA-03 search radar)
0	SA-10 Grumble/SA-12 Gladiator
1	SA-11 Gadfly
2	SA-02 Guideline (Fan song)
3	SA-03 Goa (Low blow)
5	SA-15 Gauntlet

6	SA-06 Gainful
8	SA-08 Gecko
9	SA-19 Grison

AIRBORNE THREATS

SYMBOL	DESCRIPTION
o	AWACS (E-2C, E3, A-50, KJ-2000)
4	F-4E
+	F-15C/F-15E
-	F/A-18C (APG-73)
*	F-16
●	F/A-18A (APG-65)
E	NATO Bomber/Subsonic attacker (S-3, A-6, B-1B, B-52)
F	NATO Supersonic attacker/Light fighter (F-5E, Tornado, AJS-37)
I	Mirage 2000C (RDI)
Q	JF-17
T	F-14 (AWG-9)
Y	Mirage 2000-5 (RDY)
↑	MiG-21 Fishbed
⎍	MiG-23 Flogger

⊥	Mig-25 Foxbat
	MiG-31 Foxhound
	Su-30 Flanker-C/Su-34 Fullback
B	Warsaw pact heavy bomber (Tu-22, Tu-95, Tu-142, Tu-160)
S	Su-27 Flanker/Su-33 Flanker-D/J-11 Flanker B+ (N001)
M	MiG-29A/S/G Fulcrum (N019)
X	Warsaw pact supersonic attacker (Su-17, Su-24)

OTHER THREATS

SYMBOL	DESCRIPTION
V	Radar lock (PSIC/STT)
^	Missile launch (Radar semi-active or active)
N	Ship
U	Unknown
W	Missile (Radar active)

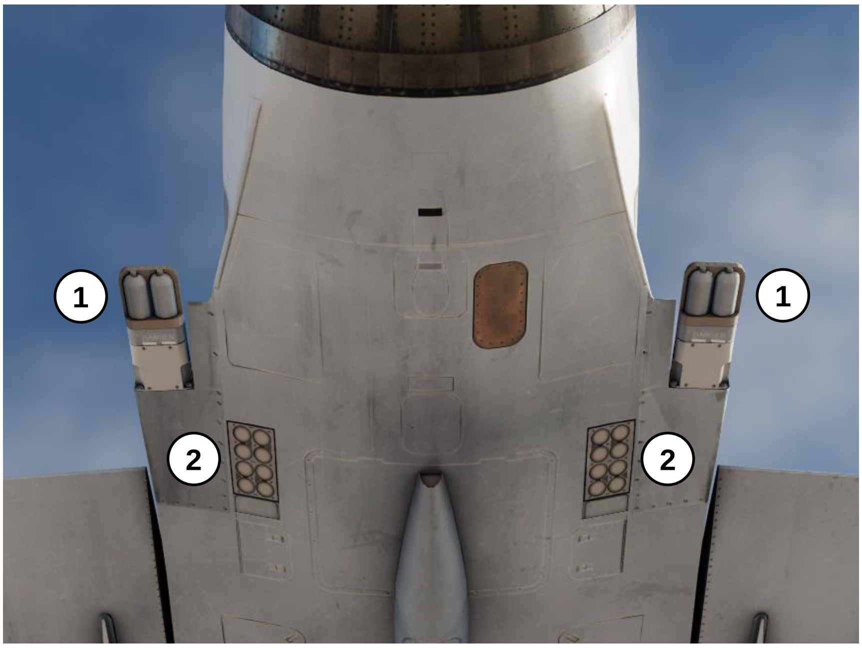
Active missile will always be displayed with the radar lock and missile launch symbology.

21 – 3 - SPIRALE

SPIRALE SYSTEM

The Spirale (*système de protection infrarouge et radar par leurrage*) system is composed of 2 chaff dispensers and 2 flare dispensers located at the rear of the aircraft. The dispensers are integrated into the airframe and add little to no drag.

The chaff and flare dispensers use incompatible storage and release methods, the countermeasure loadout of the aircraft is fixed and cannot be changed, only the Éclair pod can add countermeasures.



1. CHAFF DISPENSERS
2. FLARE DISPENSERS

CHAFF DISPENSERS

The chaff dispensers hold up to 120 aluminum coated glass fiber decoys called chaff. These chaffs are used to confuse radar systems by reflecting radar waves and creating false targets. The Spirale chaff dispensers work with the Sabre and Serval system to cut the chaffs to a specific length corresponding to the threat radar's wavelength.

FLARE DISPENSERS

The flare dispensers hold 16 infrared decoys called flares. These flares are used to confuse infrared system by providing another heat source to track and guide on.

DECOY LAUNCHER INDICATOR PANEL

The decoy launcher indicator panel (*tableau de signalisation lance-leurre*) indicates the status of the Spirale system and over the right glare. It indicates the release of countermeasure as well as the rough decoy quantity.

This panel is powered by the decoy dispenser operation mode switch on the PCCM. All the lights will turn on for 1 seconds when powered on to allow the pilot to check for malfunctions.

1. LL LIGHT (*Lance-leurres* – Decoy dispenser): The light briefly turns on whenever any decoy (flare or chaff) is released.
2. EM LIGHT (*Electromagnétique* - Electromagnetic):
   - Steady, indicates that the chaff dispensers are empty.
   - Blinking, indicates that chaff quantity is low (12 or less).
3. IR LIGHT (*Infrarouge* - Infrared):
   - Steady, indicates that the flare dispensers are empty.
   - Blinking, indicates that flare quantity is low (6 or less).
4. EO LIGHT (*Electro-optique* – Electro-optical): Reserve light for electro-optical decoys, not available for our aircraft. Will remain on at all time when the Spirale system is powered. NO FUNCTION
5. EFF. BUTTON: (*Effacer* – Remove): Turns off all the panel lights. Used to reduce glare when looking through NVG.

COUNTERMEASURE PROGRAMS

The countermeasures are released following a set program.

A program is decomposed in cycles themselves decomposed in a number of individual countermeasure release at set interval. The cycles can be repeated at a set interval.

PROGRAM	NAME	CHAFF	FLARE	INTERVAL	CYCLES	CYCLE INT.
1	BVR 1	6	0	0.5	1	-
2	BVR 2	6	0	0.5	2	2.0
3	BVR 3	6	0	0.5	3	2.0
4	CCM 1	0	1	-	1	-
5	CCM 2	1	1	-	1	-
6	SAM 1	12	0	0.75	1	-
7	SAM 2	20	0	0.25	1	-
8	IR SAME	0	6	0.25	1	-
9	AG Mix	20	6	0.25	1	-
10	Flare jettison	0	32	0.05	1	-
Panic	Panic	6	3	0.5	1	-

BVR 1 to **BVR 3** programs are to be used when engaging in BVR combat when expecting radar guided missiles. The 3 programs have the same cycle, the only difference is the number of cycles executed.

CCM 1 is to be used in close combat scenario where infrared missile are expected.

CCM 2 is to be used in close combat scenario where the expected missile type is unknown.

SAM 1 is to be used against older SAMs like the SA-02 or SA-06.

SAM 2 is to be used against newer SAMs like the SA-10 and higher.

IR SAM is to be used when flying at low altitude and expecting MANPAD of short-range IR guided SAMs.

AG Mix is to be used during the low altitude penetration of a well defended area, it combines the SAM 2 and IR SAM programs.

Flare Jett. dumps all the flares in a short-timed burst. Used in case of emergency, not suitable to defend against missiles.

PANIC is to be used when the missile threat is unexpected or unknown. It releases mix of chaff and flares to try and deal with the widest types of threats.

All the programs except the PANIC program can be edited.

HOTAS CONTROLS

The Mirage HOTAS has 2 countermeasure commands, one on the stick, one on the throttle. In order for them to work, the decoy dispenser operation mode switch on the PCCM has to be in the **S.A.** position.

The stick command is the countermeasure switch, it releases the program selected by the decoy dispenser program selector on the PCCM. If the program selector is in the **A** position, this command has no effect.

The throttle command is the PANIC pushbutton, it release the PANIC program.

21 – 4 - SABRE

SABRE SYSTEM

The Sabre (*système d'autoprotection par brouillage électromagnétique*) is a jamming and deception system. The system is composed of an emitter and 2 antennas all located in the tail-fin.

1. FORWARD ANTENNA. Sends the jamming signal in all directions around the aircraft. This induces that all aircraft around the jammer will receive the jamming signal.
2. EMITTER AND REAR ANTENNA. Generates the jamming signal and transmits to the antennas.

The Sabre system is highly sophisticated and provide defensive jamming against radar threats. The pilot has minimal control over the system as the way it operates is pre-programmed. Its main use is to protect the aircraft against active and semi-active radar guided missiles by reducing the lock range and confusing the missile or missile supporting system radar.

HOTAS CONTROLS

The Mirage HOTAS has 1 electronic countermeasure command, the jammer toggle switch, located on the throttle. This command toggles the emission of the jammer if the jammer operation mode switch is in the **[ ]** (HOTAS command) position.

If the jammer operation mode is in the PCM position, the jammer is always emitting.

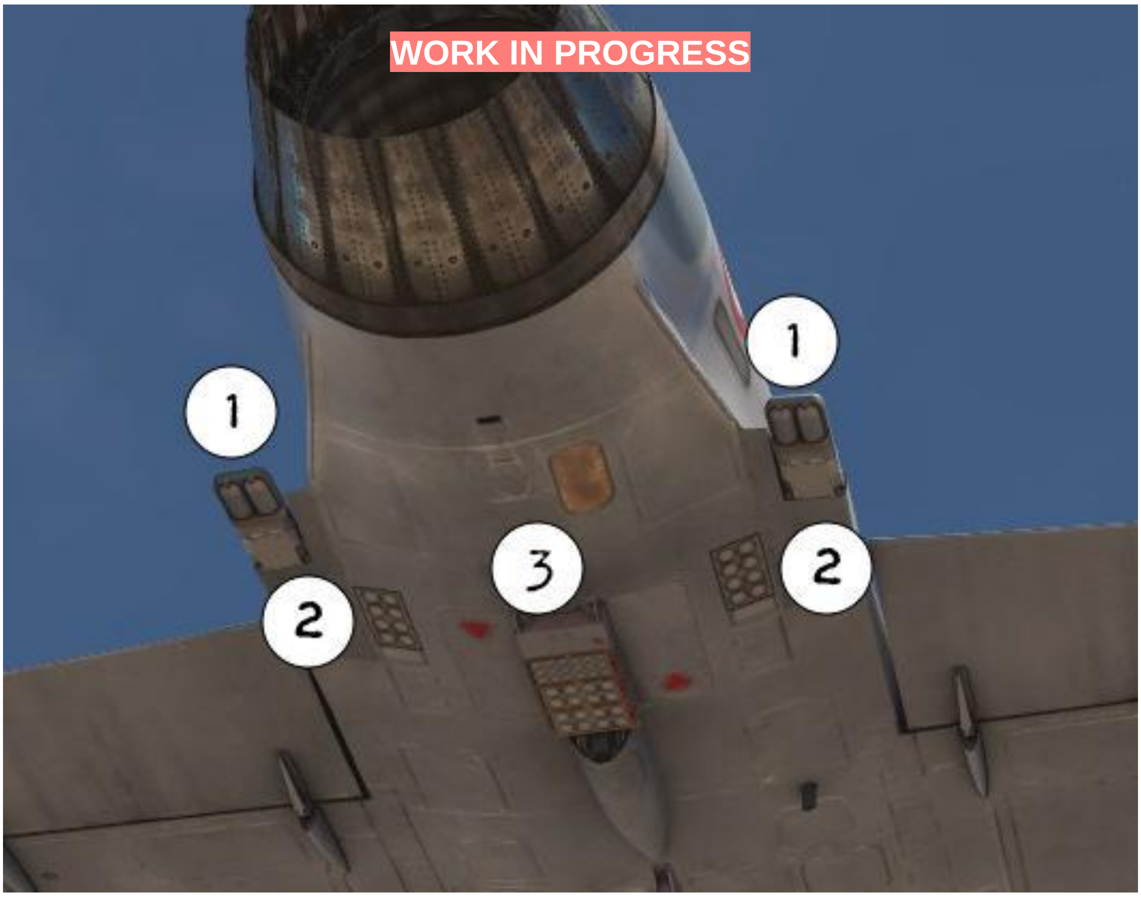
WARNING

Jammer are a formidable tool to improve survivability during combat, but the radar waves emitted by the system can be detected by other system and even be used as guidance by missiles. Use this system with precaution.

21 – 5 - ÉCLAIR

The Éclair pod is an addon countermeasure dispenser that is attached in place of the drag chute. The pod is composed of 3 countermeasure racks, 2 flares racks containing 8 cartridges and 1 chaff rack containing 16 cartridges. Its configuration is not editable, the flare and chaff capacity is fixed at 16 each.

This addon is directly integrated with the Spirale system and does on require any special configuration from the cockpit.

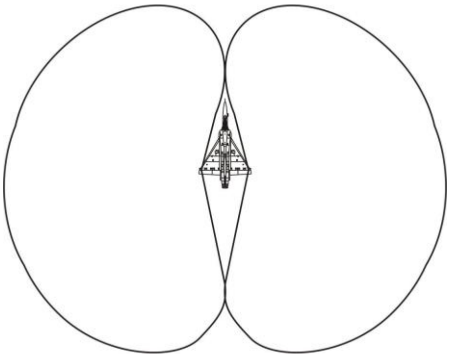


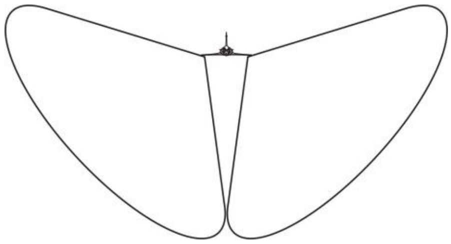
1. ÉCLAIR POD

WARNING	It is important to remember that the Éclair pod replaces the drag chute. This needs to be considered when selecting main and divert landing airbase and calculating maximum landing weight.

21 – 6 - D²M

The D²M (*détecteur de départ missile*) is an optional missile launch warning system. The system is composed of 2 ultraviolet sensors located in an addon fairing at the back of the MAGIC II pylon. The system is dedicated to MANPAD and short-range IR SAM launch detection, the sensors only cover the area below the aircraft.





The D²M uses the ultraviolet light emitted by rocket motors to detect missiles, this means that for the system to detect a missile, its engine needs to be burning. It will detect any burning rocket motor at close range and cannot determine if a missile is aimed at the aircraft or not. This means that friendly missiles shot close might be detected and trigger the system.

The system sensors are cooled by using the MAGIC II liquid nitrogen. The D²M system consumption is about the same as the missiles, this means that when both the MAGIC II and the D²M are cooled, the coolant lasts half as long as if only the MAGIC II was cooled.

When turned on, the D2M starts a cooling sequence that lasts about 45 seconds and is indicated by the blinking **D.²M.** light on the suite status indicator. During this time the system is not operational.

1. D²M SENSOR

When the D²M detects a burning rocket motor, the VCM will display a line from its center to the direction of the detected threat. It is accompanied by a continuous 3 kHz signal.

22 - AIRCRAFT EMPLOYMENT

INTRODUCTION

This section is dedicated to the employment of the Mirage 2000C systems and instruments for navigation, take-off, landing and ground operations.

The Mirage 2000C is an all-weather aircraft capable of autonomous and radio navigation. The VTH is the main navigation instrument meaning that it can be relied upon for IFR navigation. It is backed up by analogic instruments that provide additional information for VFR or IFR flight.

22 – 1 - GROUND OPERATIONS

INTRODUCTION

The aircraft ground operations englobe the ramp-start and shutdown procedure.

Once strapped into the cockpit, the pilot should execute a quick pre-flight check of the controls before doing anything, even before applying power.

After the pre-flight check is done, the ramp start can be done in 2 ways:

- With ground power
- Without ground power

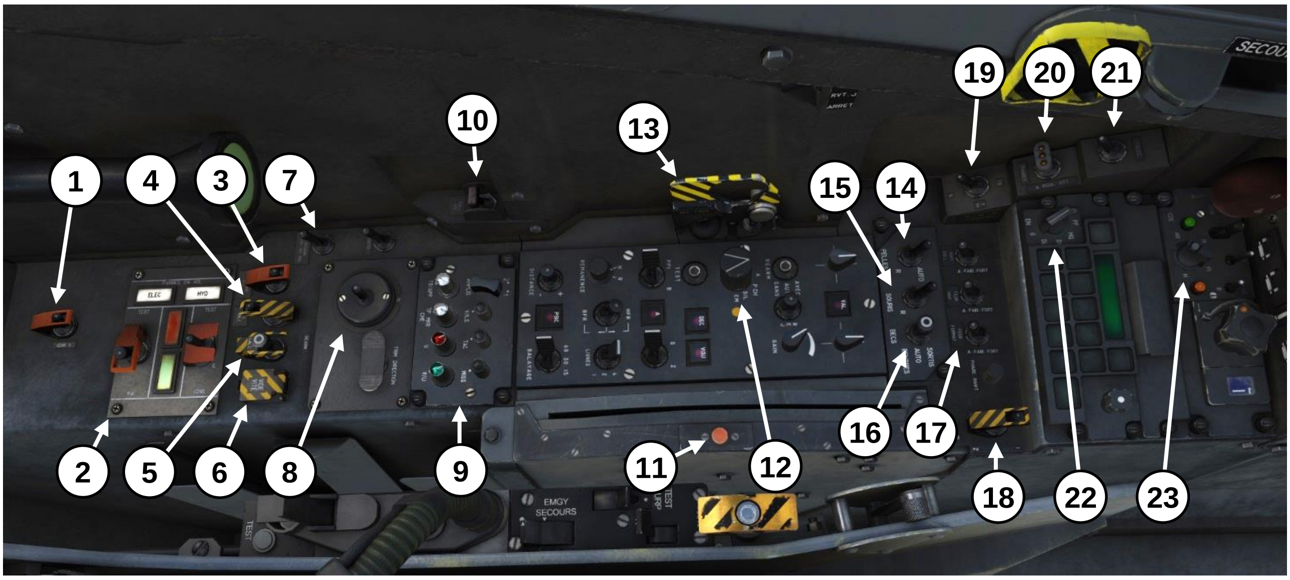
Using the ground power is preferred as it will reduce the draw on the battery and allow the INS to be aligned with the engine off, which will save fuel.

PRE-FLIGHT

The pre-flight check starts at left console, then the left wall, left vertical panel, front dash, center pylon, right vertical panel, right wall and right console.

NOTE	In DCS, the pre-flight check can be skipped as the aircraft is always set correctly for the ramp-start.

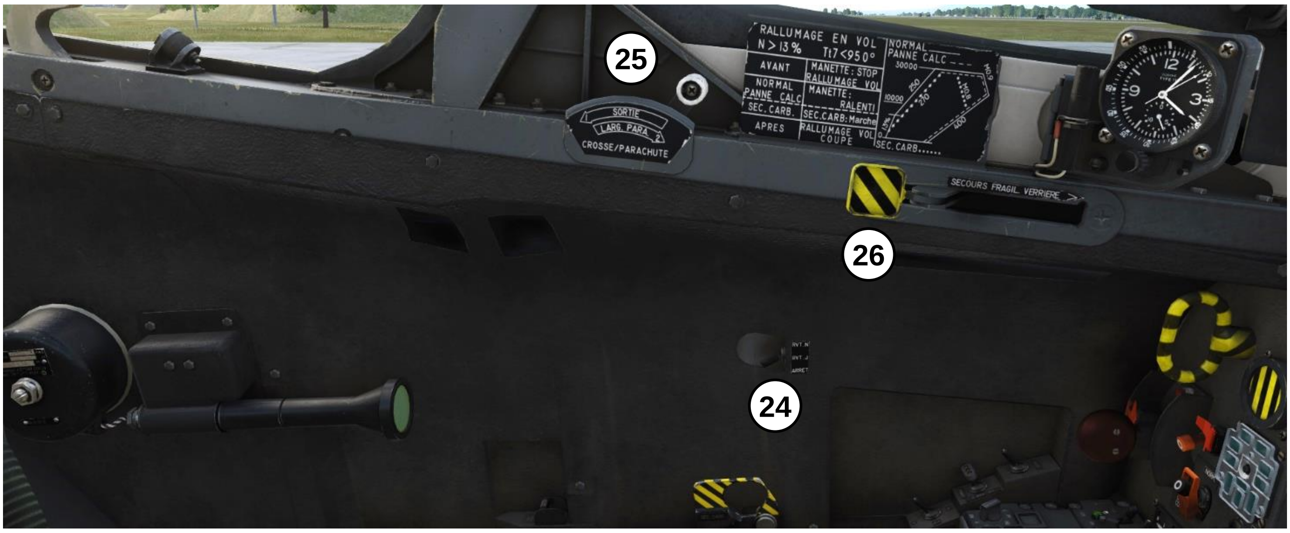
LEFT CONSOLE



1. FBW CHANNEL 5 SWITCH: Off (cover closed)
2. FBW AND AP TEST SWITCHES: Off (cover closed)
3. EMERGENCY AFTERBURNER CUTOFF SWITCH: Off (cover closed)
4. EMERGENCY OIL SWITCH: Off (cover closed)
5. ENGINE COMPUTER RE-ARMING AND EMERGENCY SWITCH: Norm (cover closed)
6. EXTERNAL FUEL TANK DUMP SWITCH: Cover closed
7. RADAR GROUND EMISSION SWITCH: Off
8. EMERGENCY TRIM: N
9. AIRCRAFT SOUND CONFIGURATION PANEL: As desired
10. INFLIGHT RESTART MAGNETIC SWITCH: Off
11. THROTTLE: Stop position
12. RADAR POWER MODE KNOB: A
13. EMERGENCY FUEL SWITCH: Off
14. SWOOPS OPERATION SWITCH: Auto
15. INLET CONES OPERATION SWITCH: Auto
16. SLATS POSITION SWITCH: Auto

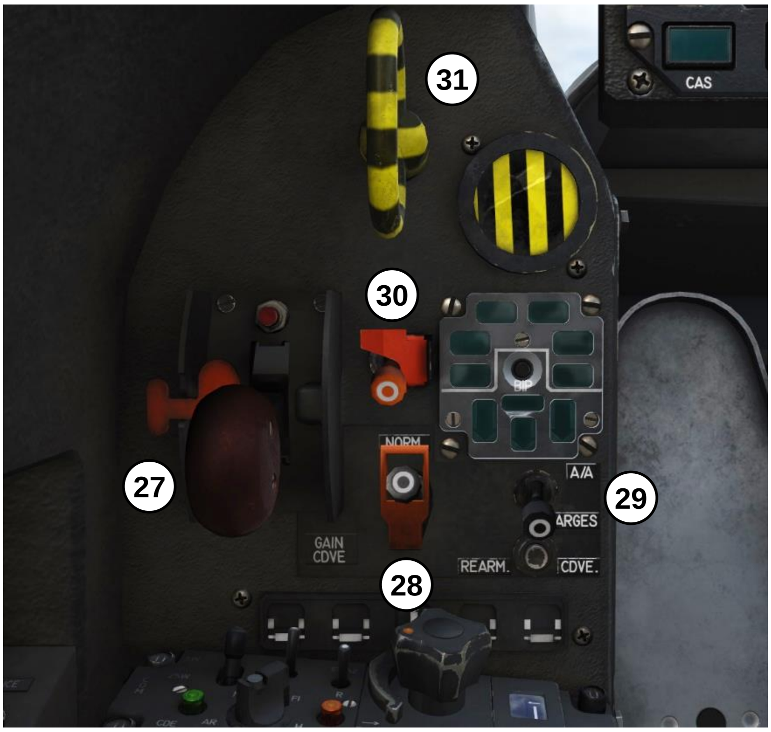
17. EXTERNAL LIGHT SWITCHES: A
18. BRAKE SYSTEM SWITCH: 1 (cover closed)
19. RECORDER SWITCH: A
20. LANDING AND TAXI LIGHT SWITCH: A
21. POLICE LIGHT SWITCH: Off
22. V/UHF RADIO OPERATION MODE SWITCH: 0
23. UHF RADIO OPERATION MODE SWITCH: AR

LEFT WALL



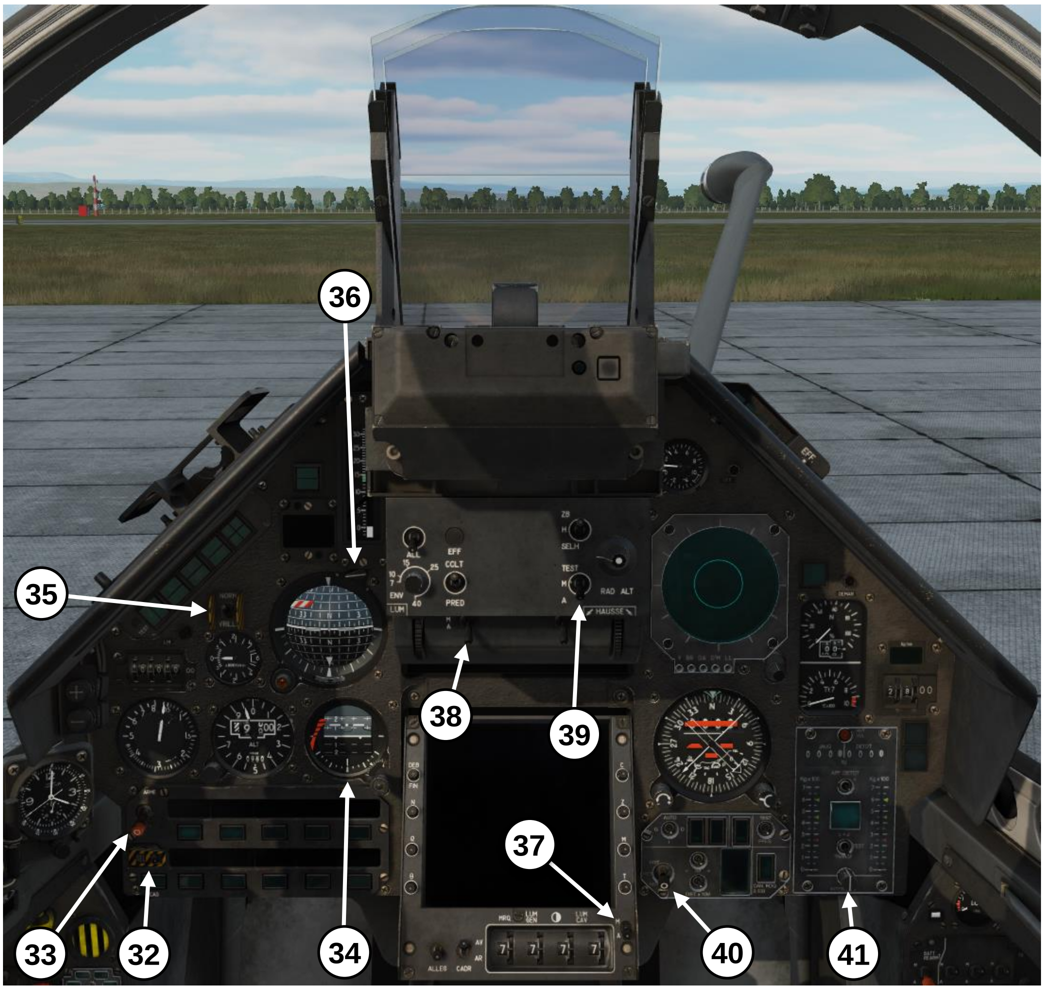
24. INFLIGHT REFUELING SWITCH: Arrêt
25. BRAKE CHUTE LEVER: Forward
26. CANOPY FRACTURE LEVER: Rearward

LEFT VERTICAL PANEL



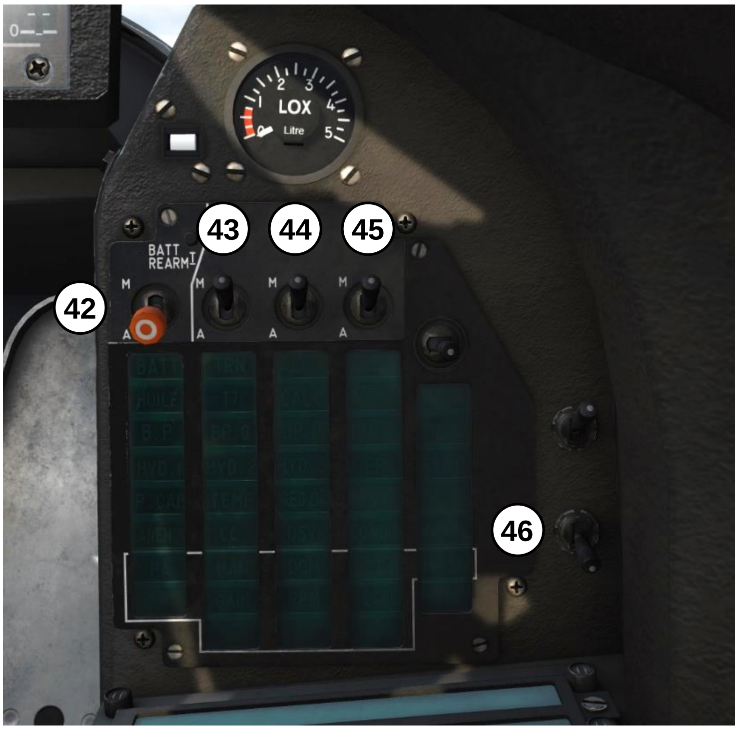
27. GEAR HANDLE: Down
28. EMERGENCY FBW GAIN SWITCH: Norm (cover closed)
29. FBW MODE SWITCH: As desired
30. GUN SAFETY SWITCH: Safe (cover closed)
31. EMERGENCY GEAR HANDLE: Normal (vertical position)

FRONT DASH



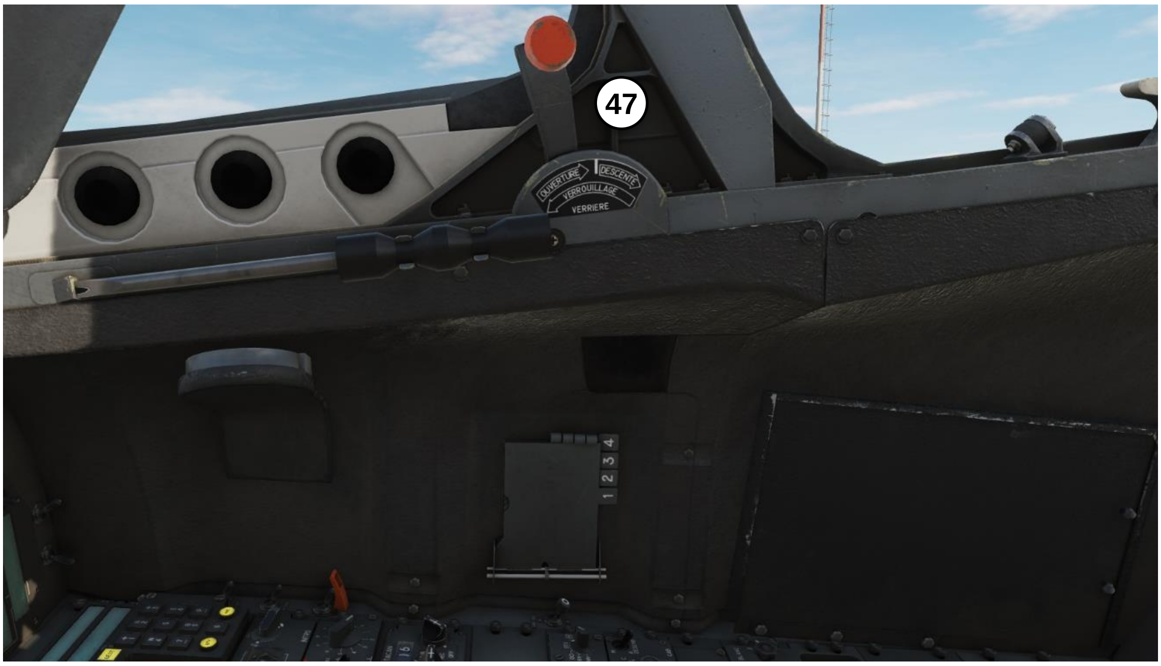
32. SELECTIVE JETTISON SWITCH: Off (cover closed)
33. MASTER ARM SWITCH: Off
34. BACKUP ATTITUDE INDICATOR: Caged
35. SPIN SWITCH: Norm
36. MAIN ATTITUDE INDICATOR POLE SWITCH: N
37. VTB POWER SWITCH: A
38. VTH POWER SWITCH: A
39. PCTH RADAR ALTIMETER SWITCH: A
40. PPA FUSE SWITCH: INERT.
41. FEEDER TANKS INTERCOM CONTROL: Closed (vertical)

RIGHT VERTICAL PANEL



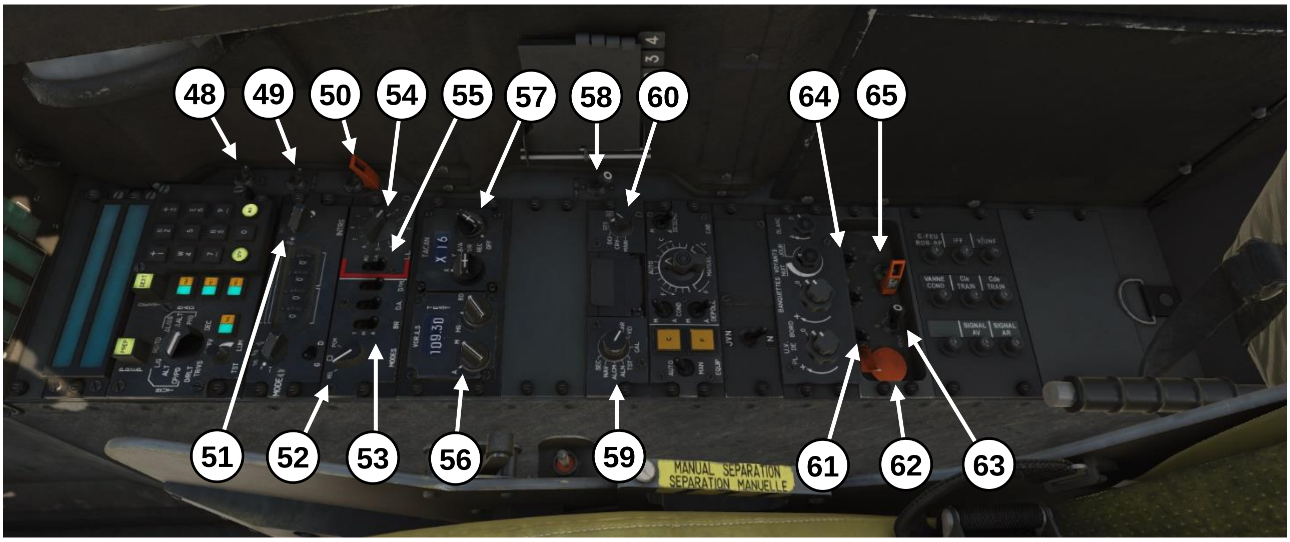
42. BATTERY SWITCH: A
43. TRANSFORMER-RECTIFIER SWITCH: M
44. ALTERNATOR 1 SWITCH: M
45. ALTERNATOR 2 SWITCH: M
46. QRA SWITCH: Off

RIGHT WALL



47. CANOPY LEVER: Open (middle position)

RIGHT CONSOLE

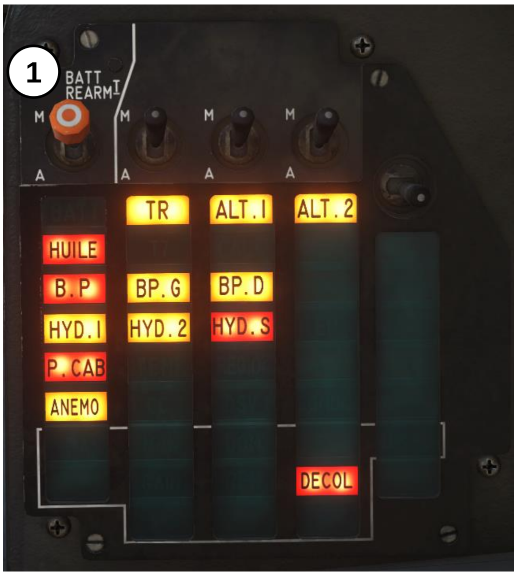


48. ELECTRIC PUMP SWITCH: Off
49. WARNING SOUND SWITCH: Off
50. PITOT HEAT SWITCH: Off (cover open)
51. IFF INTERROGATION MODE SELECTOR: Off
52. JAMMER OPERATION MODE SWITCH: VEI.
53. COUNTERMEASURE POWER AND TEST SWITCHES: A
54. DECOY DISPENSER PROGRAM SELECTOR: A
55. DECOY DISPENSER OPERATION MODE SWITCH: A.
56. VOR POWER SWITCH: A
57. TACAN MODE SWITCH: OFF
58. EMERGENCY ATTITUDE AND HEADING SWITCH: A
59. PSM MODE SELECTOR KNOB: AR
60. PSM OPERATIONAL MODE SELECTOR KNOB: N
61. STARTER FUEL PUMP SWITCH: Off (left)
62. STARTER BUTTON COVER: Closed
63. IGNITION/VENTILATION SWITCH: G or D
64. BOOST FUEL PUMP SWITCHES: Off (left)
65. FUEL SHUT-OFF VALVE SWITCH: Closed (left and cover open)

RAMP-START WITH GROUND POWER

For the ramp-start with ground power, the INS will be aligned using a normal alignment.

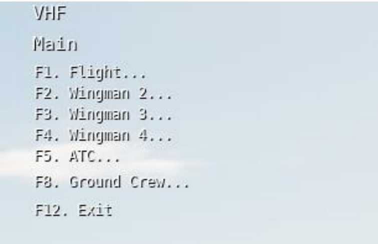
1. Set the battery switch to the **M** position.

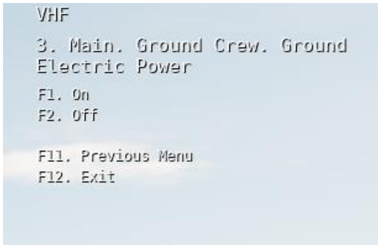


2. Turn on the V/UHF by setting its operation mode switch to the **FF** position.
3. Turn on the UHF by setting its operation mode switch to the **M** position.

4. Set the navigation lights switch to the **FORT** position.

5. Connect the ground power.





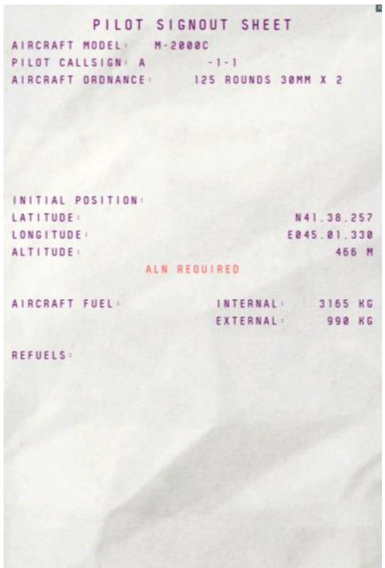
6. Start the normal alignment.

a. Set the PSM mode selector to the **VEI** position.

b. Insert the aircraft coordinates in a BUT.

NOTE	Any BUT (except BUT 00) can be used for alignment but the most convenient one would be the BUT 20, as 20 waypoint flight plan is seldom used.

c. Select the BUT with the aircraft coordinates as the PREP BUT.



d. Set the PSM mode selector to the **ALN** position.

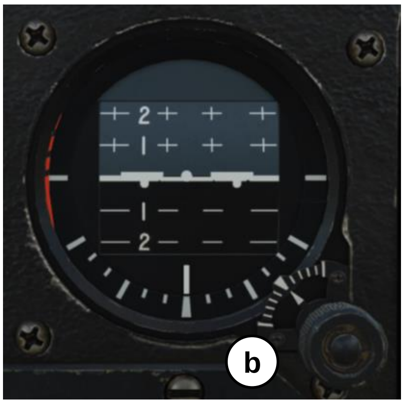
e. Press the VAL function key.

f. The status of the alignmentcan be displayed on the PCN by placing the PSM operational mode selector know in the **STS** position.

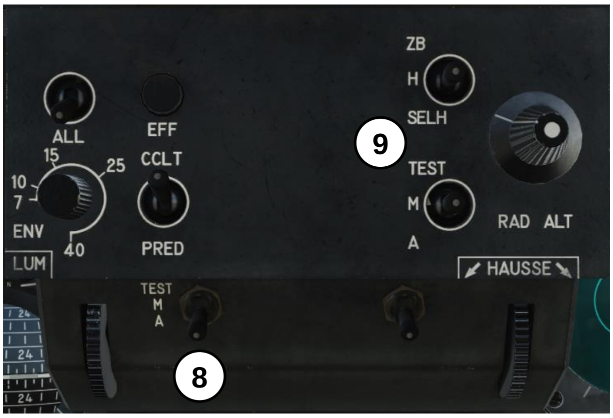
7. Turn on and uncage the back-up attitude indicator.

   a. Set the Emergency attitude and heading switch to the **AUTO** position.

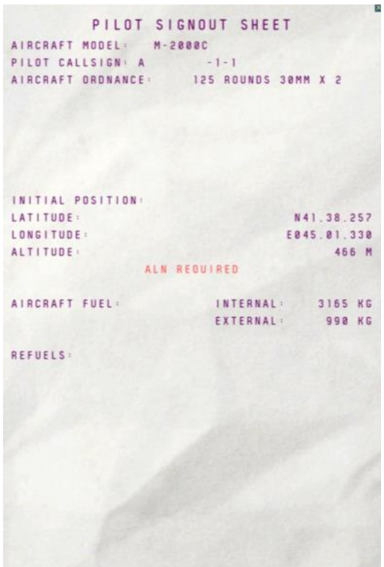
   b. Uncage and set the back-up attitude indicator using the cage/aircraft symbol adjustment knob.



8. Turn on the VTH by setting the VTH power switch to the **M** position.
9. Turn on the radar altimeter by setting the radar altimeter switch to the **M** position. Set the altitude display selector switch as desired.
10. Turn on the VTB by setting the VTB power switch to the **M** position.



11. Check and set the DETOT fuel amount counter to the value displayed on the kneeboard pilot signout sheet page using the AFF DETOT switch.

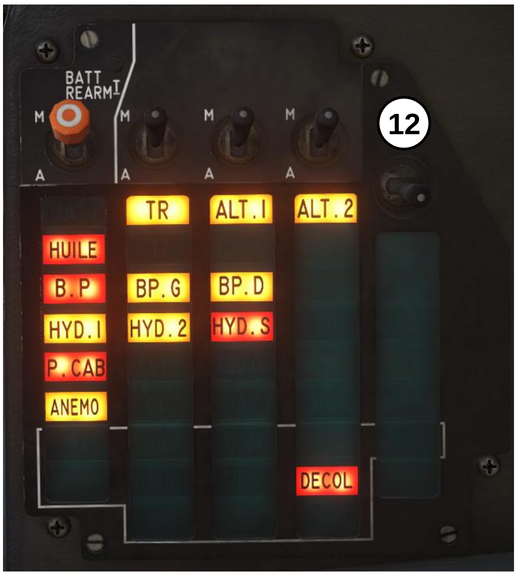

PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2

INITIAL POSITION:
LATITUDE: N41.38.257
LONGITUDE: E045.01.330
ALTITUDE: 466 M
ALN REQUIRED

AIRCRAFT FUEL: INTERNAL: 3165 KG
EXTERNAL: 990 KG

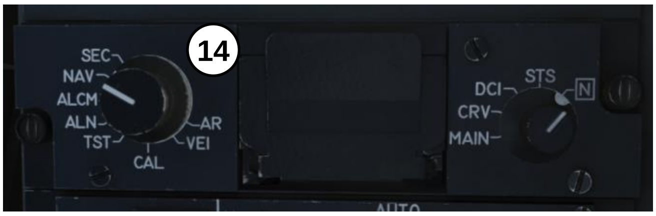
REFUELS:

12. Test the cockpit lights by setting the lights test switch to the **1** and **2** position.



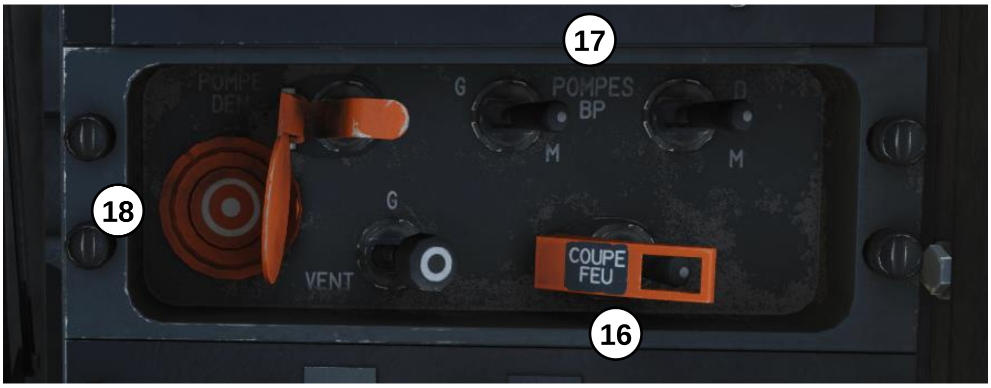
13. Set the electric pump switch to **TEST** then to **A** position.

14. Wait until the alignment is complete (steady green *PRET* light on the PCN) and set the PSM mode selector to **NAV**.



15. Close and secure the canopy using the canopy lever (backward then forward).

16. Set fuel shut-off valve switch to the open position and close the cover.
17. Set the 2 boost fuel pumps switches to the **M** position.
18. Open the starter button cover, this will set the starter fuel pump switch to on.



19. Press and hold the starter button for 1 second.

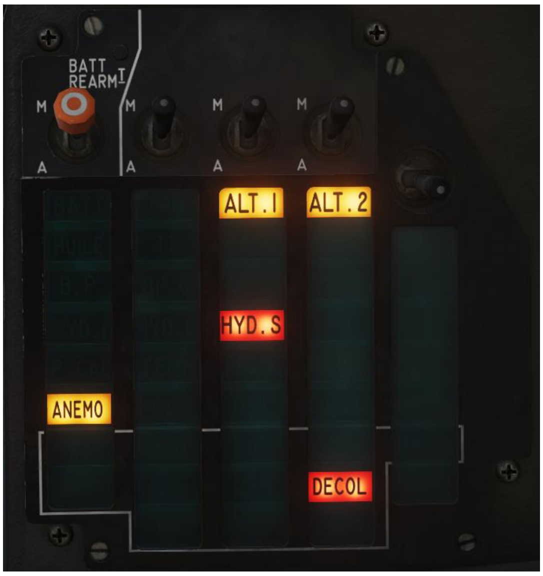
    Close the starter button cover, leave the starter fuel pump switch to on.

20. Once the engine RPM reaches 10%, set the throttle to the idle position.

    Watch that the engine Tt7 temperature stays below 950°C.

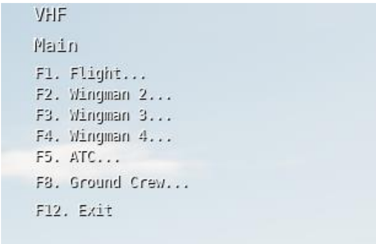
    If the engine Tt7 exceed 950°C, abort the start-up by setting the starter fuel switch to off (left) and setting the throttle to the cutoff position by using the engine cutoff button.

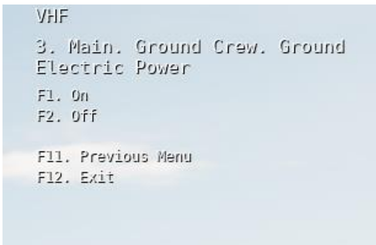
21. Once the engine PRM reaches around 48%, check that both the **HUILE** and **T7** warning lights turns off.
22. Check that the **HYD.1** and **HYD.2** caution lights are off.

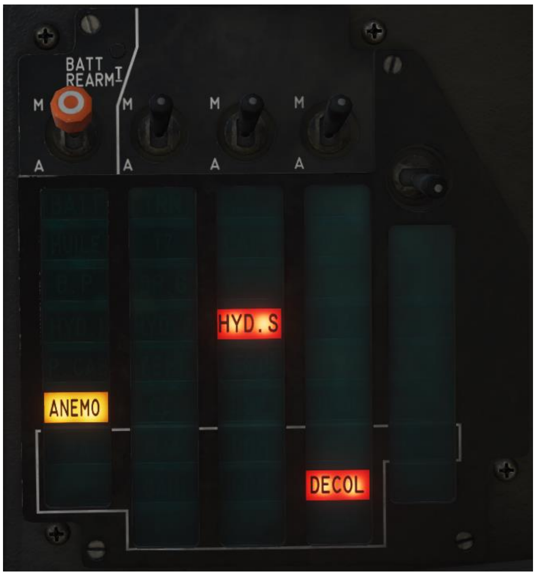


23. Disconnect the ground power.

Check that the **ALT.1** and **ALT.2** caution lights are off.

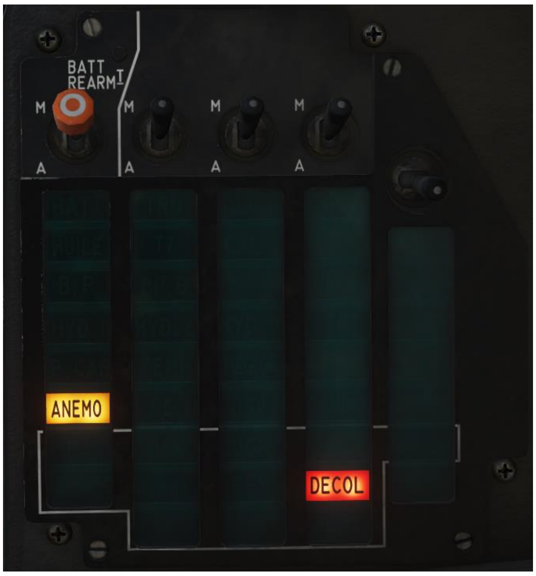






24. Set the emergency pump switch to the **AUTO** position.

Check that the **HYDS** warning light is off.

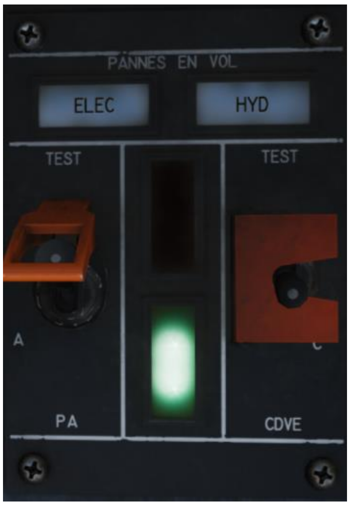


25. Set the IFF master mode knob to the **SBY** position.

26. Set the radar power mode knob to the **SIL** position.

27. Start the short CDVE (down) test, wait for the green light to turn on to indicate that the test has passed.

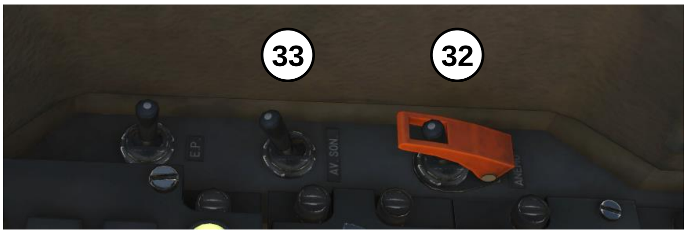
    Do the same for the PA test.



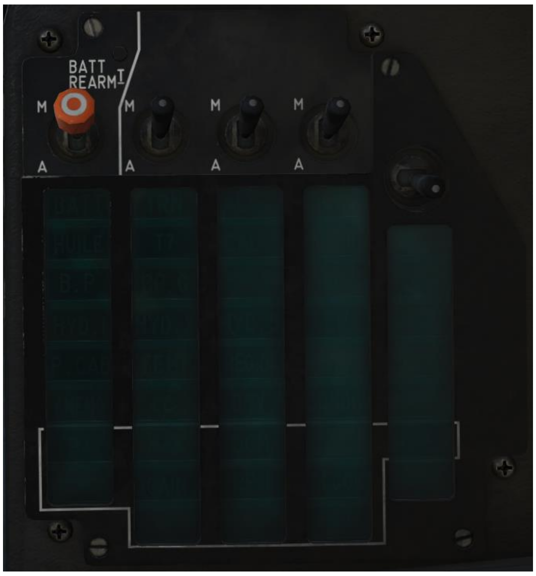
28. Set the anti-collision light switch to the **FORT** position and set the formation light switch as desired.

29. Wipe the controls.
30. Test the air-brakes using the HOTAS command and checking the configuration panel.
31. Test the slats by setting the slat switch to the **SORTIS** position, then the **AUTO** position.

32. Set the pitot heat switch to the on position and close the cover.
33. Set the warning sound switch to the on position.



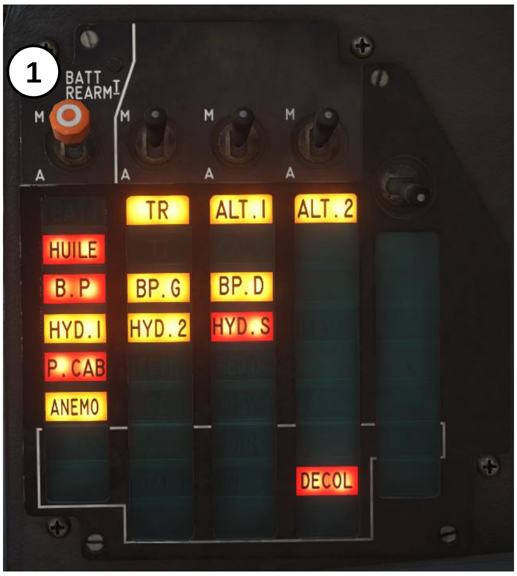
34. Check that all caution and warning lights on the alarm panel are off.



RAMP-START WITHOUT GROUND POWER

For the ramp-start without ground power, the INS will be aligned using a stored heading alignment.

1. Set the battery switch to the **M** position.

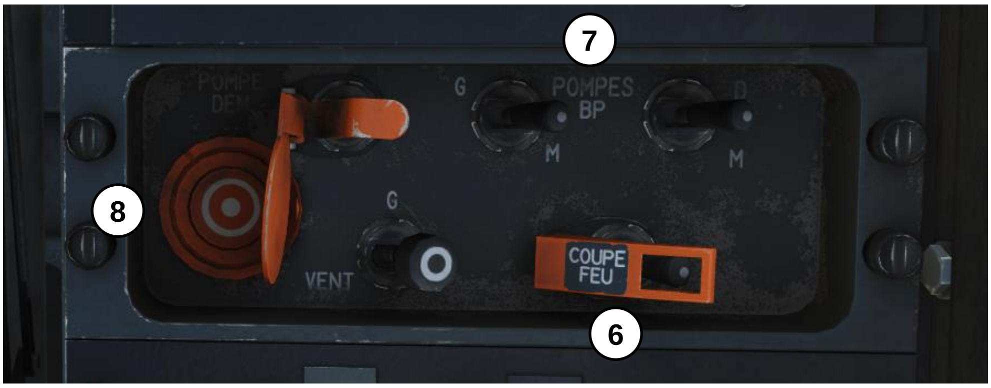


2. Turn on the V/UHF by setting its operation mode switch to the **FF** position.
3. Turn on the UHF by setting its operation mode switch to the **M** position.

4. Set the navigation lights switch to the **FORT** position.

5. Close and secure the canopy using the canopy lever (backward then forward).

6. Set fuel shut-off valve switch to the open position and close the cover.
7. Set the 2 boost fuel pumps switches to the **M** position.
8. Open the starter button cover, this will set the starter fuel pump switch to on.



9. Press and hold the starter button for 1 second.

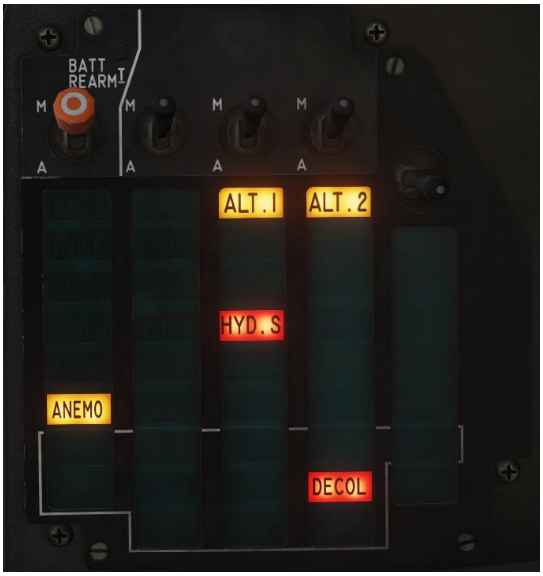
   Close the starter button cover, leave the starter fuel pump switch to on.

10. Once the engine RPM reaches 10%, set the throttle to the idle position.

    Watch that the engine Tt7 temperature stays below 950°C.

    If the engine Tt7 exceed 950°C, abort the start-up by setting the starter fuel switch to off (left) and setting the throttle to the cutoff position by using the engine cutoff button.

11. Once the engine PRM reaches around 48%, check that both the **HUILE** and **T7** warning lights turns off.
12. Check that the **HYD.1** and **HYD.2** caution lights are off.



13. Start the alignment.

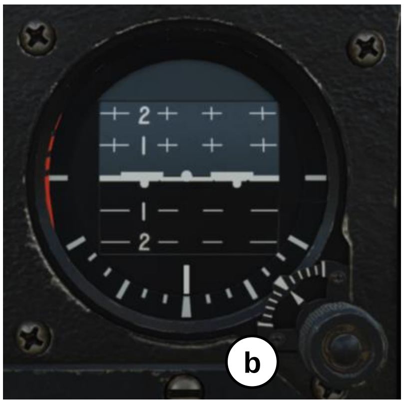
a. Set the PSM mode selector to the **ALCM** position.

b. Select the BUT 00 as the PREP BUT.

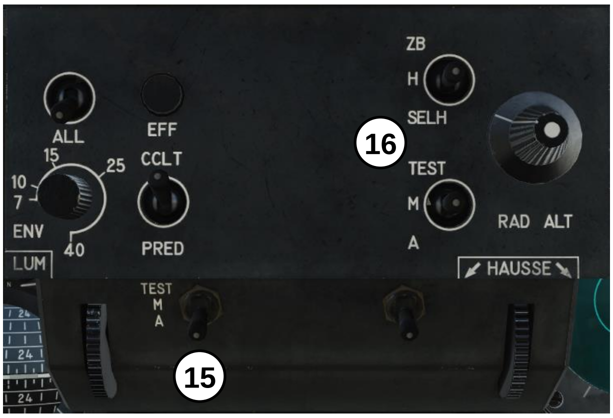
c. Press the VAL function key.

d. The status of the alignment can be displayed on the PCN by placing the PSM operational mode selector know in the **STS** position.

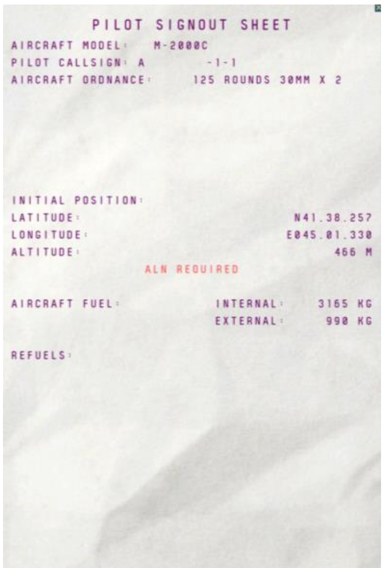
14. Turn on and uncage the back-up attitude indicator.
    a. Set the Emergency attitude and heading switch to the **AUTO** position.
    b. Uncage and set the back-up attitude indicator using the cage/aircraft symbol adjustment knob.



15. Turn on the VTH by setting the VTH power switch to the **M** position.
16. Turn on the radar altimeter by setting the radar altimeter switch to the **M** position.
    Set the altitude display selector switch as desired.
17. Turn on the VTB by setting the VTB power switch to the **M** position.



18. Check and set the DETOT fuel amount counter to the value displayed on the kneeboard pilot signout sheet page using the AFF DETOT switch.



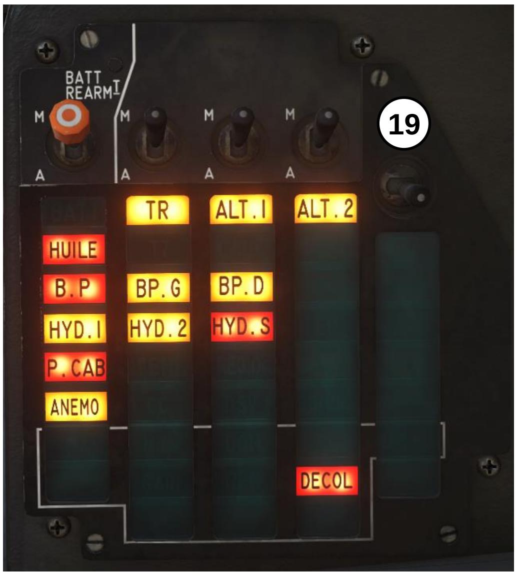
PILOT SIGNOUT SHEET
AIRCRAFT MODEL: M-2000C
PILOT CALLSIGN: A -1-1
AIRCRAFT ORDNANCE: 125 ROUNDS 30MM X 2

INITIAL POSITION:
LATITUDE: N41.38.257
LONGITUDE: E045.01.330
ALTITUDE: 466 M
ALN REQUIRED

AIRCRAFT FUEL: INTERNAL: 3165 KG
EXTERNAL: 990 KG

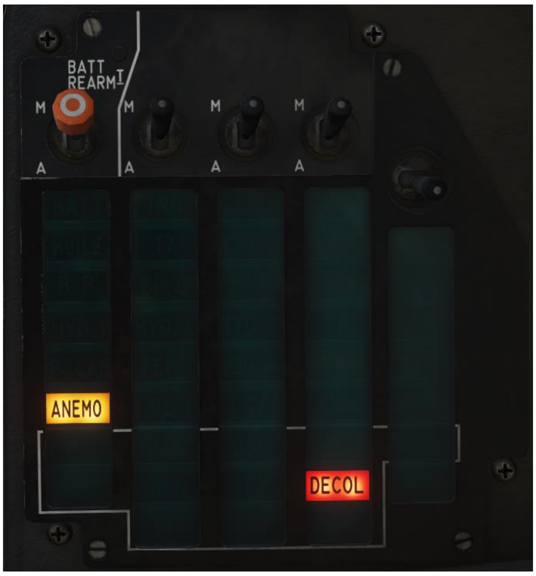
REFUELS:

19. Test the cockpit lights by setting the lights test switch to the **1** and **2** position.



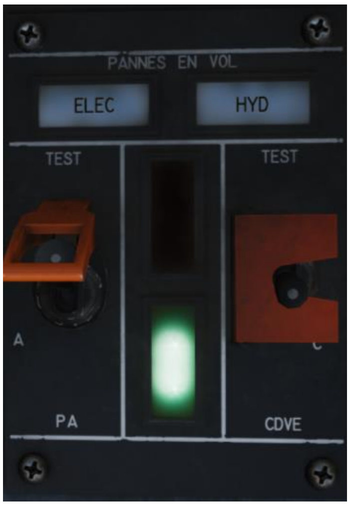
20. Set the electric pump switch to **TEST** then to **AUTO**.

    Check that the **HYDS** warning light is off.



21. Start the short CDVE (down) test, wait for the green light to turn on to indicate that the test has passed.

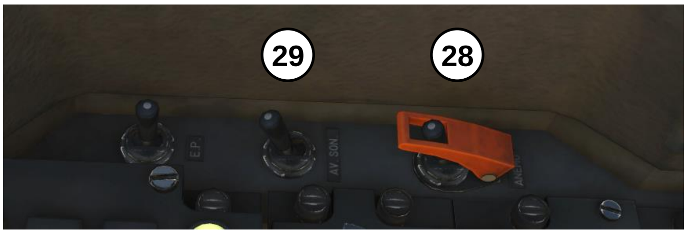
    Do the same for the PA test.



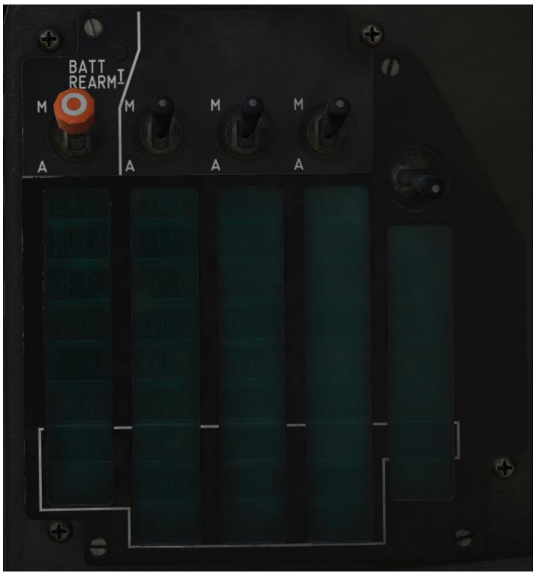
22. Set the IFF master mode knob to the **SBY** position.
23. Set the radar power mode knob to the **SIL** position.
24. Set the anti-collision light switch to the **FORT** position and set the formation light switch as desired.

25. Wipe the controls.
26. Test the air-brakes using the HOTAS command and checking the configuration panel.
27. Test the slats by setting the slat switch to the **SORTIS** position, then the **AUTO** position.

28. Set the pitot heat switch to the on position and close the cover.
29. Set the warning sound switch to the on position.



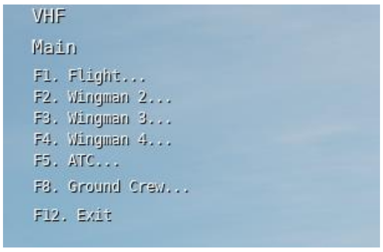
30. Check that all caution and warning lights on the alarm panel are off.

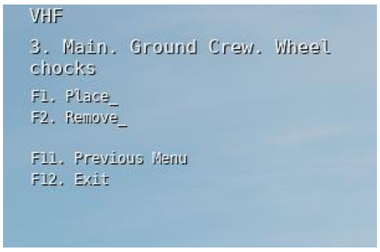


31. Wait until the alignment is complete (steady green *PRET* light on the PCN) and set the PSM mode selector to **NAV**.

SHUTDOWN

1. Install the wheel chocks.



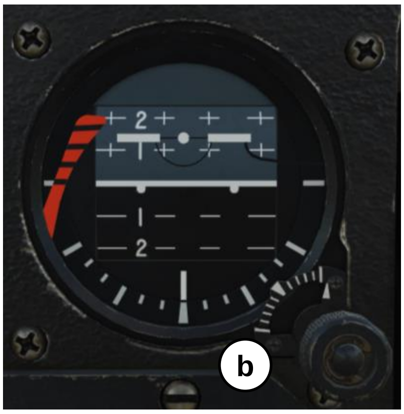


2. Turn off the landing light by setting the landing lights switch to the **A.** position.

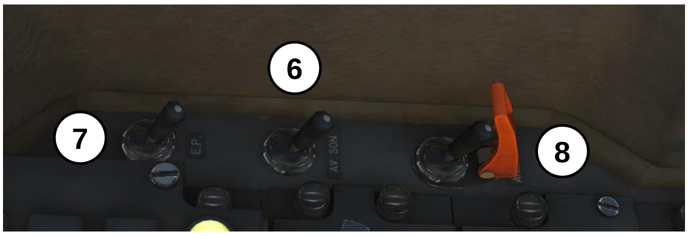
3. Set the radar power mode knob to the **A** position.

4. Set the PSM mode selector to the **AR** position.

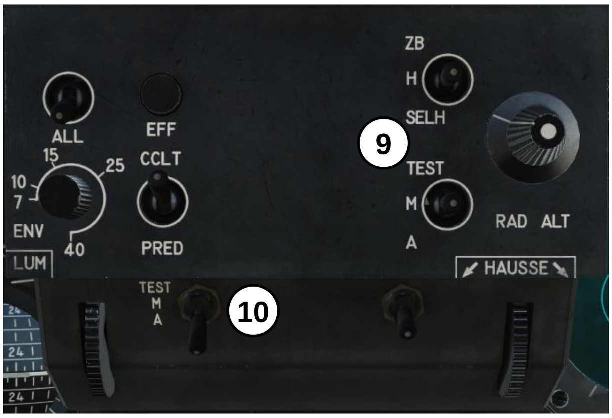
5. Turn off and cage the back-up attitude indicator.
   a. Set the emergency attitude and heading switch to the **A** position.
   b. Cage the back-up attitude indicator using the cage/aircraft symbol adjustment knob.



6. Set the warning sound switch to the off position.
7. Set the emergency pump switch to the **A** position.
8. Set the pitot heat switch to the off position.

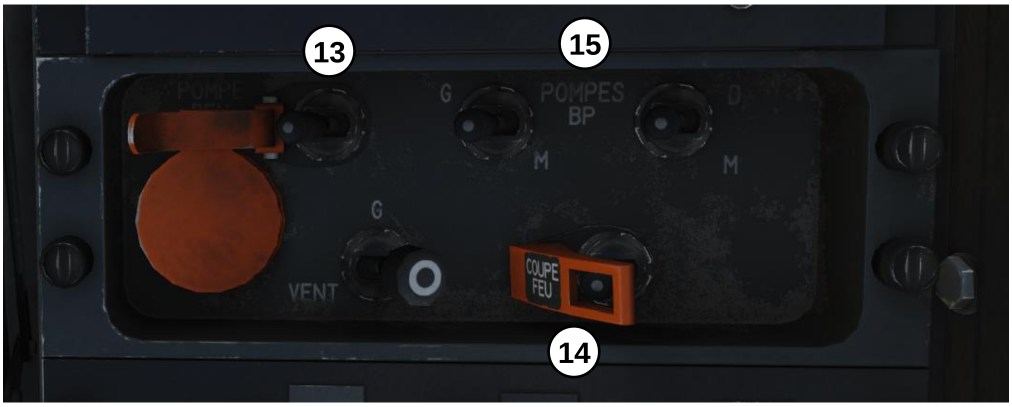


9. Turn off the radar altimeter by setting the radar altimeter switch to the **A** position. Set the altitude display selector switch to the **ZB** position.
10. Turn off the VTH by setting the VTH power switch to the **A** position.
11. Turn off the VTB by setting the VTB power switch to the **A** position.



12. Turn off the engine by setting the throttle in the cutoff position using the engine cutoff button.

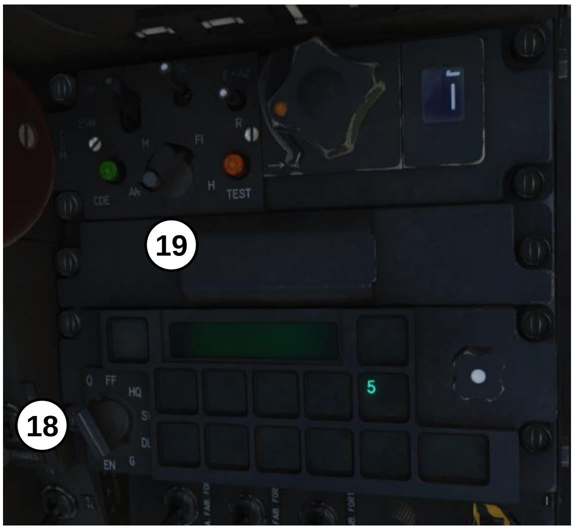
13. Once the engine PRM reaches 0%, set the starter fuel pump switch to off.
14. Set fuel shut-off valve switch to the closed position.
15. Set the 2 boost fuel pumps switches to the off position.



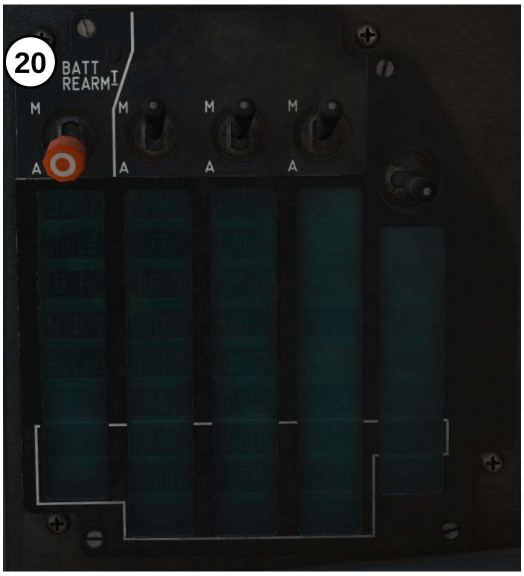
16. Open the canopy as desired using the canopy lever and canopy handles.

17. Turn off the external lights by setting all the external lights switches to the **A.** position.

18. Turn off the V/UHF by setting its operation mode switch to the **0** position.
19. Turn off the UHF by setting its operation mode switch to the **AR** position.



20. Set the battery switch to the **A** position.



22 – 2 - AIRPORT OPERATIONS

INTRODUCTION

The Mirage 2000C is equipped with all necessary equipment to execute VFR and IFR airport operations.

TAXI

WORK IN PROGRESS

VFR TAKE-OFF

WORK IN PROGRESS

IFR TAKE-OFF

WORK IN PROGRESS

VFR LANDING

WORK IN PROGRESS

VFR BREAK LANDING

WORK IN PROGRESS

IFR LANDING

WORK IN PROGRESS

22 – 3 - AUTONOMOUS NAVIGATION

INTRODUCTION

The Mirage 2000C is equipped with an INS system that provides the aircraft with its position as well as the position of points defined by coordinates. This system allows the aircraft to perform autonomous navigation providing correct configuration and alignment.

This system is not perfect and drifts with time, this drift needs to be considered when performing autonomous navigation. Autonomous navigation should only be used for rough navigation and never be relied upon for precision navigation. Visual, radio and radar navigation should be used when precision is needed.

The INS use BUTs (waypoints) as reference points for navigation. These points are defined by a number and configured with coordinates and an altitude. Multiple instruments display navigation information from the DEST BUT.

BUTs are the primary autonomous navigation reference points, BAD and MRQ can be also be used in the same way.

For more information on the INS system, see the **INS SECTION**.

USING A BUT

In order to navigate using a BUT, the BUT needs to be configured with the coordinates of the destination point, this is done via the PCN. Altitude is not required for navigation.

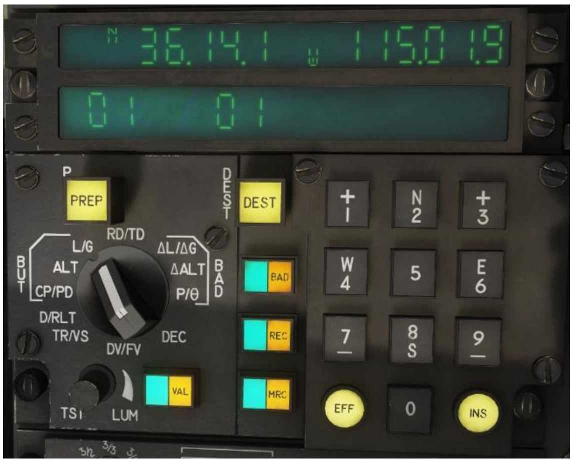
The VTH and IDN are the primary means for autonomous BUT navigation, the BUT needs to be selected as the DEST BUT, SNA in NAV or AG memorized and pre-selected sub-mode for the VTH and the IDN set to the CvNav or CmNav mode. The VTH will display BUT direction, distance and number and the IDN distance and direction.

The VTB will also display the position of the BUT with the NAV BUT symbol.

Additionally, the PCN can be used. The BUT needs to be set in PREP and the parameter selector in the D/RLT position, the PCN will then display the distance and azimuth to the BUT.

EXAMPLE

NAVIGATION TO THE BUT 01



1. Select the BUT 01 as DEST on the PCN.

2. If the SNA is in NAV or AG memorized mode, follow the heading error indicator on the VTH and the distance to the BUT using the VTH distance to BUT indication.

   The VTB will also display the BUT position with NAV BUT symbol.

3. If IDN selected mode indicator is in the CvNav or CmNav position, the wide needle will indicate the direction and the distance window the distance to the BUT.

NAVIGATION TO THE BUT 01 USING THE PCN

1. Select the BUT 01 as PREP on the PCN.
2. Set the parameter selector knob to the D/RLT position.
3. The PCN upper visualization windows now displays distance and azimuth to the BUT 01 that can be used for navigation.

USING A BAD

In order to navigate using a BAD, a BUT first needs to be created and a BAD added to it.

The VTH and IDN are the primary means for autonomous BAD navigation, the BAD hosting BUT needs to be selected as the DEST BUT then the BAD is selected using the BAD button, SNA in NAV mode for the VTH and the IDN set to the CvNav or CmNav mode. The VTH will display BAD direction, distance and number (as well as an asterisk indicating that the BUT's BAD is selected) and the IDN distance and direction.

EXAMPLE

NAVIGATION TO THE BAD 01

1. Select the BUT 01 as DEST on the PCN.
2. Select the BUT BAD by pressing the BAD button on the PCN. The BAD button orange light is lit up as long as the BAD is selected.

3. If the SNA is in NAV or AG memorized mode, folow the heading error indicator on the VTH and the distance to the BAD using the VTH distance to BUT indication. When a BAD is selected, the VTH BUT number is followed by an asterisk.

   The VTB will also display the BAD position with NAV BUT symbol.

4. If IDN selected mode indicator is in the CvNav or CmNav position, the wide needle will indicate the direction and the distance window the distance to the BAD.

   NAVIGATION TO THE BAD 01 USING THE PCN

1. Select the BUT 01 as PREP on the PCN.
2. Select the BUT BAD by pressing the BAD button on the PCN. The BAD button orange light is lit up as long as the BAD is selected.
3. Set the parameter selector knob to the D/RLT position.
4. The PCN upper visualization windows now displays distance and azimuth to the BUT 01 BAD that can be used for navigation.

USING AN MRQ

In order to navigate using an MQR, it first needs to be created using the PCN.

The VTH and IDN are the primary means for autonomous MRQ navigation, the MQR needs to be selected as the DEST BUT, SNA in NAV mode for the VTH and the IDN set to the CvNav or CmNav mode. The VTH will display MRQ direction, distance and number and the IDN distance and direction.

EXAMPLE

NAVIGATION TO THE MQR 91

1. Select the MRQ 91 as DEST on the PCN.

2. If the SNA is in NAV mode, follow the heading error indicator on the VTH and the distance to the MRQ using the VTH distance to BUT indication.
3. If IDN selected mode indicator is in the CvNav or CmNav position, the wide needle will indicate the direction and the distance window the distance to the MRQ.

USING A RD

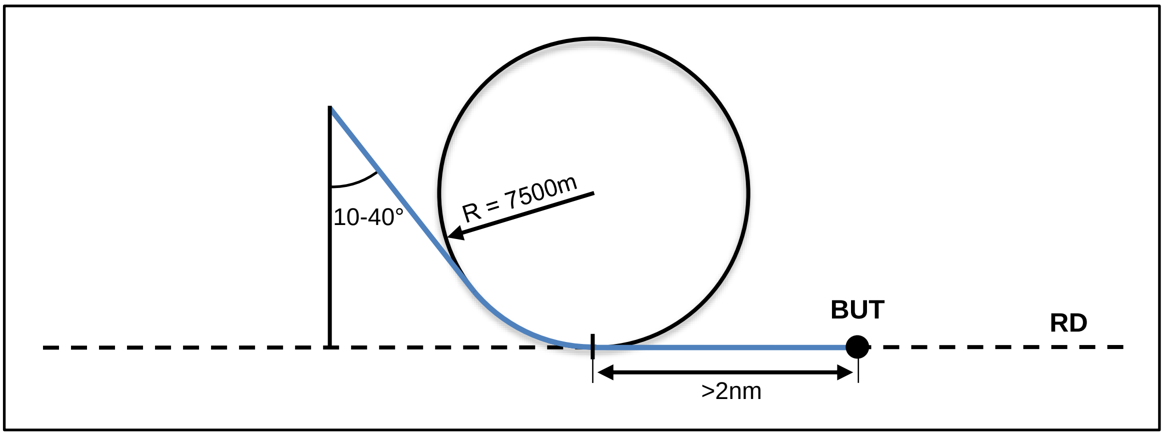
The RD (desired heading) mode guides the aircraft to arrive at a BUT or BAD while flying at a desired heading. The desired heading needs to be set in true north to the destination BUT on the PCN.

The PCA RD option is available when SNA is in navigation mode or air-to-ground memorized sub-mode. The VTH and VTB will display the RD symbology when the RD option is selected and the SNA is in navigation mode or air-to-ground memorized sub-mode.

The desired heading needs to be set in true north. In order to convert a magnetic heading to a true heading, the local magnetic declination needs to be added or subtracted to the magnetic heading. The PCN stores the magnetic declination in the DEC parameter.

The VTH lateral guidance symbol will guide the aircraft to the desired heading in 3 phases:

- First the lateral guidance symbol will guide the aircraft into a 45° to 80° intercept course to the desired heading until a 7500m radius circle tangent to the desired heading is reached.
- Then the symbol will guide the aircraft on this circle until the RD is reached.
- Lastly the lateral guidance will indicate small corrections to keep the desired heading.



The tangent point of the circle needs to be at more that 2nm from the BUT, if this condition is not met, the lateral guidance symbol will guide the aircraft to the BUT just like the heading error indicator.

EXAMPLE

NAVIGATION TO THE BUT 05 WHILE FLYING HEADING 090

1. Select the BUT 05 as PREP and DEST on the PCN.
2. Check the DEC, it is +6.6°.
3. Set the RD at 096.6.

4. If the SNA is in navigation mode or air-to-ground memorized sub-mode, select the RD option on the PCA top row.

   If the RD option is not available, check that no weapon is selected and that selective jettison mode is not selected.

5. Once the lateral guidance symbology is displayed on the VTH,follow it by placing the acceleration chevrons inside the 2 vertical lines.

   The arrival desired route will also be displayed on the VTB.

USING A TD

The TD (time to target) mode provides speed guidance to arrive to a BUT or BAD after a set time. The time to target needs to be set in minutes to the destination BUT on the PCN.

The PCA TOP (literally GO) option is available when SNA is in navigation mode or air-to-ground memorized sub-mode. The VTH will display the TD symbology when the TOP option is selected and the SNA is in NAV or AG memorized mode.

The TOP button starts the speed guidance to arrive to the destination at the time it is pressed plus the TD value.

EXAMPLE

NAVIGATION TO THE BUT 04 WITH A TIME TO TARGET OF 16 MINUTES

1. Select the BUT 04 as PREP and DEST on the PCN.
2. Set the TD to 016.00.

3. If the SNA is in navigation mode or air-to-ground memorized sub-mode, select the TOP option on the PCA top row.

   If the TOP option is not available, check that no weapon is selected and that selective jettison mode is not selected.

4. Once the speed guidance symbology is displayed on the VTH, follow it by placing the acceleration chevrons inside the parentheses.

EXECUTING A NAVIGATION FIX

WORK IN PROGRESS

22 – 4 - RADIO NAVIGATION

INTRODUCTION

The Mirage 2000C is equipped with 3 radio navigation systems, a TACAN transceiver, a VOR/ILS receiver and a marker beacon receiver. These systems allow the aircraft to perform precise navigation in IFR or VFR conditions.

Even if radio navigation is not perfect, these systems are not subject to drift, making them a lot more accurate than an INS system.

TACAN stations are a military radio navigation system that is most of the time used on airbases, aircraft and helicopter carriers as well as tankers. It provides direction and distance information at up to 200nm but requires line of sight between the station and the transceiver. This system is mainly used in NATO countries by NATO aircraft.

VOR beacons are a civil radio navigation system, it is mainly used for commercial and general aviation aircraft navigation. It provides direction information at up to 200nm but requires line of sight between the beacon and the receiver. This system is the radio navigation standard, used everywhere in the world and by most air-forces.

ILS stations are a civil and military radio navigation system that is used for precision instrument approach on airports. It provides deviation information from the airport glideslope and localizer. This system is mainly used in NATO countries but is also present in most civil airports around the world. This radio navigation system usage will be detailed in the **AIRPORT OPERATIONS SECTION**.

USING A TACAN

In order to navigate using a TACAN, its channel needs to be set on the TACAN configuration panel and the TACAN operation mode selected depending on the desired information and TACAN type.

The IDN is the only instrument that displays TACAN navigation information, for that, it needs to be set to the CmTAC mode.

The Mirage 2000C can also navigate with what's called a VAD (offset TACAN). A VAD is a point in space at a set azimuth and distance from a TACAN station. It is setup using the IDN Cmρ (rho) and Cmθ (theta) modes and displayed using the CmVAD mode. More information on how to setup a VAD in the **FLIGHT-PLAN CREATION SECTION**.

EXAMPLE

NAVIGATION TO THE TACAN STATION X21

1. Set the TACAN channel on the TACAN configuration panel.
2. Set the **T/R** operation mode.

   The **R** operation mode could be used if only azimuth from the TACAN was desired.
3. The TAC knob on the SIB panel can be used to check the TACAN Morse identification code.

4. If the IDN selected mode indicator is in the CmTAC position, the wide needle will indicate the direction and the distance window the distance to the station.

REJOIN AN AIRCRAFT WITH THE TACAN Y04

1. Set the TACAN channel on the TACAN configuration panel.
2. Set the A/A operation mode.
3. The TAC knob on the SIB panel can be used to check the TACAN Morse identification code.

4. If the IDN selected mode indicator is in the CmTAC position, the wide needle will indicate the direction and the distance window the distance to the aircraft.

   The aircraft movement can also be determined by watching the tip of the wide needle moving left or right.

NAVIGATION TO THE VAD 270°/15NM OF THE TACAN STATION X21

1. Set the TACAN channel on the TACAN configuration panel.
2. Set the T/R operation mode.
3. The TAC knob on the SIB panel can be used to check the TACAN Morse identification code.

4. Set the VAD using the IDN Cmρ and Cmθ modes.
5. Set the IDN mode to the CmVAD position, the wide needle will indicate the direction and the distance window the distance to the TACAN VAD.

USING A VOR

In order to navigate using a VOR, its frequency needs to be set on the VOR/ILS configuration panel and it needs to be turned on.

The IDN is the only instrument that displays VOR navigation information, for that, it needs to be set to any mode except in CmTEL mode.

The VOR direction indication is displayed by the thin needle on the IDN, this is its only use. This means that VOR direction information can be displayed at the same time than TACAN or BUT information.

EXAMPLE

NAVIGATION TO THE VOR STATION 117.6MHZ

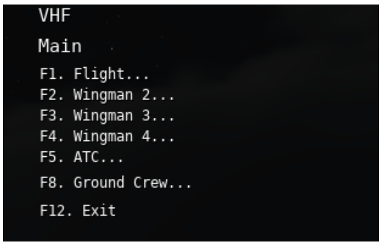
1. Set the VOR frequency on the VOR/ILS configuration panel.
2. Set the VOR/ILS system to ON.
3. The V/ILS knob on the SIB panel can be used to check the TACAN Morse identification code.

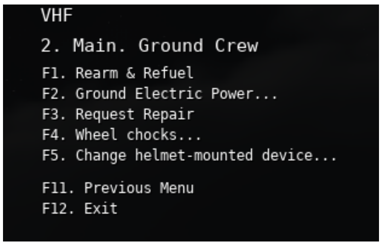
4. If the IDN selected mode indicator is in any other position than CmTEL mode, the thin needle will indicate the direction of the VOR station.

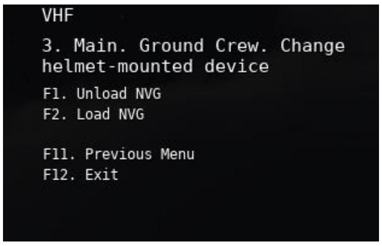
22 – 5 - NIGHT OPERATIONS

INSTALLING NVGS

If the NVGs are not installed in the aircraft (no NVG bag over the parking brake), the ground crew can be asked to install them using the radio.





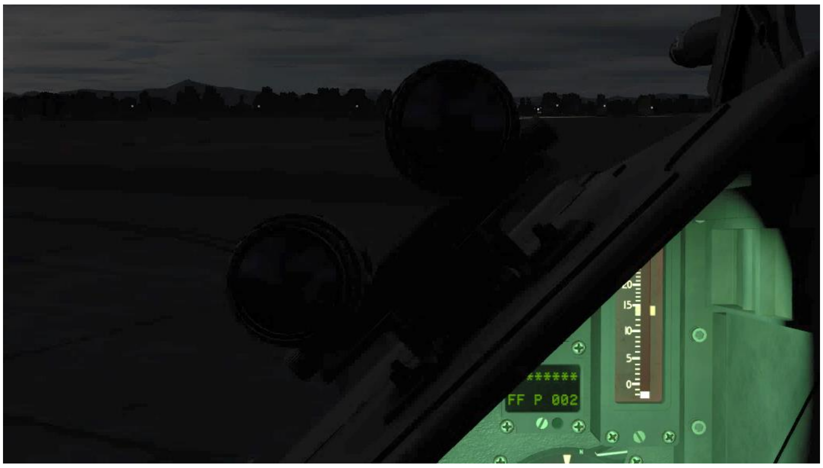


The NVGs are installed when the NVG bag is present over the parking brake.

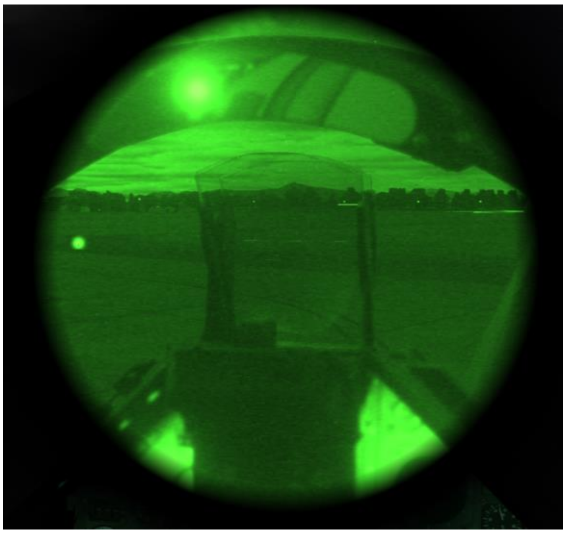
USING NVGS

In order to be able to use the goggles, they first have to be installed on the night vision google mount. To do so, click on the NVG bag.

Once the NVGs are placed on their mount a click on the mount will install them on the pilot’s helmet.



Once installed on the pilot’s helmet, the NVG can be brought to the eyes of the pilot using the default keybind.



22 – 6 - FLIGHT-PLAN CREATION

INTRODUCTION

WORK IN PROGRESS

FROM THE MISSION EDITOR

WORK IN PROGRESS

FROM THE COCKPIT

WORK IN PROGRESS

23 - WEAPONS

Introduction

The Mirage 2000C can carry 2 types of air-to-air missile as well as a variety of guide and unguided bombs and rockets in addition to its internal cannons. It can also carry 2 types of external fuel tanks for extended range.

Internal weapons:

- 2 DEFA 554: 30mm cannon.

External weapons:

- Super 530D: Semi-active radar guided missile.
- MAGIC II: Infrared guided missile.
- Mark-82: Low drag bomb.
- Mark-82 Snakeye: High drag bomb.
- Mark-82 Air: High drag bomb.
- BGL-66 Belouga: High drag sub-munition dispenser.
- BAP-100: Anti-runway penetration bomb.
- GBU-12: Laser guided bomb.
- GBU-16: Laser guided bomb.
- GBU-24: Laster guided bomb.
- Type F4: Rocket pod.

External fuel tanks:

- RP-522: 1300 liters fuel tank.
- RP-541/542: 1700 liters fuel tank.

The external stores are loaded under the wings and fuselage on removable pylons.

Weapon profiles

The Mirage 2000C SNA weapon profiles are loaded by the ground crew when the aircraft is rearmed, 2 weapon profiles are available:

- Air-to-air profile: Contains the Super-530D missile data needed for the weapon employment and symbology.
- Air-to-ground profile: Contains the high and low drag bombs as well as rockets data needed for the aircraft to display weapon symbology.

Only one weapon profile can be loaded at a time, this means that the Super 530D missiles are incompatible with any underwing air-to-ground weapon. If 530D are loaded at the same time as air-to-ground weapon, the PCA will display an error and the weapons will be unusable.

The air-to-air and air-to-ground gun and MAGIC II missile profiles are stored separately and don't interfere with other weapons profiles.

AIR-TO-GROUND WEAPON MIX

While air-to-ground weapon mixing is possible, French Air Force does not employ mixed loadouts. This is due to doctrine choices in the employment of the aircraft as well as mixed loadout not having been tested for separation clearance, aerodynamic instability or weight distribution.

The only factor that needs to be respected is the symmetry of the loadout, each half plane should be loaded identically or the PCA will display an error and weapon employment will be impossible.

The DCS M-2000C allows mixed loadout and does not simulate possible separation or aerodynamic problems to provide a broader possibility to the user. In order to achieve better realism, only one type of air-to-ground weapon should be loaded at a time.

BOMBS DELIVERY MODE

The Mirage 2000C SNA provide 2 bomb delivery modes:

- *Calcul continu du point d'impact* – CCPI (Continuously calculated impact point – CCIP): The aircraft provides the pilot with the instantaneous impact point for the weapon and will release the bombs on the MiCRoB trigger press.
- *Calcul continu du point de largage* – CCPL (Continuously calculated release point – CCRP): The pilot needs to designate the desired impact point and the aircraft will provide symbology guiding the pilot to the release point. The MiCRoB trigger acts as a release consent and the aircraft releases the bombs when the release point is reached.

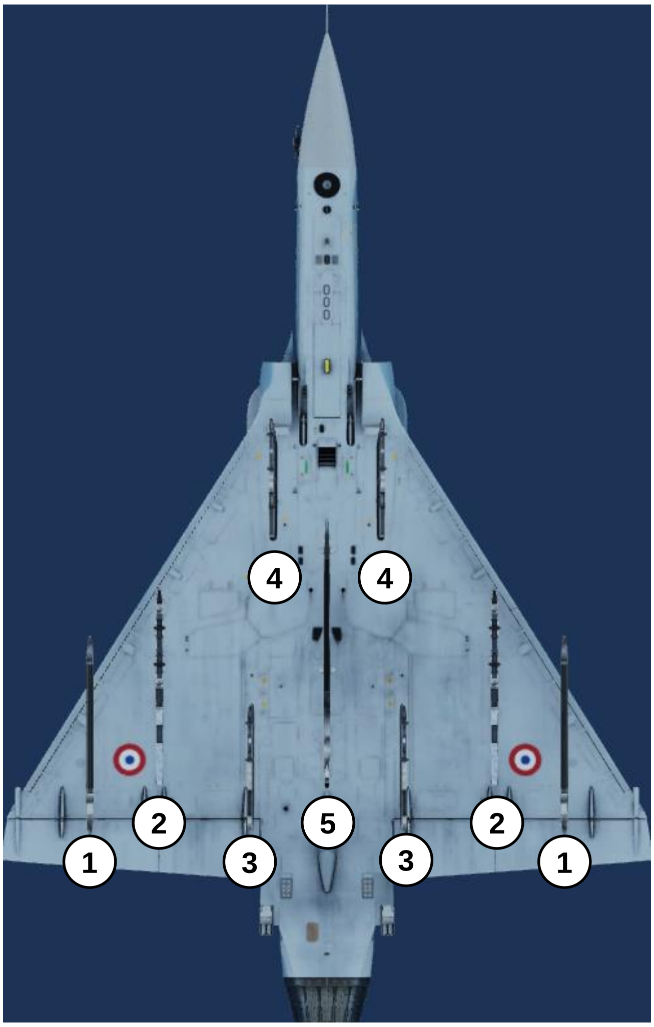
The bomb delivery mode is forced depending on the bomb type, all high drag bombs use CCPI while low drag bombs use CCPL:

- CCPI:
    - Mark-82 Snakeye
    - Mark-82 Air
    - BGL-66 Belouga
    - BAP-100
- CCPL:
    - Mark-82
    - GBU-12
    - GBU-16
    - GBU-24

This impossibility to select the bomb delivery mode is due to the Mirage 2000C weapon employment doctrine in the French Air Force: High drag bombs are meant to be released at low altitude and high speed while low drag bombs are meant to be released at medium to high altitude or in low altitude toss.

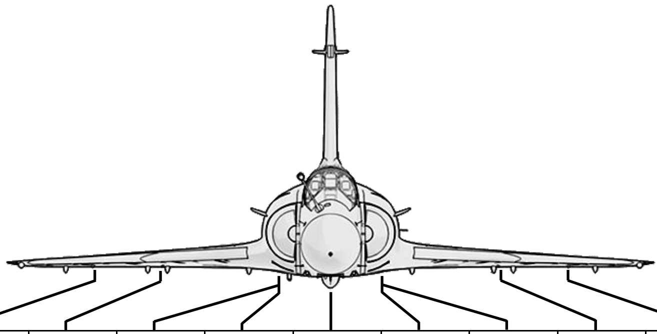
23 – 1 - LOADOUT CHART

The Mirage 2000C has 9 hardpoints:



1. Outboard wing (*Extérieur voilure*)
2. Inboard wing (*Intérieur voilure*)
3. Rear side (*Latéral arrière*)
4. Front side (*Latéral avant*)
5. Fuselage (*Fuselage*)

The loadout chart indicates which weapon can be loaded on the aircraft hardpoints.



Hardpoints			9	8	7	6	5	4	3	2	1
Weapon		PCA code									
Air-to-air weapons	Super 530D	530									
	MAGIC II	MAG									
Air-to-ground weapons	Mk-82	BL1									
	Mk-82 Snakeye	BF1									
	Mk-82 Air	BF2									
	BLG-66	BF4									
	BAP-100	BF8									
	GBU-12	EL2									
	GBU-16	EL6									
	GBU-24	EL4									
	Type F4	RK									
External fuel tanks	RPL-522	RL									
	RPL-541/542	RL									

In addition to those hard points, the drag chute can be replaced by the Eclair pod on hardpoint 10.

23 – 2 - INTERNAL CANNON

DEFA 554

INTRODUCTION

The DEFA 554 is an aircraft revolver 30mm cannon. It is the last variant of the DEFA 550 cannon family, only mounted on the Mirage 2000. Its main use is for the destruction of hostile aircraft in close combat and strafes against ground target in a close air support context.

The cannon characteristics are the following:

- Introduction date: 1984
- Length: 195 cm
- Weight: 80 kg
- Caliber: 30x113 mm
- Shell mass: 240 g
- Maximum range: 1000 m
- Muzzle velocity: 830 m/s
- Rate of fire: 1200 to 1800 round/min

CONFIGURATION

The Mirage 2000C is equipped with 2 DEFA 554 30mm cannons located on the underside of the airframe between the engine air intake.

The ammo boxes are located over the cannon action between the intakes and the external fuselage. Each box contains a 125 round disintegrating belt.

The spent casings are ejected outside the aircraft while the belt links are collected in a dedicated box.

On the fuselage, between the 2 cannons is the aerodynamic safety paddle, it is raised on the ground by the ground crew and folds when the airspeed is above 150 knots. Its purpose is to provide and additional safety to prevent the weapon from firing on the ground.

OPERATION

The DEFA 554 5 chamber revolver action works just like a classic revolver action, it is gas operated and use electrical ignition. The revolver action allows for high rate of fire while obtaining a better accuracy as well as reducing the spun and total weight compared to rotary cannons.

The fire rate of the cannon is adjustable by the pilot in flight. The higher 1800 round/min rate is intended to be used against air targets while the lower 1200 round/min rate is intended for ground targets.

The high weight (240 g compared to 105 g for 20 mm equivalent) and relatively low velocity (830 m/s compared to 1050 m/s for 20 mm equivalent) of the shell increase the bullet drop and time of flight, making the maximum range lower than aircraft equipped with 20mm cannons. The low muzzle velocity also complicates air-to-air employment by needing a bigger lead or closer range in high deflection shots.

AMMO TYPES

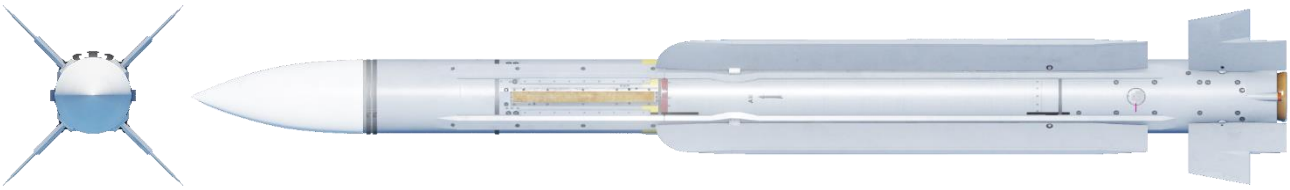
2 ammo belt type are available:

- AP: Armor piercing
- APT: Armor piercing tracer

23 – 3 - MISSILES

SUPER 530D

INTRODUCTION



The Matra Super 530D is a radar guided semi-active missile. It is the last and most advanced member of the Matra 530 missile family, specifically developed for the Mirage 2000C equipped with RDI radars. It is considered as a medium range missile (MRM) capable of engaging aircraft beyond visual range (BVR).

The missile characteristics are the following:

- Introduction date: 1987
- Dimensions:
    - Length: 380 cm
    - Wingspan: 62 cm
- Weight: 270 kg
- Maximum range: 30 nm
- Maximum speed: 4.5 Mach
- Maximum altitude: 80 000 ft

The Mirage 2000C can carry 2 Super 530D, 1 under each inboard wing hardpoint.

The missile is composed of 5 sections:

- Seeker section: Hosts the semi-active seeker under the radome with a gyroscope used for the seeker just behind it.
- Military payload section: Hosts the explosives, the armament safety device and the electromagnetic proximity fuses.
- Thruster section: Hosts the rocket engine solid fuel and nozzle.
- Guidance section: Hosts the guidance unit, the power supply and the rear antennas. The guidance unit is composed of a calculator, a gyrometer and the servomotors. The power supply is powered by a primed battery.
- The steering section: Composed of 4 wings and 4 control surfaces. The wings are of high surface area and length to provide lift and smooth the airflow for the control surfaces. The control surfaces provide pitch, yaw and roll control.

PYLON

When attached to its 2153A pylon, the missile is set on a rail. It will slide off it by its own thruster at launch.

The pylons host the aerodynamic safety paddle, it is raised on the ground by the ground crew and folds when the airspeed is above 150 knots. Its purpose is to provide and additional safety to prevent the weapon from firing on the ground.

PROPULSION

The missile thruster is a 2 stage solid fuel rocket engine that burns for 10 seconds. The 1st stage, called boost, lasts 2 seconds and produce a higher trust than the 2nd stage, called sustain, that lasts 8 seconds. After the solid fuel is expended the missile has no other means of propulsion and must use its stored energy (kinetic or potential) to reach its target.

POWER SUPPLY

The missile is powered by an internal battery that is primed a launch, this battery can only power the missile for about 45 seconds. When the battery runs out of power, the missile self-destruct.

GUIDANCE

The Super 530D seeker is radar guided semi-active, meaning it homes on the shooter aircraft radar waves reflected by the target. This guidance method requires that the shooter aircraft illuminates the target during the totality of the missile flight. The missile is lock on before launch (LOBL) meaning that it has to acquire its target before it can be fired, this is done automatically when a target is locked in PSIC and the missiles are selected.

The missile rear antenna purpose is to receive a reference wave from the shooter’s aircraft radar and use them to calculate the expected doppler shift of the target’s reflected radar waves.

A PSIC lock is required in order for the missile to track the target. The missile has the capacity to reacquire its target after the lock is lost momentarily if the target is still in its seeker field of view.

If the target is equipped with a radar warning receiver (RWR), it may be able to detect the missile and warn the pilot. Most modern aircraft will be able to detect and react to a Super 530D shot.

PAYLOAD

The missile’s military payload is 30 kg HE fragmentation that gives a lethal zone of about 20 meters. The explosives are triggered by 2 electromagnetic proximity fuses located on the side of the military payload section.

RANGE

The Super 530D range is dependent on multiple factors:

- Shooter aircraft speed
- Shooter aircraft altitude
- Target speed
- Target altitude
- Target aspect
- Target angle from shooter aircraft
- Altitude difference

Target maneuvers during the missile flight can also affect the missile range.

Missile range is mostly affected by the altitude at which it will travel and the aspect of the target.

By design, rocket engine get more efficient as the air density is reduced, meaning that the missile thruster will produce more energy at altitude than sea level. In addition to the engine thrust, the missile will generate less drag at high altitude also due to the lower air density.

The target aspect will affect the target and missile closing speed. A head aspect target will have its speed added to their combined closing speed, reducing the distance to be traveled by the missile while a tail aspect target will have its speed subtracted to their combined closing speed, increasing the distance to be traveled by the missile.

The best conditions for missile employment are a fast shooting aircraft at high altitude against a high and fast target flying head-on.

MANEUVERING

The Super 530D is a highly maneuverable missile, it is capable of up to 18G at super-sonic speed. This high G capability means that it is almost impossible for a target to evade it only by turning.

In order to maneuver to the target, the missile needs to have sufficient speed over its wings and control surfaces to generate lift. It keeps significant maneuvering capabilities down until 700 kt IAS, below this speed, the wings and control surfaces don’t provide enough lift to maneuver the missile efficiently.

MAGIC II

INTRODUCTION

The Matra MAGIC II is an all-aspect infrared guided missile. It is the second iteration of the French designed MAGIC infrared missile, in use for self-defense and close combat on all French Air Force aircraft until its replacement by the MICA IR. It is considered as a short-range missile (SRM) for engaging aircraft within visual range (WVR). The name of the missile is an acronym: *Missile auto-guidé d'interception et de combat* (Self-guided interception and combat missile).

The missile characteristics are the following:

- Introduction date: 1986
- Dimensions:
  - Length: 275 cm
  - Wingspan: 66 cm
- Weight: 89 kg
- Maximum range: 5 nm
- Maximum speed: 3 Mach
- Maximum altitude: 60 000 ft

The Mirage 2000C can carry 2 MAGIC II, 1 under each outboard wing hardpoint. Additionally, the aircraft can be retrofitted to carry 2 more MAGIC II under the inboard wing hardpoint. This configuration is not part of the French Air Force doctrine for the Mirage 2000C but has been employed by other operators.

The missile is composed of 2 sections:

- Electronic section: Hosts the infrared seeker with its gyroscope, the guidance unit, the fixed wings, the control surfaces, the power supply, the armament safety device and the electromagnetic proximity fuse. The guidance unit is composed of a calculator and 2 gyrometers. The power supply is powered by a primed battery.
- Pyrotechnic section: Hosts the explosives, the rocket engine solid fuel and nozzle and the rotary wings.

PYLON

When attached to its 2255 or 2255A pylon, the missile is set on a rail. It will slide off it by its own thruster at launch. The pylons host the aerodynamic safety paddle, it is raised on the ground by the ground crew and folds when the airspeed is above 150 knots. Its purpose is to provide and additional safety to prevent the weapon from firing on the ground.

2 pylons are available for the MAGIC II:

- 2255 Pylon: Standard pylon with aerodynamic rear fairing.
- 2255A Pylon: Standard pylon capable of receiving the D^2M sensor in place of the rear fairing.

The pylons house the nitrogen bottles used to cool the missile to operating temperature. The bottles can supply the missiles with coolant for 90 minutes after which the seeker won't be cooled anymore.

The D^2M sensor also uses the nitrogen for cooling when operating. It consumes as much as a MAGIC seeker, dividing the autonomy by 2 when both systems are cooled.

The initial cooling sequence for the MAGICs and the D^2M consume about 10 minutes of coolant.

PROPULSION

The missile thruster is a single stage solid rocket engine that burns for 2 seconds. After the solid fuel is expended it has no other means of propulsion and must use its stored energy (kinetic or potential) to reach its target.

POWER SUPPLY

The missile is powered by an internal battery that is primed a launch, this battery can only power the missile for about 30 seconds. When the battery runs out of power, the missile self-destruct.

GUIDANCE

The MAGIC II seeker is all-aspect infrared guided, meaning it homes on the heat radiated by the target aircraft. Being all-aspect, the missile can detect the heat coming from the engine (reactor, turbine or piston engine) or the skin of the aircraft. This all-aspect capacity requires the missile to be cooled to very low temperature (few degrees above absolute zero), this is done by using liquid nitrogen stored in the missile pylon. The missile is lock on before launch (LOBL) meaning that it has to acquire its target before it can be fired. The missile seeker can autonomously lock a target or be slaved to the aircraft radar.

Even if the missile is considered all-aspect, the target type and orientation play a great role in the lock range of the seeker. Aircraft equipped with reactor can be locked from further out in rear aspect while for single piston or turboprop engine aircraft it's the front aspect.

Once the missile is fired, it is autonomous. The shooter aircraft can safely disengage while the missile flies to its target.

The MAGIC II guidance system is passive, meaning that radar warning receivers (RWR) cannot detect that a missile has been fired. The only systems able to detect this type of missiles are missile warning system (MWS) that detects UV light produced by the missile rocket engine (just like the Mirage D^2M system).

PAYLOAD

The missile's military payload is 13 kg HE fragmentation that gives a lethal zone of about 10 meters. The explosives are triggered by 8 electromagnetic proximity fuses located around the missile fuselage behind the control surfaces.

RANGE

The MAGIC II range is dependent on multiple factors:

- Shooter aircraft speed
- Shooter aircraft altitude
- Target speed
- Target altitude
- Target aspect
- Target angle from shooter aircraft
- Altitude difference

Target maneuvers during the missile flight can also affect the missile range.

Missile range is mostly affected by the altitude at which it will travel and the aspect of the target.

By design, rocket engine get more efficient as the air density is reduced, meaning that the missile thruster will produce more energy at altitude than sea level. In addition to the engine thrust, the missile will generate less drag at high altitude also due to the lower air density.

The target aspect will affect the target and missile closing speed. A head aspect target will have its speed added to their combined closing speed, reducing the distance to be traveled by the missile while a tail aspect target will have its speed subtracted to their combined closing speed, increasing the distance to be traveled by the missile.

The best conditions for missile employment are a fast shooting aircraft at high altitude against a high and fast target flying head-on.

MANEUVERING

The MAGIC is a highly maneuverable missile, it is capable of up to 30G at supersonic speed. This high G capability means that it is virtually impossible for a target to evade it only by turning.

In order to maneuver to the target, the missile needs to have sufficient speed over its wings and control surfaces to generate lift. It keeps significant maneuvering capabilities down until 500 kt IAS, below this speed, the wings and control surfaces don't provide enough lift to maneuver the missile efficiently.

23 – 4 - LOW DRAG BOMBS

INTRODUCTION

Low drag bombs are designed to be released on targets from aircraft flying at medium to high altitude, in level flight or in a dive. These bombs then follow a ballistic trajectory to their target.

This delivery method precision relies on the aircraft following the correct parameter for the altitude, speed and dive angle. The inherent imprecision of this method often requires employing multiple bombs to hit one target.

Laser guided bombs are also considered low drag bombs. They differ from “dumb” bombs by the addition of a guidance kit. The most common type of guided bombs are laser guided bombs, they track their target by following a laser emitted by the releasing aircraft or an external designator.

Low drag bombs can also be released using a toss delivery profile. In this profile the aircraft releases the bombs while climbing to give the bomb a parabolic trajectory, increasing their range at the cost of precision. This type of profile can be used from low altitude to medium altitude.

MARK-82

INTRODUCTION

The Mark-82 (Mk-82) is an unguided, low-drag general-purpose bomb (LDGP). It is the most common bomb in service in NATO countries and is the main LDGP bomb in the French Air Force inventory. The bombs are produced in France under license and replace the older French SAMP-250 bombs.

The bomb characteristics are the following:

- Introduction date: 1954
- Dimensions:
    - Length: 222 cm
    - Diameter: 27 cm
- Weight: 227 kg
- Explosive mass: 87 kg
- Explosive type: Tritonal

The Mirage 2000C can carry up to 8 Mark-82:

- 2 on the front side hardpoints.
- 2 on the rear side hardpoints.
- 2 or 4 on the internal wing hardpoints.

The bomb body holds the explosives. At the forward end of the bomb is the nose fuse and at the rearward end the tail fuse with 4 stabilizing fins.

PYLONS

The bomb pylons contain the fuse arming mechanism. 2 bombs can be carried under the internal wing hardpoint by using the AUF2 adaptor.

PRECISION

Since the Mark-82 is unguided, is precision is entirely dependent on the releasing aircraft. Additionally, the bomb has a circular error probable (CEP) of 30m, meaning that if released perfectly, 50% of the bombs will impact within 30 meters of the aiming point.

PAYLOAD

The bomb payload is 89 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 60 to 100m against infantry.

FUSING

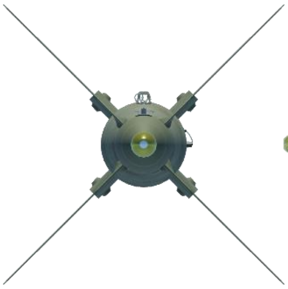
The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger the explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have a safety timer of 6 seconds to ensure that the releasing aircraft is not in the blast and fragment area when the bomb impacts the ground.

GBU-12

INTRODUCTION




The GBU-12 (guided bomb unit) is a laser guided bomb based on the Mark-82 LDGP. It is the most common laser guided bomb in service in NATO countries and is the main laser guided bomb in the French Air Force inventory.

The bomb characteristics are the following:

- Introduction date: 1976
- Dimensions:
    - Length: 372 cm
    - Diameter: 45 cm
- Weight: 273 kg
- Explosive mass: 87 kg
- Explosive type: Tritonal

The Mirage 2000C can carry up to 4 GBU-12:

- 2 on the front side hardpoints.
- 1 or 2 under the fuselage hardpoint.

The bomb is a standard Mark-82 mounted with a Paveway II guidance kit. The bomb body holds the explosives. At the forward end of the bomb is the nose fuse, the laser tracking system and control surfaces and at the rearward end the tail fuse with 4 stabilizing fins that deploy when the bomb is released.

PYLONS

The bomb pylons contain the fuse arming mechanism. 2 bombs can be carried under the fuselage hardpoint by using the AUF2 adaptor.

The bombs are not cleared to be mounted on the front side or internal wing hardpoints.

GUIDANCE

The GBU-12 uses the Paveway II guidance kit, it is composed of a laser seeker, 4 control surfaces and 4 deployable stabilizing fins.

The target needs to be designated by a laser pointer, it can be coming from a hand-held device (generally from a JTAC), a vehicle or another aircraft. The Mirage 2000C is unable to self-designate as it can't carry a targeting pod. The bomb seeker searches for a laser at a specific frequency set on the bomb guidance unit on the ground, the designation laser needs to match this frequency or the bomb won't track the laser.

The bomb is lock on after launch (LOAL), the bomb is released conventionally on the target and the seeker spot and track the laser once the bomb nose is pointing at the target.

The Paveway II guidance is very simple, the bomb steers at its maximum capacity in the direction of the laser. If the seeker overshoots the mark, it steers at its maximum capacity in the opposite direction. This guidance method is less precise and use more energy than proportional guidance but allows for a cheap and simple system.

PRECISION

The GBU-12 guidance system removes the dependence on precision from the releasing platform and achieve a much better circular error probable (CEP) of 9 to 10 meters from the laser aiming point.

PAYLOAD

The bomb payload is 89 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 60 to 100m against infantry.

FUSING

The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have a safety timer of 6 seconds to ensure that the releasing aircraft is not in the blast and fragment area when the bomb impacts the ground.

GBU-16

INTRODUCTION

The GBU-16 (guided bomb unit) is a laser guided bomb based on the Mark-83 LDGP. The bomb bigger size and explosive filling allow for a larger lethal zone and bigger damage on the target.

The bomb characteristics are the following:

- Introduction date: 1976
- Dimensions:
  - Length: 370 cm
  - Diameter: 66 cm
- Weight: 496 kg
- Explosive mass: 204 kg
- Explosive type: Tritonal

The Mirage 2000C can carry 1 GBU-16 under the fuselage hardpoint.

The bomb is a standard Mark-83 with a Paveway II guidance kit. The bomb body holds the explosives. At the forward end of the bomb is the nose fuse, the laser tracking system and control surfaces and at the rearward end the tail fuse with 4 stabilizing fins that deploy when the bomb is released.

PYLONS

The bomb pylons contain the fuse arming mechanism. Only the fuselage hardpoint is cleared to carry the GBU-16.

GUIDANCE

The GBU-16 uses the Paveway II guidance kit, it is composed of a laser seeker, 4 control surfaces and 4 deployable stabilizing fins.

The target needs to be designated by a laser pointer, it can be coming from a hand-held device (generally from a JTAC), a vehicle or another aircraft. The Mirage 2000C is unable to self-designate as it can't carry a targeting pod. The bomb seeker searches for a laser at a specific frequency set on the guidance unit on the ground, the designation laser needs to match this frequency or the bomb won't track the laser.

The bomb is lock on after launch (LOAL), the bomb is released conventionally on the target and the seeker spot and track the laser once the bomb nose is pointing to the target.

The Paveway II guidance is very simple, the bomb steers at its maximum capacity in the direction of the laser. If the seeker overshoots the mark, it steers at its maximum capacity in the opposite direction. This guidance method is less precise and use more energy than proportional guidance but allows for a cheap and simple system.

PRECISION

The GBU-16 guidance system removes the dependence on precision from the releasing platform and achieve a much better circular error probable (CEP) of 9 to 10 meters from the laser aiming point.

PAYLOAD

The bomb payload is 204 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 150 to 200m against infantry.

FUSING

The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have a safety timer of 6 seconds to ensure that the releasing aircraft is not in the blast and fragment area when the bomb impacts the ground.

GBU-24

INTRODUCTION

The GBU-24 (guided bomb unit) is a laser guided bomb based on the Mark-84 LDGP. The improved guidance system allows for greater precision, reliability and range than previous laser guided bombs.

The bomb characteristics are the following:

- Introduction date: 1983
- Dimensions:
    - Length: 439 cm
    - Diameter: 94 cm
- Weight: 1050 kg
- Explosive mass: 910 kg
- Explosive type: Tritonal

The Mirage 2000C can carry 1 GBU-24 under the fuselage hardpoint.

The bomb is a standard Mark-84 with a Paveway III guidance kit. The bomb body holds the explosives. At the forward end of the bomb is the nose fuse, the laser tracking system and control surfaces and at the rearward end the tail fuse with 4 stabilizing fins that deploy when the bomb is released.

PYLONS

The bomb pylons contain the fuse arming mechanism. Only the fuselage hardpoint is cleared to carry the GBU-24.

GUIDANCE

The GBU-24 uses the Paveway III guidance kit, it is composed of a laser seeker, 4 control surfaces and 4 deployable stabilizing fins.

The target needs to be designated by a laser pointer, it can be coming from a hand-held device (generally from a JTAC), a vehicle or another aircraft. The Mirage 2000C is unable to self-designate as it can't carry a targeting pod. The bomb seeker searches for a laser at a specific frequency set on the guidance unit on the ground, the designation laser needs to match this frequency or the bomb won't track the laser.

The bomb is lock on after launch (LOAL), the bomb is released conventionally on the target and the seeker spot and track the laser once the bomb nose is pointing to the target.

The Paveway III guidance is more advanced than the older Paveway II kits, the bomb will adjust its trajectory to impact the designated target while using the least energy possible. This better guidance system gives the bomb a better range and greater precision compared to older laser guided bombs.

The Mirage SNA is not able to take advantage of the bomb greater range as it is designed to release the weapon on a ballistic trajectory to the target. This limitation can be circumvented by selectively jettisoning the bomb when in range of the target.

PRECISION

The GBU-24 guidance system allows the bomb to optimize its trajectory and achieve an even better circular error probable (CEP) of 1 meter from the laser aiming point.

PAYLOAD

The bomb payload is 429 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 300 to 370m against infantry.

FUSING

The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have a safety timer of 6 seconds to ensure that the releasing aircraft is not in the blast and fragment area when the bomb impacts the ground.

23 – 5 - HIGH DRAG BOMBS

INTRODUCTION

High drag bombs are designed to allow delivery at low altitude (300 ft) and high speed by increasing the separation between the aircraft and the impact point. Low altitude delivery is impossible with low drag bombs because the aircraft will be inside the blast or fragmentation radius. Slowing down the bomb using high drag fins, a ballute or a parachute allows the bomb to separate faster and explode “behind” the aircraft.

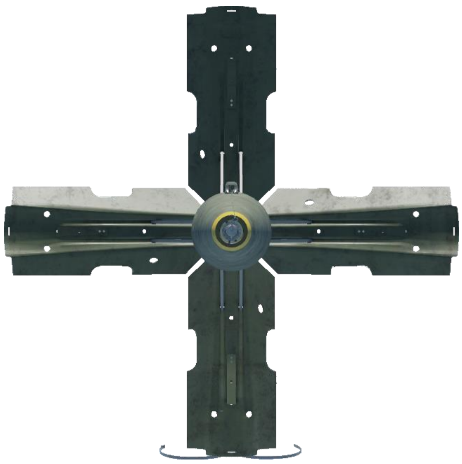
The bombs high drag devices are stowed when the bomb is loaded under the aircraft to reduce the airframe drag.

For some high drag bombs the deployment of the high drag devices can be selected at release, allowing a greater domain of employment for the bomb.

The trajectory of high drag bombs forces delivery profiles to be either at low altitude and high speed or in a very steep dive. The increased time of flight also means that they are more susceptible to wind and turbulences, resulting in a reduced precision.

MARK-82 SNAKEYE

INTRODUCTION



The Mark-82 Snakeye (Mk-82S) is an unguided, high-drag general-purpose bomb (HDGP). The bombs are produced in France under license and replace the older French SAMP-250 bombs.

The bomb characteristics are the following:

- Introduction date: 1967
- Dimensions:
    - Length: 221 cm
    - Diameter: 27 cm
- Weight: 241 kg
- Explosive mass: 87 kg
- Explosive type: Tritonal

The Mirage 2000C can carry up to 8 Mark-82 Snakeye:

- 2 on the front side hardpoints.
- 2 on the rear side hardpoints.
- 2 or 4 on the internal wing hardpoints.

The bomb body holds the explosives. At the forward end of the bomb is the nose fuse and at the rearward end the tail fuse with 4 deployable high drag fins.

PYLONS

The bomb pylons contain the fuse arming mechanism. 2 bombs can be carried under the internal wing hardpoint by using the AUF2 adaptor.

PRECISION

Since the Mark-82 Snakeye is unguided, is precision is entirely dependent on the releasing aircraft. Additionally, the bomb has a circular error probable (CEP) of 30m, meaning that if released perfectly, 50% of the bombs will impact within 30 meters of the aiming point.

PAYLOAD

The bomb payload is 89 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 60 to 100m against infantry.

FUSING

The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger the explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have no safety timer, the releasing aircraft needs to use a profile that guarantee sufficient separation from the explosion.

Mark-82 Air

Introduction

The Mark-82 Air (Mk-82Air) is an unguided, high-drag general-purpose bomb (HDGP). The bombs are produced in France under license and replace the older French SAMP-250 bombs.

The bomb characteristics are the following:

- Introduction date: 1986
- Dimensions:
  - Length: 221 cm
  - Diameter: 27 cm
- Weight: 241 kg
- Explosive mass: 87 kg
- Explosive type: Tritonal

The Mirage 2000C can carry up to 8 Mark-82 Air:

- 2 on the front side hardpoints.
- 2 on the rear side hardpoints.
- 2 or 4 on the internal wing hardpoints.

The bomb body holds the explosives. At the forward end of the bomb is the nose fuse and at the rearward end the tail fuse with the deployable air ballute.

Pylons

The bomb pylons contain the fuse arming mechanism. 2 bombs can be carried under the internal wing hardpoint by using the AUF2 adaptor.

Precision

Since the Mark-82 Air is unguided, is precision is entirely dependent on the releasing aircraft. Additionally, the bomb has a circular error probable (CEP) of 30m, meaning that if released perfectly, 50% of the bombs will impact within 30 meters of the aiming point.

Payload

The bomb payload is 89 kg of tritonal HE under a thick steel casing case that generate fragmentation on detonation. The weapon lethal zone is 60 to 100m against infantry.

FUSING

The bomb explosives are triggered by 1 of the 2 fuses:

- Nose fuse: Will trigger the explosives as soon as the bomb hits hard surface, exploding just above the ground and creating a large blast and fragment area. This is effective against vehicle and soft target but will inflict minimal damage against hardened targets like bunkers or infrastructure.
- Tail fuse: Will trigger the explosives after the bomb has penetrated a hard surface, exploding inside it. This is effective against hardened targets like bunkers or infrastructure but will have a reduced blast and fragment area. Penetration of hardened or underground bunkers is still limited as the bomb is not equipped with a dedicated penetrator kit.

Both fuses have no safety timer, the releasing aircraft needs to use a profile that guarantee sufficient separation from the explosion.

BLG-66 BELOUGA

INTRODUCTION

The BLG-66 Belouga (*bombe lance-grenade 66mm* – 66mm grenade launcher bomb) is an unguided, high-drag, cluster bomb. The bombs are of French design and are can be used by any aircraft fitted with standard NATO bomb suspension lugs.

The bomb characteristics are the following:

- Introduction date: 1979
- Dimensions:
    - Length: 222 cm
    - Diameter: 55 cm
- Weight: 290 kg
- Sub-munitions: 151x1.2 Kg
- Sub-munitions types:
    - Anti-tank: GR-66-AC
    - Fragmentation: GR-66-EG
    - Interdiction: GR-66-IZ

The Mirage 2000C can carry up to 9 BLG-66 Belouga:

- 2 on the front side hardpoints.
- 2 on the rear side hardpoints.
- 1 on the fuselage hardpoint.
- 2 or 4 on the internal wing hardpoints.

The bomb body holds the 151 sub-munitions distributed in rings. At the forward end of the bomb is the nose fuse and at the rearward end the deployable drag chute assembly and the 4 stabilizing fins.

PYLONS

The bomb pylons contain the fuse arming mechanism. 2 bombs can be carried under the internal wing hardpoint by using the AUF2 adaptor.

RELEASE SEQUENCE

Just after the bomb is released, the parachute is deployed, separating the bomb from the aircraft. After about 1 second, the parachute is jettisoned and the sub-munitions are released by rings from to back. Once all the sub-munitions are released the bomb is inert and will continue on a ballistic trajectory.

Each sub-munition has a small parachute that is deployed just after release to improve the warhead effectiveness by making them impact vertically.

SUB-MUNITION PATTERN

The bomb is capable of using 2 different sub-munition patterns by changing the delay between each ring ejection:

- Long pattern: 240x40 meters.
- Short pattern: 120x40 meters.

The short pattern will have a higher sub-munition density.

The sub-munition pattern can be selected at weapon release by arming the nose or tail fuse.

SUB-MUNITIONS

The bomb can be loaded with 3 sub-munition types:

- GR-66-AC (*Anti-char*): This sub-munition is a high explosive shaped charge capable of piercing up to 300mm of steel.
- GR-66-EG (*Grenade à fragmentation*): This grenade type sub-munition holds 396 g of high explosive in a pre-fragmented case fitted with an instantaneous contact fuse. It has a lethal zone of 15 meters against infantry and its fragment can perpetrate up to 4 mm of steel. **NOT FUNCTIONAL**
- GR-66-IZ (*Interdiction de zone*): This sub-munition is the same as the GR-66-EG but the contact fuse is replaced by a randomly delayed fuse adjustable to up to several hours. **NOT FUNCTIONAL**

The bombs are only loaded with 1 type of sub-munition at a time.

FUSING

The bomb fuse selection sets the sub-munition patterns:

- Nose fuse: Short pattern.
- Tail fuse: Long pattern.

Both fuses have no safety timer, the releasing aircraft needs to use a profile that guarantee sufficient separation from the explosion.

BAP-100

INTRODUCTION

The BAP-100 (*bombe anti-piste 100mm* – 100mm anti-runway bomb) is an unguided, high-drag, rocket assisted anti-runway bomb. The bombs are of French design and are used mainly used by the French Air Force and the Royal Air Force.

The bomb characteristics are the following:

- Introduction date: 1980
- Dimensions:
    - Length: 180 cm
    - Diameter: 10 cm
- Weight: 66 kg
- Explosive mass: 3.5 kg

The Mirage 2000C can carry up to 18 BAP-100 under the fuselage hardpoint.

The forward half of the bomb holds the explosives, the penetrator and the fuse. The aft half contains the booster, the 4 stabilizing fins and the deployable chute.

PYLONS

The bombs are mounted on the fuselage hardpoint using the 30-6-M2 adaptor. 6, 12 or 18 bombs can be loaded.

RELEASE SEQUENCE

Just after the bomb is released, the parachute is deployed, separating the bomb from the aircraft and slowing it down. After 3.75 seconds and when the bomb is less than 40° from the vertical, the parachute is jettisoned and the booster is fired accelerating the bomb to 260 m/s into the ground. After penetration is achieved the bomb explodes creating a crater.

PAYLOAD

The bomb payload contains a penetrator which combined with the speed provided by the booster can penetrate up to 40 cm of concrete. The 3.5 kg of high explosive will create a 4 meter wide, 50 cm deep crater.

FUSING

The bomb contains only 1 fuse in its nose. The bomb has an arming delay of 2.25 seconds after release for all the pyrotechnic components to ensure good separation from the aircraft when the booster is fired.

23 – 6 - ROCKETS

TYPE F4

INTRODUCTION

The Type F4 is an 68mm rocket pod. It is of French design and is used by many countries. It can carry a wide variety of SNEB rockets.

The pod characteristics are the following:

- Introduction date: 1984
- Dimensions:
    - Length: 234 cm
    - Diameter: 41 cm
- Weight: 180 kg
- Rockets: 18x68mm SNEB
- Rocket types:
    - Fragmentation: Type 256P EAP

The Mirage 2000C can carry up to 4 Type F4:

- 2 on the internal wing hardpoints.
- 2 on the external wing hardpoints.

The pod nose contains the aerodynamic fairing, the body holds the 18 68mm rockets and the rear contains a blast deflector.

ROCKETS

Only 1 rocket type is available, the type 256P EAP: It is an air-to-ground fragmentation rocket to use against un-armored or lightly armored targets. Its warhead contains 3Kg of high explosives. It has a lethal zone of 25 meters against infantry.

FIRING SEQUENCE

The Type F4 rocket pod is capable of total and partial ripple as well as single shot firing. This is set by the ground crew on the pod face, behind the aerodynamic fairing. The options are:

- 1: Single shot, 1 rocket is fired per firing command.
- 3: Partial ripple, 3 rockets are fired per firing command.
- 6: Partial ripple, 6 rockets are fired per firing command.
- 18: Total ripple, the pod 18 rockets are fired per firing command.

Rockets are fired at an interval of 33 ms, giving it a rate of fire of 1800 rounds per minutes. A rocket pod is empty after 0,6 second of firing.

23 – 7 - EXTERNAL FUEL TANKS

RPL-522

INTRODUCTION

The RPL-522 is the centerline external tank for the Mirage 2000. It holds 1300 l of fuel.

The fuel tank is capable of supersonic flight and is rated for 9 G (FBW mode switch to air/air) when empty and 6 G (FBW mode switch to charge) when not. The tank can be jettisoned from its pylon

The tank characteristics are the following:

- Dimensions:
    - Length: 570 cm
    - Diameter: 63 cm
- Empty weight: 200 kg
- Capacity: 1300 l or 990 kg

The Mirage 2000C can carry only 1 RPL-522 under the fuselage hardpoint.

RPL-541/542

INTRODUCTION

The RPL-541/542 are the 2 wing external tank for the Mirage 2000, they hold 1700 l of fuel each.

The fuel tanks are supposed to be subsonic only, but they can sustain transonic speeds and are rated for 6 G (FBW mode switch to charge) full or empty.

The tank pylons are an integral part of the tank.

The tanks characteristics are the following:

- Dimensions:
  - Length: 630 cm
  - Diameter: 80 cm
- Empty weight: 260 kg
- Capacity: 1700 l or 1580 kg

The Mirage 2000C can carry 1 RPL-541 under the left internal wing hardpoint and 1 RPL-542 under the right internal wing hardpoint.

24 - AIR-TO-AIR EMPLOYMENT

SECTION 24

AIR-TO-AIR EMPLOYMENT

INTRODUCTION

This section is dedicated to the employment of the Mirage 2000C systems and weapons against aerial targets.

The Mirage 2000C is an all-weather interceptor whose primary mission is to intercept, identify and destroy hostile aircraft. It is capable of employing semi-active radar guided missiles, infrared missiles and internal guns to carry out its mission.

The interception is done using the onboard radar or guidance from an AWACS or GCI station. The aircraft is guided to a position that allows weapon employment or identification depending on the target and rules of engagements.

The identification can be done multiple ways:

- Visually
- IFF
- Non-cooperative target recognition (NCTR)
- Radar signals
- AWACS/GCI declare

Most of the time, the rules of engagements will require that the identification of the aircraft is corelated by at least 2 sources.

The destruction of hostile aircraft is done using the most appropriate weapon depending on the target, the distance and the geometry between the aircrafts.

24 – 1 - DEFA 554

SYMBOLOGY

The following symbology is relative to the air-to-air guns employment. It is representative the symbology displayed on the VTH and VTB with and without a PSIC lock, with the SNA in air-to-air mode and the air-to-air guns selected.

For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION** and **RADAR SECTION**.

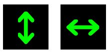
VTH

CAN SUB-MODE (*Mode canon air-air*):

CAN

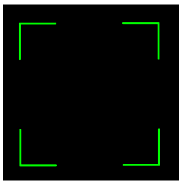
Displayed when the VTH is in air-to-air gun sub-mode. Steady indicates that the guns are ready, flashing that the master arm or gun safety are off.

MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*):



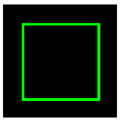
Indicates the current scan mode for the MAGICs, vertical or horizontal.

MAGIC NARROW SEARCH (*Secteur étroit MAGIC*):

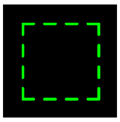


Indicates that the MAGICs are in narrow search and its limits.

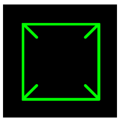
RADAR TARGET POSITION (*Carré but*):



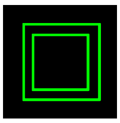
The square indicates the direction of the locked radar contact. It is flashing during a MAGIC to radar slave.



The dashed square indicates the direction of the locked contact when it is outside the VTH.



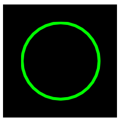
The square with the hollowed-out cross indicates that the radar is disturbed by jammer signals.



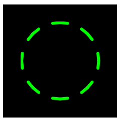
The doubled square represents the shoot incitation, present when the aircraft estimates that the current firing solution will result in a hit.

The radar target position symbols can be mixed.

MAGIC LOCK (*Direction d'accrochage MAGIC*):

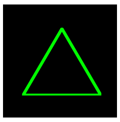


The circle indicates the direction of the priority MAGIC lock. It is flashing during a radar to MAGIC slave.

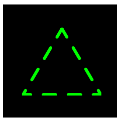


The dashed circle indicates the direction of the locked contact when it is outside the VTH.

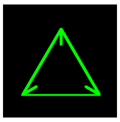
MAGIC AND RADAR COINCIDENCE (*Coïncidence radar MAGIC*):



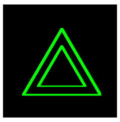
Indicates that the radar and MAGICs are locked on the same target.



The dashed triangle indicates the direction of the radar and MAGIC contact when it is outside the VTH.



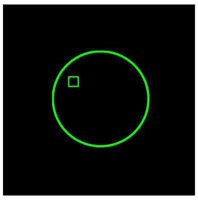
The triangle with the hollowed-out cross indicates that the radar is disturbed by jammer signals.



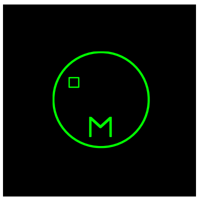
The doubled triangle represents the shoot incitation, present when the aircraft estimates that the current firing solution will result in a hit.

The radar and MAGIC target position symbols can be mixed.

INTERCEPTION DIRECTOR AND MEMORY MODE INDICATION (*Directeur d'ordre et indication du mode mémoire*):

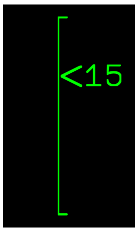


Displayed when the radar is locked, the point is positioned relative to the fixed diameter circle and indicates the maneuvers necessary to place the aircraft in the air-to-air gun employment zone. The pilot needs to place the point at the center of the interception director circle.
Displayed if the target range is over 1 nm.
The circle flashes when the target is performing evasive maneuvers (aspect angle over 135°) or the radar antenna is close to its gimbal limits (within 5°)



The memory mode indication is only displayed in PSIC when the radar has lost the target to indicate that the radar keeps illuminating on the target trajectory to try and reacquire it. This will last 5 seconds after which the radar will return to bar search.

RANGE SCALE (*Echelle de distance*):



Displayed when the radar is locked, the range scale provides a scale for the target range symbology. Possible max scale distances: 80, 40, 20, 10 and 2 nm.

The target range indicates the distance to the target relative to the range scale. The value is in nautical mile with tenths of nm under 10nm and in hectometers under 2nm.

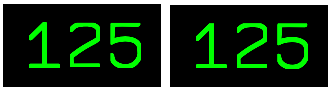
TARGET CLOSING SPEED (*Vitesse de rapprochement cible*):

Displayed when the radar is locked, represents the combined speed of the aircraft and the target in knots. Positive when closing, negative when opening.

TARGET ASPECT ANGLE (*Angle de présentation cible*):

Displayed when the radar is locked, represents the target aspect angle (0 is nose hot, 180 is nose cold) from 0° to 180° and 5° by 5°.

REMAINING SHELLS (*Nombre d'obus restants*):

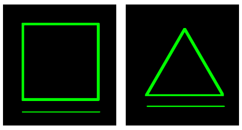


Indicates the remaining shell count for each DEFA 554 cannons.

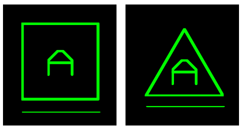
SHOOT INDICATION (*Conseil de tir*):

Indicates that the radar target is inside most restrictive firing domain (*domaine de tir le plus contraignant*) for the MAGIC II, but outside the air-to-air gun employment range.

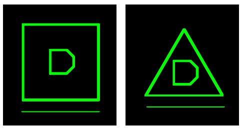
IFF INTERROGATION IN PROGRESS AND IFF CORRELATION (*Interrogation IFF en cours et Corrélation IFF*):



Indicate that the radar target is being interrogated by the IFF system.

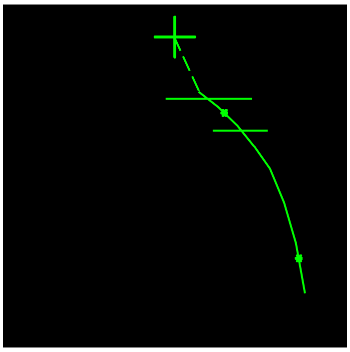


Indicates that the radar target has replied as a friend to the IFF interrogation.



Indicates that the radar as received a friendly reply from the target but the position of the IFF replying aircraft does not correspond to the target position.

GUN CROSS, TRACER LINE, WINGSPAN MARKERS 300M, 600M AND SHELL MARKERS (*Croix canons, ligne de traceurs, barres stadimétriques 300m, 600m et repères cyclistes*):



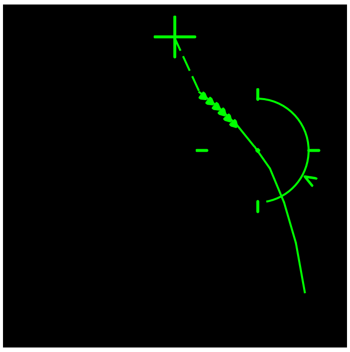
The gun cross represents the gun and MAGICs boresight.

The tracer line represents the trajectory of a continuous, virtual stream of shell. This line does not predict the trajectory of the shells if they were to be fired now, it represents the trajectory of the shell as if they were fired up until now. It starts at the gun cross and finishes when the shell stream has traveled 1000 meters.

The wingspan markers are placed along the tracer line where the virtual stream of shells reaches 300m and 600m. They are always parallel to the aircraft plane and there are used by comparing the marker width to the target wingspan.

The shell markers represent the speed of two virtual shells along the tracer line.

SHOOTING CIRCLE, DISTANCE METER, ANALOG CLOSING SPEED AND SALVO MARKERS (*Réticule de tir, distancemètre, vitesse de rapprochement analogique et notation pilote*):



The shooting reticle is sliding along the tracer line to represent the “critical shell” (*obus critique*) that is at the same range as the target.

The distance meter is centered on the shooting reticle. It unwinds counterclockwise to provide radar range relative to the 4 distance markers. It is displayed below 1nm to target and each circle quadrant represents 300m.

Relative to the distance meter, the analog closing speed represents the range at which the target will be in 5 seconds.

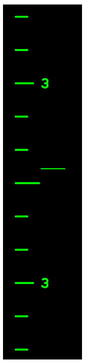
The salvo markers represent the trajectory of the shell salvo along the tracer line. Presented when the first or second stage of the MiCRoB trigger is pressed.

VTB

TARGET INFORMATION (*Infomations cible*):

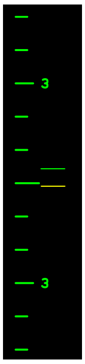
Presents the tracked target information.
From left to right:
Target speed in Mach
Target bearing
Target closing speed in knots
Target altitude in hundreds of feet

ELEVATION SCALE, ANTENNA ELEVATION INDICATOR AND MAGIC ELEVATION (*Echelle de site, repère de site et site MAGIC*):



The elevation scale provides a reference for the antenna elevation indicator relative to the horizon. Each dash is 10°, longer dashes at -30°, 0° and +30° with a 3 next to the - 30° and +30°.

The antenna elevation indicator indicates the position of the tracked target relative to the elevation scale.



The MAGIC elevation is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the elevation scale.

When the MAGIC and the radar are locked on the same target, the antenna elevation indicator and the MAGIC elevation symbology are merged.

HEADING SCALE, TARGET AZIMUTH AND MAGIC AZIMUTH (*Echelle de cap, relèvement cible et gisement MAGIC*):

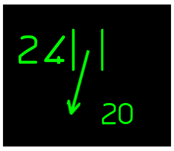
The Heading Scale moves horizontally against the base of the aircraft vector indicating aircraft heading from 0º to 360º. The scale is numbered tens of degrees, with a short line every 10° and the azimuth in tens of degrees every 30°.

The target azimuth indicates the tracked target azimuth relative to the heading scale.

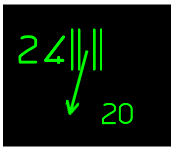
The MAGIC azimuth is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the heading scale.

When the MAGIC and the radar are locked on the same target, the antenna and MAGIC azimuth symbology are merged.

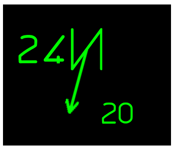
TRACKED TARGET (*Cible poursuivie*):



Indicates the position of the target, its velocity vector, its range in nm and B angle (reverse heading relative to the aircraft: 0° is hot, 180° is cold).

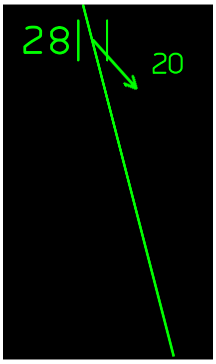


The doubling of the vertical bars indicates that the contact has replied to an IFF interrogation.



A diagonal line indicates that the received reply is doubtful, meaning that the position of the IFF replying aircraft does not totally correspond to the position of the tracked target.

AIRCRAFT TARGET LINE (*Droite chasseur cible*):



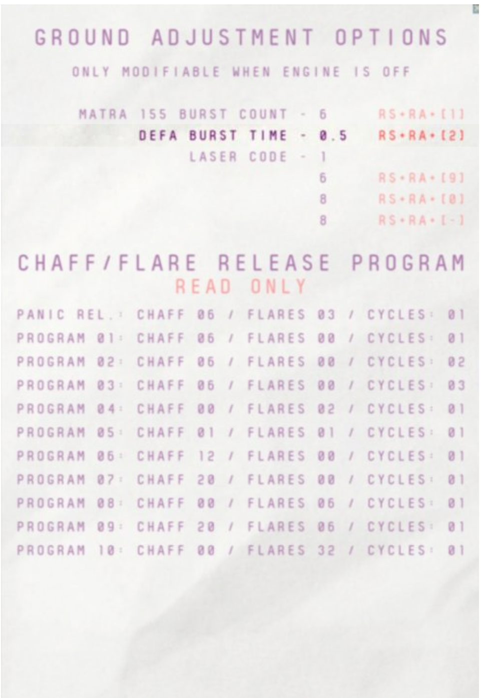
The aircraft target line indicates the direction of the tracked target. It starts from the bottom center of the display, where the aircraft is positioned, passes by the tracked target and ends just above the range marker. It flashes when the antenna is at less than 5° from its gimbal limits.

EMPLOYMENT

In order to destroy a target with the air-to-air gun, multiple steps have to be followed:

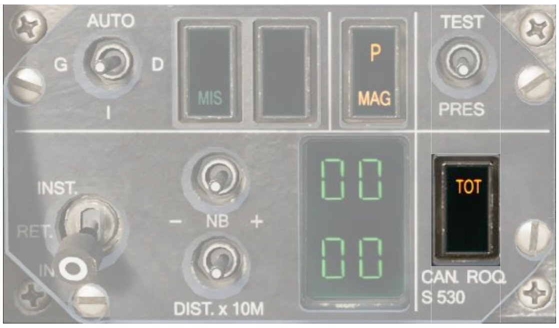
SALVO DURATION

The gun salvo duration is set by the ground crew. The salvo duration can be visualized on the kneeboard “Ground adjustment option” page. It can be selected in the mission editor or using the kneeboard key command (right shift + right alt + 2 by default) while on the ground with the engine off.



SALVO SETTING

The salvo firing or the guns is set using the weapon salvo selection button on the PPA.

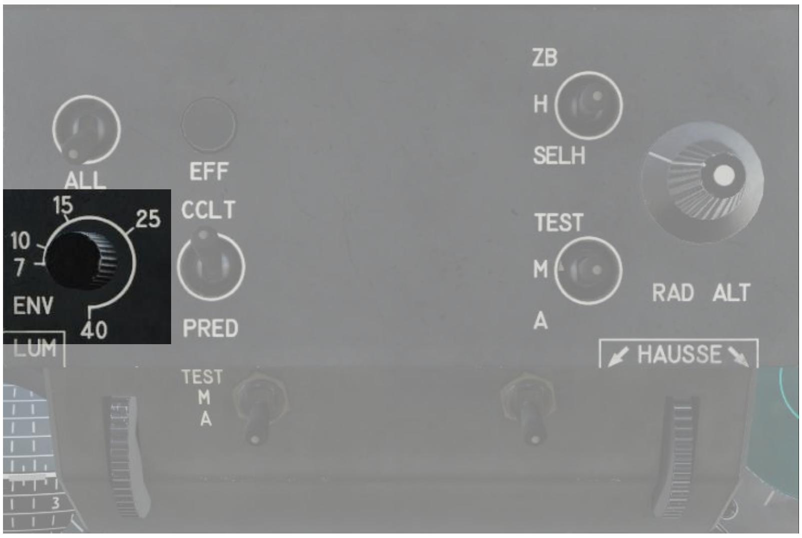


2 yellow lights display the selected mode:

- TOT (*Total*): The guns fire as long as the trigger is pressed.
- PAR (*Partiel* – Partial): The guns fire in salvo of 0,5 or 1 second.

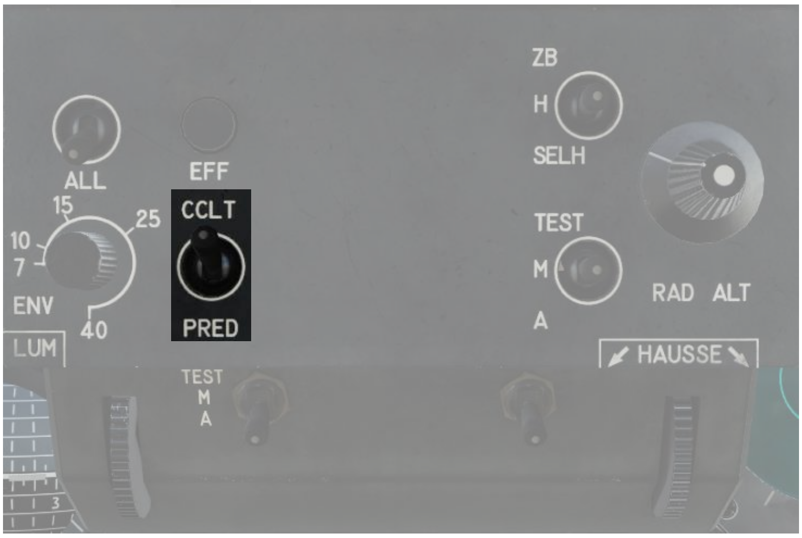
WINGSPAN SETTING

The target wingspan is set on the PCTH, the rotator is used to set the expected target wingspan that will set the width of the 300m and 600m wingspan marker. This setting will also set the size of the target for the shoot incitation symbology. The target wingspan can be set from 7m to 40m.



SHOOT INCITATION SETTING

The shoot incitation setting is set on the PCTH and toggles the display of the shoot incitation symbology.



- **CCLT** (*Calcul continu de la ligne de tir* – Tracer line): No shoot incitation symbology is diplayed.
- **PRED** (*Prédictif* – Shoot incitation): The shoot incitation symbology will be displayed with a radar lock and the correct geometry between the aircraft and the target.

SELECTION

The air-to-air guns are selected by setting the CNM HOTAS command in the C (*canon air-air*) position. Since the air-to-air gun selection is a priority selection, it can always be selected, even in selective jettison mode.

The VTH will display the air-to-air gun sub-mode and show if how many rounds are loaded per gun. For more information on the VTH air-to-air gun sub-mode, see the **HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION**.

FIRING RATE SELECTION

With the air-to-air guns selected, the PCA top row displays the weapons options. These options allow the selection of the guns firing rate.

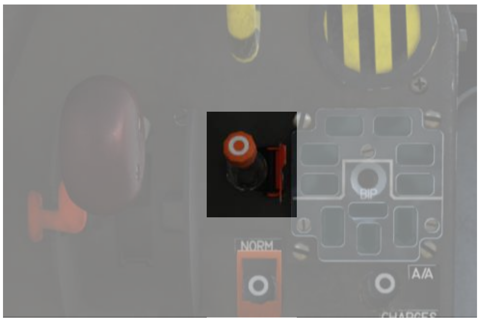
2 options are selectable:

- LEN (*Lent* – Low): 1200 round/min.
- RAP (*Rapide* – High): 1800 round/min.

The firing rate is initialized at high. High firing rate is preferred when using the guns in air-to-air.

MASTER ARM

In order to release the gun, the master arm and the gun safety switches needs to be in the armed position.



If the master arm and gun safety are armed, the VTH CAN mode indication should be steady.

TARGET ACQUISITION

The tracer line, wingspan markers and shell markers provide a weapon employment solution that does not require the target to be locked by the radar. Since, if loaded and prepared, the MAGIC missiles are executing a background search with the air-to-air guns selected, a MAGIC lock can be used to keep a better track of the target without having to use the radar.

A radar lock allows the display of the aiming circle, distance meter and analog closing speed indicator. The radar also allows the display of the shoot incitation symbology.

At guns range, using the radar in bar search won't be effective when searching for targets, the close combat auto-acquisition modes are more appropriate.

As in MAGIC mode, the MAGIC can be slaved to the radar line of sight and vice versa using the weapon system paddle on the HOTAS.

When the MAGIC has a good lock, the pilot will hear a continuous 650 Hz.

For more information on target acquisition using the radar, see the RADAR SECTION.

AIMING

The air-to-air gun aiming solution depends on the solution being radar assisted or not.

RADAR ASSISTED

With the target radar locked, the air-to-air gun aiming is done by placing the target along the tracer line and making the aiming circle converge with it by closing the distance or increasing the target lead.

Since the tracer line and aiming circle are relative to the already fired fictive stream of shells, the guns firing needs to be done one time of flight before the aiming circle is over the target, the time of flight being the time the shells need to reach the target. This means that if the target is sliding along the tracer line, firing when the aiming circle is over the target is too late.

With the shoot incitation setting activated, the radar target position or MAGIC and radar coincidence symbology will be doubled when the aiming circle is at one time of flight from the target.

Example:

The target is placed along the tracer line

The aiming circle is made to converge with the target by closing the distance or increasing the lead.

Once the aiming circle is at one time of flight from being over the target the guns are fired. With the shoot incitation setting activated, the radar target position or MAGIC and radar coincidence symbology will be doubled when it is time to shoot.

Once the aiming circle is over the target, the stream of shells hit.

WITHOUT RADAR

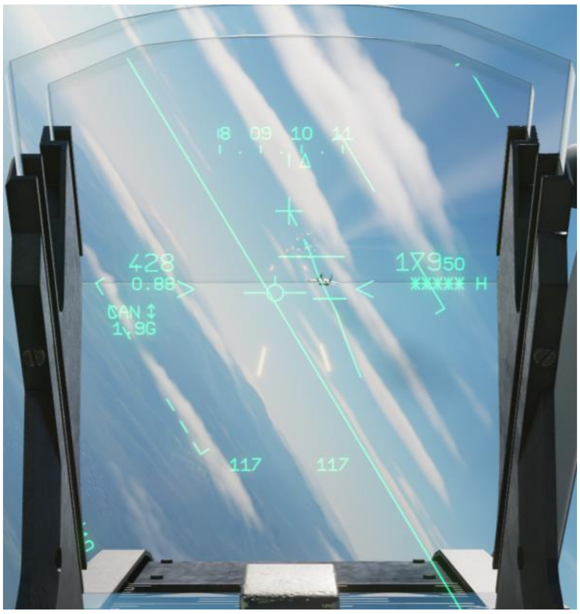
Without radar, the air-to-air gun aiming is done by placing the target along the tracer line and under the 600m wingspan marker. The PCTH wingspan setting needs to be set to the target wingspan.

The distance needs to be deceased until the target wingspan has at least the same width as the 600m wingspan marker, the target is now in range. Since the tracer line and wingspan markers are relative to the already fired fictive stream of shells, the guns firing needs to be done one time of flight before the target is between the wingspan markers, the time of flight being the time the shells need to reach the target.

In order to appreciate duration of this time of flight, the shell markers and salvo markers can be used. The shell markers represent the speed of 2 shells along the tracer line and are always displayed while the salvo markers are displayed when the first MiCRoB detent is pressed and represents the full shell salvo.

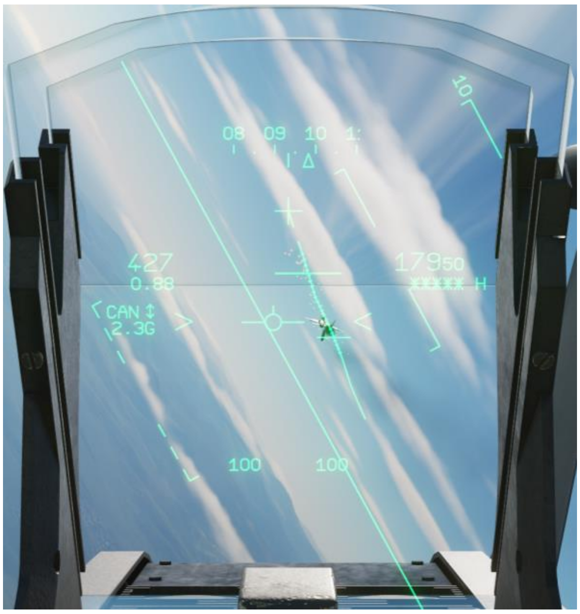
Example:

The target is placed along the tracer line and the 600m wingspan marker is placed next to the target to estimate the range, and the range is reduced by closing the distance or increasing the lead.



Once the target wingspan has at least the same width as the 600m wingspan marker, the shell markers are used to estimate the shell time of flight to the target. With the target being one time of flight of being between the 2 wingspan markers, the guns are fired.

Since the range is estimated, it is better to fire a longer salvo and sooner than one time of flight in order to maximize the hit chance.



Once the target is between the wingspan markers, the stream of shells hit.

EMPLOYMENT DOMAIN

In order to employ the air-to-air guns symbology effectively, the target needs to be in front of the aircraft and in a tail chase. The gun can be used from any other aspect but the symbology won't be usable.

The representation of the employment domain depends if the symbology is radar assisted or not.

RADAR ASSISTED

When radar assisted, the employment domain is represented by the distance meter centered around the aiming circle. It indicates the position of the target relative to the guns firing domain:

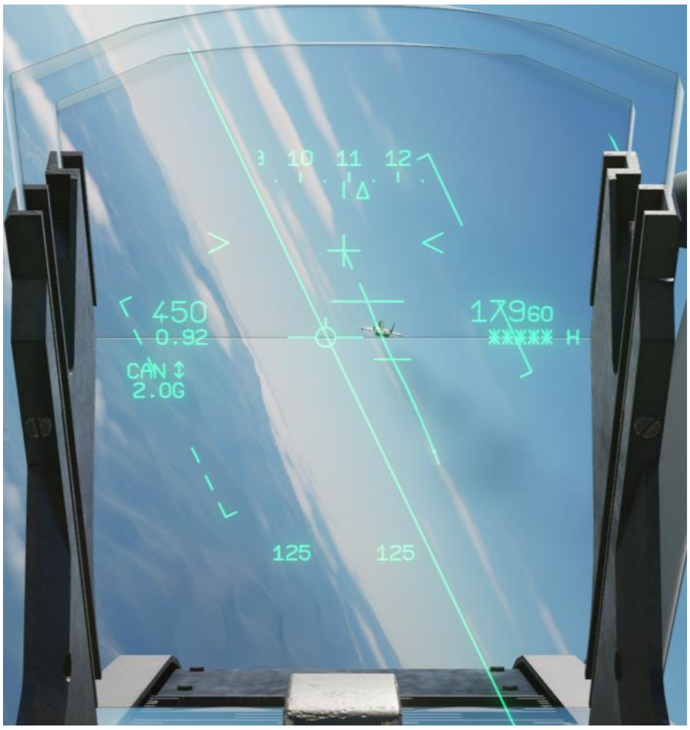
- A full circle indicates that the target is out of range.
- The circle starts to unwind counter-clockwise when the aircraft enters the air-to-air guns firing domain: 1200 meters.
- The 9 o'clock position indicates the maximum range: 900 meters.
- The 6 o'clock position indicates the optimum range: 600 meters.
- The 3 o'clock position indicates the minimum range: 300 meters.

Displayed relative to the distance meter is the analogue closing speed symbol, it represents the range at which the target will be in 5 seconds.

WITHOUT RADAR

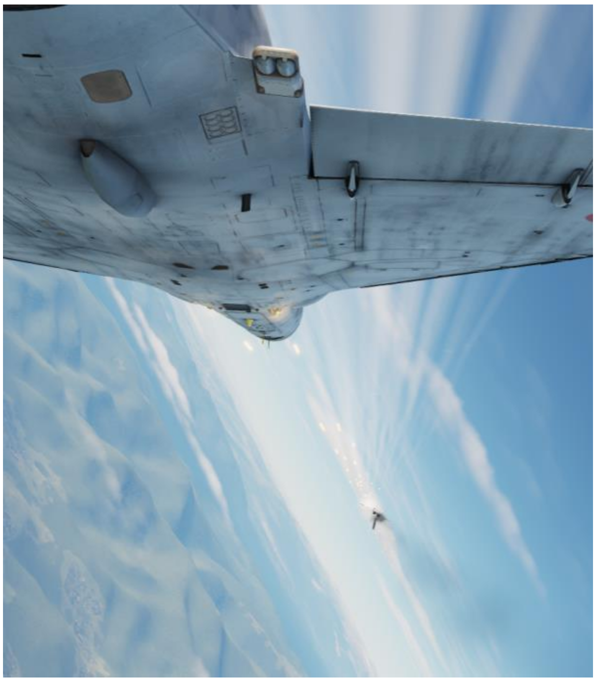
Without the radar, the position of the target relative to the guns employment domain needs to be estimated using the 300 m and 600 m wingspan markers.

First, the target wingspan needs to be set on the PCTH, then the target wingspan needs to be compared to the 2 wingspan markers placed along the tracer line. If the target wingspan is between the 600 m and 300 m wingspan markers, it is in range.



GUNS FIRING

The guns are fired using the MiCRoB second stage trigger on the HOTAS. The guns fire at the fire rate selected on the PCA and in a salvo depending on the PPA selection and salvo length set by the ground crew.



24 – 2 - SUPER 530D

SYMBOLOGY

The following symbology is relative to the Super 530D missile employment. It is representative the symbology displayed on the VTH and VTB with the target locked in PSIC, the SNA in air-to-air mode and the Super 530D selected.

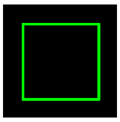
For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION** and **RADAR SECTION**.

VTH

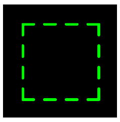
530 SUB-MODE (*Mode 530*):

Displayed when the VTH is in 530 air-to-air sub-mode. Steady indicates that the missiles are ready, flashing that the master arm is off.

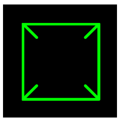
RADAR TARGET POSITION (*Carré but*):



The square indicates the direction of the locked radar contact.



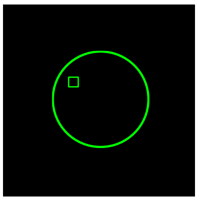
The dashed square indicates the direction of the locked contact when it is outside the VTH.



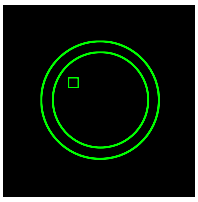
The square with the hollowed-out cross indicates that the radar is disturbed by jammer signals.

The radar target position symbols can be mixed.

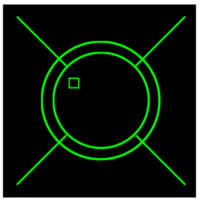
INTERCEPTION DIRECTOR, BREAK AWAY CROSS AND MEMORY MODE INDICATION (*Directeur d'ordre, croix de dégagement et indication mode mémoire*):



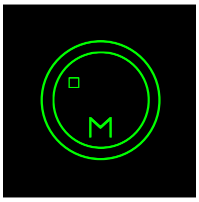
Displayed when the radar is locked, the point is positioned relative to the fixed diameter circle and indicates the maneuvers necessary to place the aircraft in the Super 530D employment zone. The pilot needs to place the point at the center of the interception director circle.
The circle flashes when the target is performing evasive maneuvers (aspect angle over 135°) or the radar antenna is close to its gimbal limits (within 5°)



The circle is doubled when the locked contact is in the least restrictive firing domain (*domaine de tir le moins contraignant*).



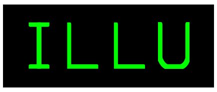
The break away cross is displayed around the interception director 5 seconds before the distance between the aircraft and the target reaches zero.



The memory mode indication indicates that the radar has lost the target but keeps illuminating on its trajectory and is trying to require it.

In PSIC Super 530 this indication is displayed for 8 seconds after which it is replaced by the illumination indication.

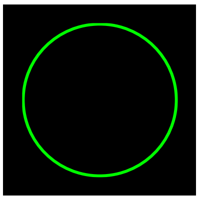
FORCED ILLUMINATION INDICATION (*Illumination forcée*):



Indicates that the radar is in forced illumination mode, selected after the memory mode has run its course. In this mode, the radar will continue to illuminate the target on its trajectory but won't try to re-acquire the lock again. Forced illumination lasts for the remainder of the PSIC Super 530 mode duration.

Also displayed when the radar is in PSIC Super 530 Pointé mode.

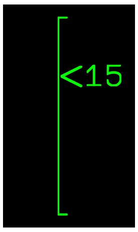
PSIC SUPER 530 POINTE ILLUMINATION SECTOR (*Secteur illumination PSIC Super 530 pointé*):



Displayed when the radar is in PSIC Super 530 Pointé mode, represents the position of the radar beam.

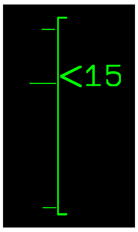
Used to aim the radar at the target.

RANGE SCALE, TARGET RANGE AND LONG AND SHORT LIMITS (*Echelle de distance, distance cible et limites longues et courtes*):



Displayed when the radar is locked, the range scale provides a scale for the target range symbology and limits symbology. Possible max scale distances: 80, 40, 20, 10 and 2 nm.

The target range indicates the distance to the target relative to the range scale. The value is in nautical mile with tenths of nm under 10nm and in hectometers under 2nm.



The long and short limits represent the radar calculated range envelope for the Super 530D missiles relative to the radar range scale. The two top lines represents the long limits and the bottom line represent short limit. The long limit without defensive maneuvers (*limite longue sans évasive*) line is thicker than the long limit with defensive maneuvers (*limite longue avec évasive*).

The long limits can move above the range scale.

TARGET CLOSING SPEED (*Vitesse de rapprochement cible*):

Displayed when the radar is locked, represents the combined speed of the aircraft and the target in knots. Positive when closing, negative when opening.

TARGET ASPECT ANGLE (*Angle de présentation cible*):

Displayed when the radar is locked, represents the target aspect angle (0 is nose hot, 180 is nose cold) from 0° to 180° and 5° by 5°.

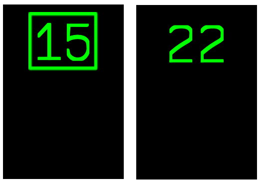
MISSILES STATUS AND MISSILES TIME OF FLIGHT (*Etat des missiles et Temps de vol missiles*):

Indicates the presence of the left (G – *gauche*) and right (D – *droit*) missiles. Flashes when the missiles are not ready.

Displayed when the radar is locked, the circle indicates that the missiles are ready and locked on the PSIC target.

The number above indicates the planned missile time of flight if they were to be launched now.

The missile status letter disappears to indicate that the missile has been fired.



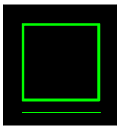
For the fired missiles, the time off flight indicates the time to impact as calculated by the aircraft. If two missiles are fired at the same time, only the time to impact of the last missile is calculated, the time to impact of the first missile is replaced by a countdown timer.

If the radar is in forced illumination or PSIC Super 530 Pointé, the time to impact is replaced by the time to missile auto-destruction, indicated by rectangle around the value.

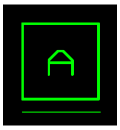
SHOOT INDICATION (*Conseil de tir*):

Indicates that the radar target is inside the most restrictive firing domain (*domaine de tir le plus contraignant*) for the Super 530D.

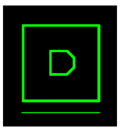
IFF INTERROGATION IN PROGRESS AND IFF CORRELATION (*Interrogation IFF en cours et Corrélation IFF*):



Indicate that the tracked target is being interrogated by the IFF system.



Indicates that the radar target contact has replied to the IFF interrogation.



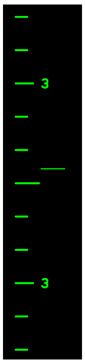
Indicates that the radar as received a friendly reply from the target but the position of the IFF replying aircraft does not correspond to the target position.

VTB

TARGET INFORMATION (*Infomations cible*):

Presents the tracked target information.
From left to right:
Target speed in Mach
Target bearing
Target closing speed in knots
Target altitude in hundreds of feet

ELEVATION SCALE AND ANTENNA ELEVATION INDICATOR (*Echelle et repère de site*):



The elevation scale provides a reference for the antenna elevation indicator relative to the horizon. Each dash is 10°, longer dashes at -30°, 0° and +30° with a 3 next to the - 30° and +30°.

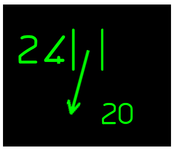
The antenna elevation indicator indicates the position of the tracked target relative to the elevation scale.

HEADING SCALE AND TARGET AZIMUTH (*Echelle de cap et relèvement cible*):

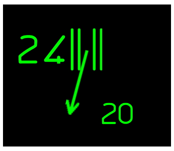
The Heading Scale moves horizontally against the base of the aircraft vector indicating aircraft heading from 0º to 360º. The scale is numbered tens of degrees, with a short line every 10° and the azimuth in tens of degrees every 30°.

The target azimuth indicates the tracked target azimuth relative to the heading scale.

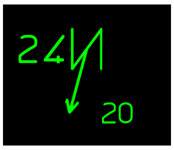
TRACKED TARGET (*Cible poursuivie*):



Indicates the position of the target, its velocity vector, its range in nm and B angle (reverse heading relative to the aircraft: 0° is hot, 180° is cold).

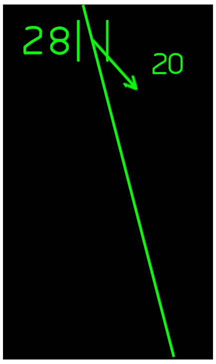


The doubling of the vertical bars indicates that the contact has replied to an IFF interrogation.

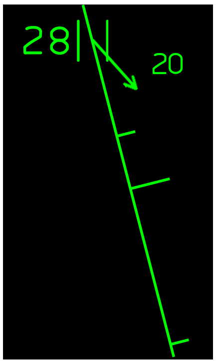


A diagonal line indicates that the received reply is doubtful, meaning that the position of the IFF replying aircraft does not totally correspond to the position of the tracked target.

AIRCRAFT TARGET LINE, LONG AND SHORT LIMITS (*Droite chasseur cible, limites longues et courte*):



The aircraft target line indicates the direction of the tracked target. It starts from the bottom center of the display, where is aircraft is positioned, passes by the tracked target and ends just above the range marker. It flashes when the antenna is at less than 5° from its gimbal limits.



The long and short limits represent the radar calculated range envelope for the Super 530D missiles relative to the target position along the aircraft target line. The two top lines represents the long limits and the bottom line represent short limit. The long limit with defensive maneuvers (*limite longue avec évasive*) line is longer that the long limit without defensive maneuvers (*limite longue sans évasive*) line.

EMPLOYMENT

In order to destroy a target with the Super 530D missile, multiple steps have to be followed:

PREPARATION

Before they can be fired, the Super 530D missiles needs to be prepared. This preparation sequence consists of:

- The missile start-up: First the seeker frequency is synchronized with the aircraft radar frequency after which the calculator, gyrometer and servomotors are powered. The seeker gyroscope is powered and spinned-up, this lasts 40 seconds after which the seeker antenna is slaved to it.
- The missile tests: The missile and missile pylon execute their self-test procedures to determine if they are operating correctly. Those tests last 45 seconds and run in parallel to the missile start-up.

The missile preparation sequence lasts 45 seconds after which the missile is ready to be selected and fired.

The missile preparation is controlled by the S530 preparation button on the PPA.

The button will start the preparation if the missiles are not ready and power them off if they are in preparation or ready except if the SNA is in 530 mode. The preparation automatically starts after a 30 seconds post engine startup delay, this can be canceled if the S530 preparation button is pressed during the post engine startup delay.

The Super 530D preparation status is indicated by the yellow P light located on the S530 preparation button:

- Fixed, indicates that at least 1 missile is ready.
- Flashing, indicates that the missiles are either in the post engine startup delay or executing the preparation sequence.

SELECTION

The Super 530D missiles are selected by pressing the PCA weapon selection button under the 530 window. In order to be able to select the 530 mode, the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA weapon selection button under the 530 window indicates that the 530 mode is selected.

The VTH will display the 530 sub-mode and show how many missiles are loaded as well as their status. For more information on the VTH 530 sub-mode, see the **HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION**.

MISSILE PRIORITY

The Super 530D missile priority can be set using the missile selection switch on the PPA.

The switch has 3 positions:

- **G** (*Gauche* – Left)
- **AUTO** (*Automatique* – Automatic)
- **D** (*Droite* – Right)

The left and right missile priority is respected by the SNA as long as the selected missile is present and not inhibited.

In automatic, the priority follows the following rules:

- The first locked missile has priority.

- If the 2 missiles are locked, the masking calculation sets the priority.
- If 1 missile is inhibited, the other one has priority.
- If only 1 missile is present, it has priority.

SALVO SETTING

If the aircraft is loaded with 2 Super 530D missiles they can be fired one after the other in a salvo. This salvo mode is set using the weapon salvo selection button on the PPA.

2 yellow lights display the selected mode:

- TOT (*Total*): Super 530: The 2nd missile will fire 2 seconds after the first if the trigger is held pressed.
- PAR (*Partiel* – Partial): Super 530: Only 1 missile is fired per trigger press.

The salvo firing is only available if both missiles are not inhibited and locked on the PSIC target. The salvo availability is indicated by the S530 salvo symbology on the VTH.

MASTER ARM

In order to fire the Super 530D, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the 530 window indicates that the master arm is armed, the missiles are ready and no failure prevent missile employment.

TARGET ACQUISITION

The Super 530D missile is guided by a passive seeker that requires the radar to illuminate the target for the seeker to acquire it. When the radar is in PSIC, the missile seeker is slaved to the radar line of sight to attempt to lock the target aircraft.

When a missile seeker is locked the corresponding missile status symbology is circled. When at least 1 missile has is locked, the pilot will hear a continuous 650 Hz tone.

If the radar target is outside of the missiles seeker field of view, the pilot will hear a 650 Hz tone chopped at 1 Hz.

If the radar is in PSID and the MiCRoB trigger is pressed, the radar will attempt to transition to PSIC and lock the missile seeker. If PSIC or seeker lock cannot be achieved, the missiles won't fire.

For more information on target acquisition using the radar, see the RADAR SECTION.

EMPLOYMENT DOMAIN

In order to employ the Super 530D effectively, the weapon needs to be fired in the correct parameters. Those parameters are:

- Missile range for the target aspect, speed and altitude.
- Target angle of the nose of the aircraft.

The missile range is calculated in real time by the aircraft and presented to the pilot on the VTH and VTB.

The employment domain is represented by 3 limits:

- Long limit without defensive maneuvers (*Limite longue sans évasive*): Represents the maximum range at which the missile can be fired and will hit the target if it maintains its course, speed and altitude.
- Long limit with defensive maneuvers (*Limite longue avec évasive*): Represents the maximum range at which the missile can be fired and will hit the target even if it flies directly away from the shooter aircraft.
- Short limit (*Limite courte*): Represents the minimum range at which the missile can be fired and will have the time to arm itself and steer to the target.

When firing on a target flying away from the shooter aircraft, both long limits will overlap.

When the target is between the long limit without defensive maneuvers and the long limit with defensive maneuvers, called the least restrictive firing domain (*domaine de tir le moins contraignant*) the interception director circle is doubled.

When the target is between the long limit with defensive maneuvers and the short limit, called the most restrictive firing domain (*domaine de tir le plus contraignant*), the shoot indication will be displayed on the VTH and the missile lock tone is replaced by a 650/1000 Hz tone interleaved at 2 Hz.

The best firing conditions are achieved when the missile is fired while the target is in the most restrictive firing domain and the interception director point is centered inside the circle, this will result in the maximum probability of kill (PK) to the missile.

A missile fired with the target outside the most restrictive firing domain but still inside the long limit without defensive maneuvers can still hit depending on the target actions while the missile is in flight, the PK depends on the closeness of the target to the most restrictive firing domain.

A missile fired while the target is outside the long limit without defensive maneuvers will result in a very low PK as the missile might self-destruct or stall before reaching the target. Firing closer that the short limit will also result in a low PK as the missile most likely won’t have enough time to arm itself and/or maneuver to the target.

Additionally, the missile expected time of flight is displayed over the missile status symbology. This information can give a cue about the missile employment domain as the missile self-destruct 45 seconds after being fired.

MISSILE FIRING

The missile is fired using the MiCRoB second stage trigger on the HOTAS. The command needs to be held during the 650ms firing sequence. The minimum time between 2 missiles fire is 2 seconds.

If the salvo mode is selected on the PPA, the second missile firing sequence starts 2 seconds after the first missile is fired.

Missile firing will trigger engine hot gas ingestion protection system.

MISSILE GUIDANCE

The Super 530D missile uses semi-active radar guidance to fly to its target, this guidance method requires the shooting aircraft to illuminate the target until the missile reaches it. In the Mirage, this means that the shooter aircraft needs to maintain a PSIC lock on the target until the missile hits or self-destructs.

Once a missile is fired the radar will switch to PSIC Super 530 sub-mode that lasts 50 seconds. During this time the radar is forced in PSIC and the only depressing the weapon system command will return the radar to bar search.

If the target lock is lost, the memory mode will continue to illuminate the target's last known trajectory and try to re-acquire it for 8 seconds.

After 8 seconds of memory mode, the radar will switch to forced illumination mode where it will continue to illuminate the target but won't try to re-acquire the lock. This will last for the remainder of the PSIC Super 530 mode duration.

If the radar has lost the target and is no longer illuminating in its direction, the radar can be switched to PSIC Super 530 pointé mode using the weapon system forward command. In this mode, the radar antenna position is fixed on the aircraft axis and the pilot needs to steer the aircraft to illuminate the target. While in this mode, the radar beam size and position are represented on the VTH by a full circle.

While the VTH is in PSIC Super 530 mode, it will display the estimated remaining time of flight in seconds for the fired missile. This number is boxed if the value indicates the remaining time before the missile self-destructs.

24 – 3 - MAGIC II

SYMBOLOGY

The following symbology is relative to the MAGIC II missile employment. It is representative the symbology displayed on the VTH and VTB with and without a PSIC lock, with the SNA in air-to-air mode and the MAGIC II selected.

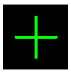
For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION** and **RADAR SECTION**.

VTH

MAG SUB-MODE (*Mode MAGIC*):

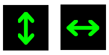
Displayed when the VTH is in MAGIC air-to-air sub-mode. Steady indicates that the missiles are ready, flashing that the master arm is off.

GUN CROSS (*Croix canons*):



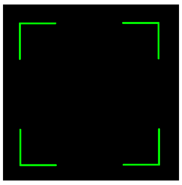
Represents the gun and MAGICs boresight.

MAGIC SEARCH SECTOR (*Secteur de recherche MAGIC*):



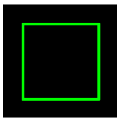
Indicates the current scan mode for the MAGIC, vertical or horizontal.

MAGIC NARROW SEARCH (*Secteur étroit MAGIC*):

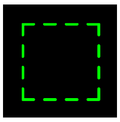


Indicate that the MAGIC are in narrow search and its limits.

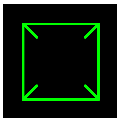
RADAR TARGET POSITION (*Carré but*):



The square indicates the direction of the locked radar contact. It is flashing during a MAGIC to radar slave.



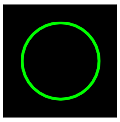
The dashed square indicates the direction of the locked contact when it is outside the VTH.



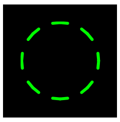
The square with the hollowed-out cross indicates that the radar is disturbed by jammer signals.

The radar target position symbols can be mixed.

MAGIC LOCK (*Direction d'accrochage MAGIC*):

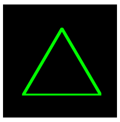


The circle indicates the direction of the priority MAGIC lock. It is flashing during a radar to MAGIC slave.

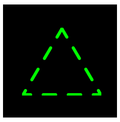


The dashed circle indicates the direction of the locked contact when it is outside the VTH.

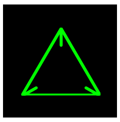
MAGIC AND RADAR COINCIDENCE (*Coïncidence radar MAGIC*):



Indicates that the radar and MAGICs are locked on the same target.



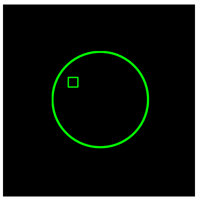
The dashed triangle indicates the direction of the radar and MAGIC contact when it is outside the VTH.



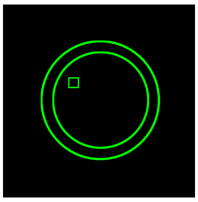
The triangle with the hollowed-out cross indicates that the radar is disturbed by jammer signals.

The radar and MAGIC target position symbols can be mixed.

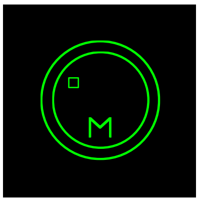
INTERCEPTION DIRECTOR AND MEMORY MODE INDICATION (*Directeur d'ordre et indication du mode mémoire*):



Dipslayed when the radar is locked, the point is positioned relative to the fixed diameter circle and indicates the maneuvers necessary to place the aircraft in the MAGIC II employment zone. The pilot needs to place the point at the center of the interception director circle.
The circle flashes when the target is performing evasive maneuvers (aspect angle over 135°) or the radar antenna is close to its gimbal

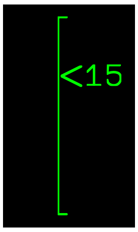


The circle is doubled when the locked contact is in the least restrictive firing domain (*domaine de tir le moins contraignant*).



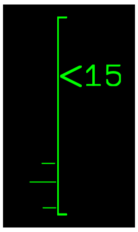
The memory mode indication is only displayed in PSIC when the radar has lost the target to indicate that the radar keeps illuminating on the target trajectory to try and require it. This will last 5 second after which the radar will return to bar search.

RANGE SCALE, TARGET RANGE AND LONG AND SHORT LIMITS (*Echelle de distance, distance cible et limites longues et courtes*):



Displayed when the radar is locked, the range scale provides a scale for the target range symbology and limits symbology. Possible max scale distances: 80, 40, 20, 10 and 2 nm.

The target range indicates the distance to the target relative to the range scale. The value is in nautical mile with tenths of nm under 10nm and in hectometers under 2nm.



The long and short limits represent the radar calculated range envelope for the MAGIC II missiles relative to the radar range scale. The two top lines represents the long limits and the bottom line represents short limit. The long limit without defensive maneuvers (*limite longue sans évasive*) line is thicker than the long limit with defensive maneuvers (*limite longue avec évasive*).

The long limits can move above the range scale.

TARGET CLOSING SPEED (*Vitesse de rapprochement cible*):

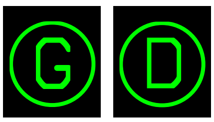
Displayed when the radar is locked, represent the combined speed of the aircraft and the target in knots. Positive when closing, negative when opening.

TARGET ASPECT ANGLE (*Angle de présentation cible*):

Displayed when the radar is locked, represents the target aspect angle (0 is nose hot, 180 is nose cold) from 0° to 180° and 5° by 5°.

MISSILES STATUS (*Etat des missiles*):

Indicates the presence of the left (G – *gauche*) and right (D – *droit*) missiles. Flashes when the missiles are not ready.

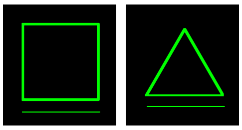


The circles indicate that the missiles are locked and ready to fire.

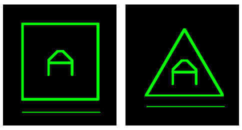
SHOOT INDICATION (*Conseil de tir*):

Indicates that the radar target is inside most restrictive firing domain (*domaine de tir le plus contraignant*) for the MAGIC II.

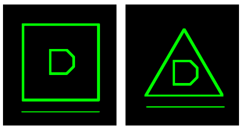
IFF INTERROGATION IN PROGRESS AND IFF CORRELATION (*Interrogation IFF en cours et Corrélation IFF*):



Indicate that the radar target is being interrogated by the IFF system.



Indicates that the radar target has replied as a friend to the IFF interrogation.



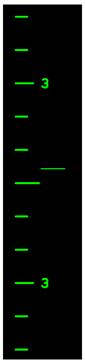
Indicates that the radar as received a friendly reply from the target but the position of the IFF replying aircraft does not correspond to the target position.

VTB

TARGET INFORMATION (*Infomations cible*):

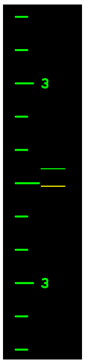
Presents the tracked target information.
From left to right:
Target speed in Mach
Target bearing
Target closing speed in knots
Target altitude in hundreds of feet

ELEVATION SCALE, ANTENNA ELEVATION INDICATOR AND MAGIC ELEVATION (*Echelle de site, repère de site et site MAGIC*):



The elevation scale provides a reference for the antenna elevation indicator relative to the horizon. Each dash is 10°, longer dashes at -30°, 0° and +30° with a 3 next to the - 30° and +30°.

The antenna elevation indicator indicates the position of the tracked target relative to the elevation scale.



The MAGIC elevation is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the elevation scale.

When the MAGIC and the radar are locked on the same target, the antenna elevation indicator and the MAGIC elevation symbology are merged.

HEADING SCALE, TARGET AZIMUTH AND MAGIC AZIMUTH (*Echelle de cap, relèvement cible et gisement MAGIC*):

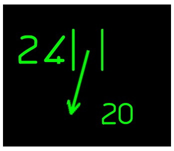
The Heading Scale moves horizontally against the base of the aircraft vector indicating aircraft heading from 0º to 360º. The scale is numbered tens of degrees, with a short line every 10° and the azimuth in tens of degrees every 30°.

The target azimuth indicates the tracked target azimuth relative to the heading scale.

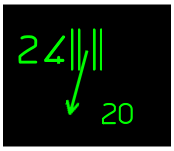
The MAGIC azimuth is displayed in yellow when the missile is locked and indicates the direction of the lock relative to the heading scale.

When the MAGIC and the radar are locked on the same target, the antenna and MAGIC azimuth symbology are merged.

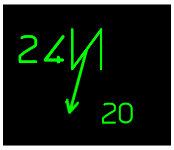
Tracked target (*Cible poursuivie*):



Indicates the position of the target, its velocity vector, its range in nm and B angle (reverse heading relative to the aircraft: 0° is hot, 180° is cold).

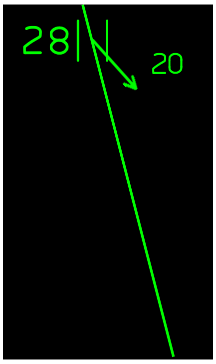


The doubling of the vertical bars indicates that the contact has replied to an IFF interrogation.

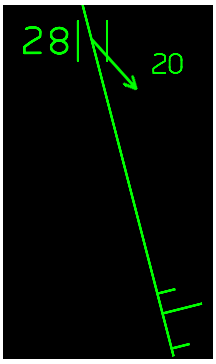


A diagonal line indicates that the received reply is doubtful, meaning that the position of the IFF replying aircraft does not totally correspond to the position of the tracked target.

AIRCRAFT TARGET LINE, LONG AND SHORT LIMITS (*Droite chasseur cible, limites longues et courte*):



The aircraft target line indicates the direction of the tracked target. It starts from the bottom center of the display, where is aircraft is positioned, passes by the tracked target and ends just above the range marker. It flashes when the antenna is at less than 5° from its gimbal limits.



The long and short limits represent the radar calculated range envelope for the MAGIC II missiles relative to the target position along the aircraft target line. The two top lines represent the long limits and the bottom line represents short limit. The long limit with defensive maneuvers (*limite longue avec évasive*) line is longer that the long limit without defensive maneuvers (*limite longue sans évasive*) line.

EMPLOYMENT

In order to destroy a target with the MAGIC II missile, multiple steps have to be followed:

PREPARATION

Before they can be fired, the MAGIC II missiles need to be prepared. This preparation sequence consists of:

- The missile start-up: The infrared seeker cooling sequence is started using the pylon's liquid nitrogen, the gyrometer and servomotors are powered. The seeker cooling sequence lasts 34 seconds.
- The missile tests: The missile and missile pylon execute their self-test procedures to determine if they are operating correctly. Those tests last 1 second and run in parallel to the missile start-up.

The missile preparation sequence lasts 42 seconds after which the missile is ready to be selected and fired.

The missile preparation is controlled by the MAGIC preparation button on the PPA.

The button will start the preparation if the missiles are not ready and power them off if they are in preparation or ready except if the MAGICs are selected. The preparation automatically starts after a 30 seconds post engine startup delay, this can be canceled if the MAGIC preparation button is pressed during the post engine startup delay.

The MAGIC II preparation status is indicated by the yellow P light located on the MAGIC preparation button:

- Fixed, indicates that at least 1 missile is ready.
- Flashing, indicates that the missiles are either in the post engine startup delay or executing the preparation sequence.

SELECTION

The MAGIC II missiles are selected by setting the CNM HOTAS command in the M (MAGIC) position. Since the MAGIC selection is a priority selection, it can always be selected, even in selective jettison mode.

The S light on the PCA weapon selection button under the MAG window indicates that the MAGIC mode is selected.

The PCA weapon selection button under the MAG window is used to select MAV mode and can't be used to select MAGIC II missile for employment.

The VTH will display the MAGIC sub-mode and show if how many missiles are loaded as well as their status. For more information on the VTH MAGIC sub-mode, see the HEAD-UP DISPLAY AIR-TO-AIR MODE SUB-SECTION.

MASTER ARM

In order to fire the MAGIC II, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the MAG window indicates that the master arm is armed, the missiles are ready and no failure prevent missile employment.

TARGET ACQUISITION

The MAGIC missile is guided by an independent seeker and does not need help from the radar to acquire its target. Therefore, target acquisition can be done using one the MAGIC search sectors. For more information on the MAGIC search sector, see the NAVIGATION AND WEAPON SYSTEM MAGIC SEARCH SECTION.

The radar can nonetheless be used for MAGIC target acquisition, the MAGIC can be slaved to the radar line of site. This is done using the weapon system paddle on the HOTAS. The opposite can also be done, if the magic is locked on a target, the radar can be slaved to the MAGIC line of sight using the same command.

When the MAGIC has a good lock, the pilot will hear a continuous 650 Hz tone.

For more information on target acquisition using the radar, see the RADAR SECTION.

EMPLOYMENT DOMAIN

In order to employ the MAGIC effectively, the weapon needs to be fired in the correct parameters. Those parameters are:

- Missile range for the target aspect, speed and altitude.
- Target angle of the nose of the aircraft.

The MAGIC missiles can’t determine target range or aspect alone, in order for the aircraft to provide the missile employment domain, the radar needs to be locked on the same target as the MAGIC missile.

The missile range is calculated in real time by the aircraft and presented to the pilot on the VTH and VTB.

The employment domain is represented by 3 limits:

- Long limit without defensive maneuvers (*Limite longue sans évasive*): Represents the maximum range at which the missile can be fired and will hit the target if it maintains its course, speed and altitude.
- Long limit with defensive maneuvers (*Limite longue avec évasive*): Represents the maximum range at which the missile can be fired and will hit the target even if it flies directly away from the shooter aircraft.
- Short limit (*Limite courte*): Represents the minimum range at which the missile can be fired and will have the time to arm itself and steer to the target.

When firing on a target flying away from the shooter aircraft, both long limits will overlap.

When the target is between the long limit without defensive maneuvers and the long limit with defensive maneuvers, called the least restrictive firing domain (*domaine de tir le moins contraignant*) the interception director circle is doubled.

When the target is between the long limit with defensive maneuvers and the short limit, called the most restrictive firing domain (*domaine de tir le plus contraignant*), the shoot indication is displayed on the VTH the missile lock tone is replaced by a 650/1000 Hz tone interleaved at 2 Hz.

The best firing conditions are achieved when the missile is fired while the target is in the most restrictive firing domain and the interception director point is centered inside the circle, this will result in the maximum probability of kill (PK) to the missile.

A missile fired with the target outside the most restrictive firing domain but still inside the long limit without defensive maneuvers can still hit depending on the target actions while the missile is in flight, the PK depends on the closeness of the target to the most restrictive firing domain.

A missile fired while the target is outside the long limit without defensive maneuvers will result in a very low PK as the missile might self-destruct or stall before reaching the target. Firing closer that the short limit will also result in a low PK as the missile most likely won't have enough time to arm itself and/or maneuver to the target.

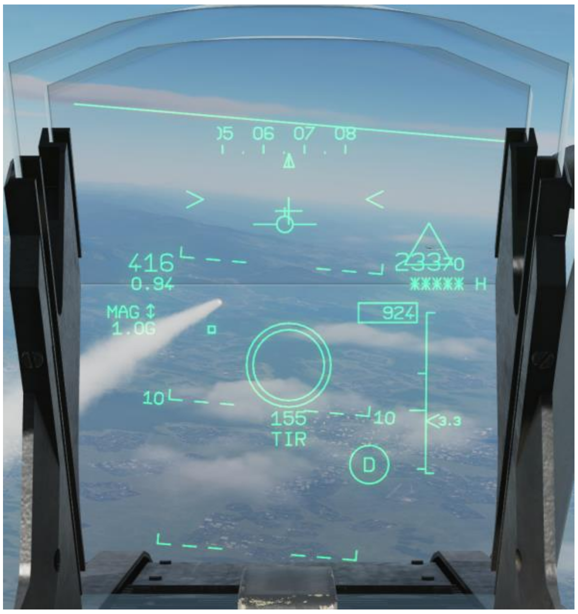
MISSILE FIRING

The missile is fired using the MiCRoB second stage trigger on the HOTAS. The command needs to be held during the 200ms firing sequence. The minimum time between 2 missiles fire is 2 seconds.

Missile firing will trigger engine hot gas ingestion protection system.

MISSILE GUIDANCE

The MAGIC II missile user passive infrared guidance to fly to its target, this guidance method does not require any action from the shooting aircraft after the missile have been fired.



24 – 4 - TACTICS

BEYOND VISUAL RANGE

WORK IN PROGRESS

WITHIN VISUAL RANGE

WORK IN PROGRESS

24 – 5 - COMMUNICATIONS

WITH THE AWACS/GCI

WORK IN PROGRESS

WITH A WINGMAN

WORK IN PROGRESS

25 - AIR-TO-GROUND EMPLOYMENT

INTRODUCTION

This section is dedicated to the employment of the Mirage 2000C systems and weapon against ground targets.

The Mirage 2000C has secondary air to ground capabilities that allows for strike and limited CAS missions. It is capable of using high and low drag bombs, cluster bombs, anti-runway bombs, rockets, internal guns and laser guided bombs with external designation.

The Mirage air-to-ground weapons are classified by method of employment:

- **BL** (*Bombe lisse* – Low drag): The pilot designates the ground target and uses the displayed symbology to reach the release point. All low drag and laser guided bombs use this method of employment.
- **BF** (*Bombe freinée* – High drag): The pilot flies the aircraft level at low altitude and uses the displayed symbology to release the weapons on the ground target. All high drag, anti-runway and cluster bombs use this method of employment.
- **RK** or **CAS** (*Roquettes ou canons air-sol* – Rockets or air-to-ground guns): The pilot uses the displayed symbology to fire the weapons on the ground target. The rockets and guns employment method are very similar and can be treated as the same.

SENSORS

For air to ground weapon employment, the aircraft needs to now the impact point position relative to itself as well as its attitude and speed.

The attitude and speed information are provided by the INS system. A degraded or turned off INS system will result in the impossibility of the aircraft to provide normal weapon employment symbology.

The impact point position can be retrieved using different methods:

- **Radar ranging** (TAS – *Télémétrie air-sol*): The radar is used to determine the distance to the impact point.
  This method is the most accurate one as the range is directly calculated and radars are good at ranging. Some precaution still needs to be followed to achieve the highest accuracy possible.
- **Radar altimeter ranging** (RS – *Radio-sonde*): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.
  This method precision depends on the terrain altitude difference at the aircraft position and the impact point, if there is a difference, the range determination will be incorrect. Over flat or near flat terrain, this method can nonetheless result in a good enough accuracy, even more over water.
- **Baro-altimetric ranging** (ZBI – *Altitude barométrique*): The altitude difference between the aircraft and the impact point altitude is used to know the aircraft's altitude over the impact point. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

This method require that the aircraft knows the impact point altitude. This can be done with an INS BUT or by ranging the target a first time with another method. The accuracy is directly dependent on the accuracy of the altitude information source.

25 – 1 - LOW DRAG BOMBS

INTRODUCTION

Low drag designates all bombs that are not equipped with high drag devices, being unguided or laser guided. On the Mirage 2000C those bombs are released using the *Calcul continu du point de largage* – CCPL (Continuously calculated release point – CCRP) delivery mode: The pilot designates the desired impact point through the VTH or the INS and the aircraft will provide symbology guiding the pilot to the release point. The MiCRoB trigger acts as a release consent and the aircraft releases the bombs when the release point is reached.

This delivery mode is most appropriate for medium to high altitude release in a dive or level as well as low altitude toss delivery.

For medium to high altitude, TAS ranging is required to determine the position of the target while at low altitude, either TAS or RS can be used depending on the terrain.

2 delivery profiles are available and they differ in the way the desired impact point is designated:

- **CCPL**: The impact point is designated by the pilot through the VTH.
- **CCPL PI**: The impact point is designated by the INS system.

CCPL

When using CCPL – *Calcul continu du point de largage* (CCRP – Continuously calculated release point) the pilot must designate the intended impact point through the VTH and then fly the aircraft to the release point by following the CCPL symbology.

This designation requires the aircraft to enter a dive to place the impact point inside the VTH, the resulting altitude loss needs to be taken into account in relation to the bomb fuse delay, enemy ground defenses and the terrain.

This bomb release method can be inaccurate due to the ranging sensor limitations, pilot inaccuracies during the designation and when following of the guidance symbology. The short interval between designation and release virtually removes inaccuracies linked to INS drift.

CCPL PI

When using CCPL PI – *Calcul continu du point de largage point initial* (CCRP IP – Continuously calculated release point initial point) the impact point is designated through the INS: The DEST BUT is the PI and its BAD is the impact point.

The pilot must fly the aircraft to the PI and execute a navigation fix on it (optional but recommended), then follow the symbology until the release point is reached.

This allows for low drag bomb delivery without visual contact to the target and/or low altitude but it requires to know the precise location of the impact point and the PI to be placed over a remarkable surface feature in order to achieve a precise navigation fix.

This delivery method accuracy is mostly dependent on the INS drift and the pilot following of the guidance symbology or navigation fix accuracy. The INS drift accumulated during the navigation to the target can be fixed by executing a navigation fix on the PI, but the drift accumulated between the PI and the impact point can't be fixed. The INS drift rate can be as high as 30 m/min or 100 ft/min.

SYMBOLOGY

The following symbology is relative to the low drag bomb employment. It is representative the symbology displayed on the VTH and VTB with the SNA in air-to-ground selected sub-mode and a low drag bomb selected with or without PI.

For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-GROUND MODE SUB-SECTION** and **RADAR SECTION**.

VTH IN CCPL

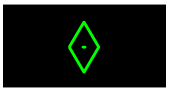
BL SUB-MODE (*Mode BL*):

Displayed when the VTH is in low drag bomb (BL – bombe lisse) air-to-ground sub-mode. Steady indicates that the bombs are ready, flashing that the master arm is off.

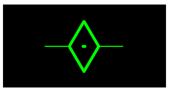
AIR-TO-GROUND RANGE (*Distance air/sol*):

Displayed when the radar has a good lock on the ground in TAS mode, indicates the slant range to the ground. Not displayed if radar altimeter (RS) is the primary ranging sensor.

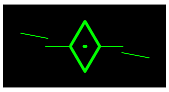
DESIGNATION DIAMOND, WEAPON READY INDICATION AND ROLL ORDER (*Réticule de désignation, indication armement prêt et ordre de roulis*):



Displayed at the top of the VTH, the point inside the diamond indicates the aiming point for the impact point designation. The designated impact point represents the center of the bomb salvo.

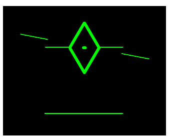


The weapon ready indication wings are displayed when the bombs are ready to release. They are absent if master arm is off, the bombs fuse is set to INERT, the selected bomb quantity is set to 00 or the aircraft load factor is under 0,5 G.



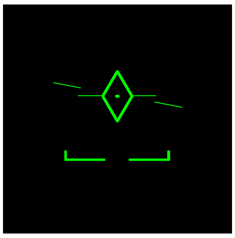
The roll order wings are displayed after the impact point designation and guide the aircraft in roll to the release point. The pilot needs to align the weapons ready indication wings with the roll order wings to reach the release point.

RELEASE BAR (*Bare de larguage*):

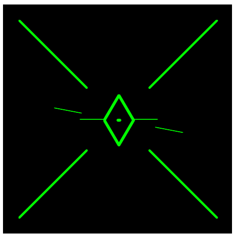


Displayed at the bottom of the VTH when the aircraft is in range for a 42° toss release, it moves up to the designation diamond. The bombs are released when the bar reaches the diamond, it stays displayed above the diamond until the all the bombs of the bomb salvo are released.

SAFETY BAR AND SAFETY CROSS (*Bare de sécuritée et croix de sécurité*):



The safety bar is displayed at the bottom of the VTH when the aircraft approaches the weapon blast zone or the safety height, it moves up to the designation diamond. It represents the remaining time before the pilot needs to execute a 5G pull out of the blast zone and above the ground safety height.



The safety cross is displayed when the safety bar reaches the designation diamond, it indicates that the pilot needs to execute an immediate 5G pull to stay out of the weapon blast zone and above the ground safety height.

VTH IN CCPL PI

BL SUB-MODE (*Mode BL*):

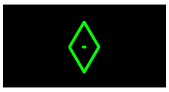
Indicates that the VTH is in low drag bomb (BL – bombe lisse) air-to-ground sub-mode. Steady indicates that the bombs are ready, flashing that the master arm is off.

AIR-TO-GROUND RANGE (*Distance air/sol*):

Displayed when the radar has a good lock on the ground in TAS mode, indicates the slant range to the ground. Not displayed if radar altimeter (RS) is the primary ranging sensor.

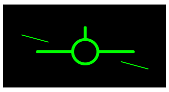
Displayed after PI designation, indicates the slant range to the impact point.

DESIGNATION DIAMOND (*Réticule de désignation*):



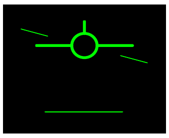
Displayed at the bottom of the VTH before PI overfly, the point inside the diamond indicates the aiming point for the PI designation.

ROLL ORDER (*Ordre de roulis*):



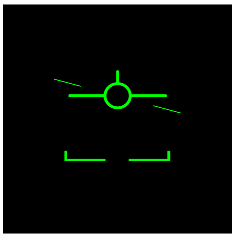
The roll order wings are displayed after PI designation or PI overfly and guide the aircraft in roll to the release point. The pilot needs to align FPM wings with the roll order wings to reach the release point.

RELEASE BAR (*Bare de larguage*):

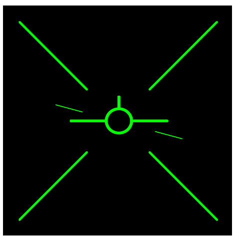


Displayed at the bottom of the VTH when the aircraft is in range for a 42° toss release, it moves up to the FPM. The bombs are released when the bar reaches the FPM, it stays displayed above the FPM until the all the bombs of the bomb salvo are released.

SAFETY BAR AND SAFETY CROSS (*Bare de sécurité et croix de sécurité*):



The safety bar is displayed at the bottom of the VTH when the aircraft approaches the weapon blast zone or the safety height, it moves up to the designation diamond. It represents the remaining time before the pilot needs to execute a 5G pull out of the blast zone and above the ground safety height.



The safety cross is displayed when the safety bar reaches the designation diamond, it indicates that the pilot needs to execute an immediate 5G pull to stay out of the weapon blast zone and above the ground safety height.

VTB

RADAR ALTITUDE (*Hauteur radiosonde*):

Displayed if the radar is in air-to-ground mode, indicates the altitude above the ground in feet. Moved at the center of the VTB, just under the aircraft model.
Displayed in red if the radar altitude is under the selected minimum altitude.

RADAR MODE (*Mode radar*):

Indicates that the radar is in TAS mode.
Flashes to indicate that the radar pre-heating sequence is still ongoing.

PROFILES

CCPL

In CCPL 3 release profiles exists:

- DIVE-DIVE (*Piqué-piqué*): The aircraft starts at medium to high altitude. The profile starts by a steep to shallow dive to place the intended impact point inside the VTH, the pilot then designates and executes a medium pull up to reduce the dive to a shallow dive until release.
- DIVE-LEVEL (*Piqué-palier*): The aircraft starts at medium to high altitude. The profile starts by a steep to shallow dive to place the intended impact point inside the VTH, the pilot then designates and executes a medium pull up to level flight until release.
- DIVE-TOSS (*Piqué-ressource*): The aircraft starts at medium altitude, this is important for the altitude to not be too high as the Mirage SNA does not support long time of flight for the bombs. The profile starts by a medium dive to place the intended impact point inside the VTH, the pilot then designates and executes a maximum pull up until release.

Each of these profiles can be started from the initial dive altitude or by doing a pop-up maneuver:

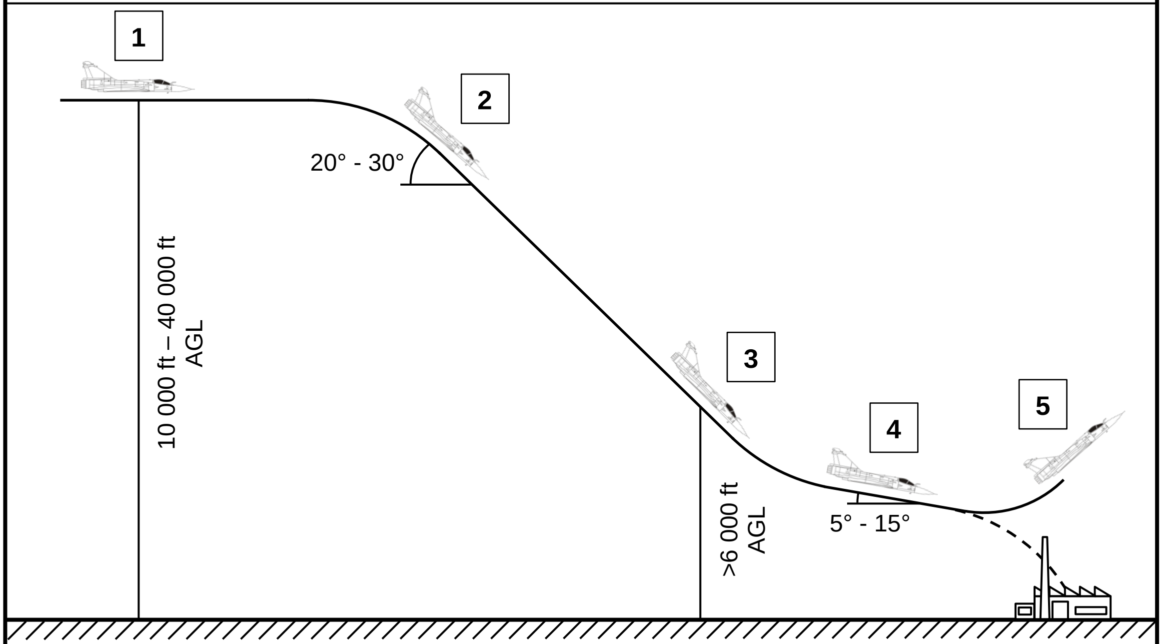
A pop-up maneuver starts at low altitude and high speed, at a distance from the target the aircraft enters a steep climb to the initial dive altitude. Once reached, the aircraft rolls over to dive toward the target.

This maneuver reduces the time the aircraft is exposed to enemy fire coming from the target area.

DIVE-DIVE

Using a dive-dive profile result in a better precision thanks to the longer time the pilot has to adjust the aircraft's trajectory and the gentler pull reducing the pilot induced lateral error tendency. This profile offers a wide range of starting altitudes but a higher minimum designation altitude. This profile trajectory brings the aircraft the closest to the impact point, it is not appropriate if the target area is well defended.

CCPL DIVE-DIVE



PROFILE

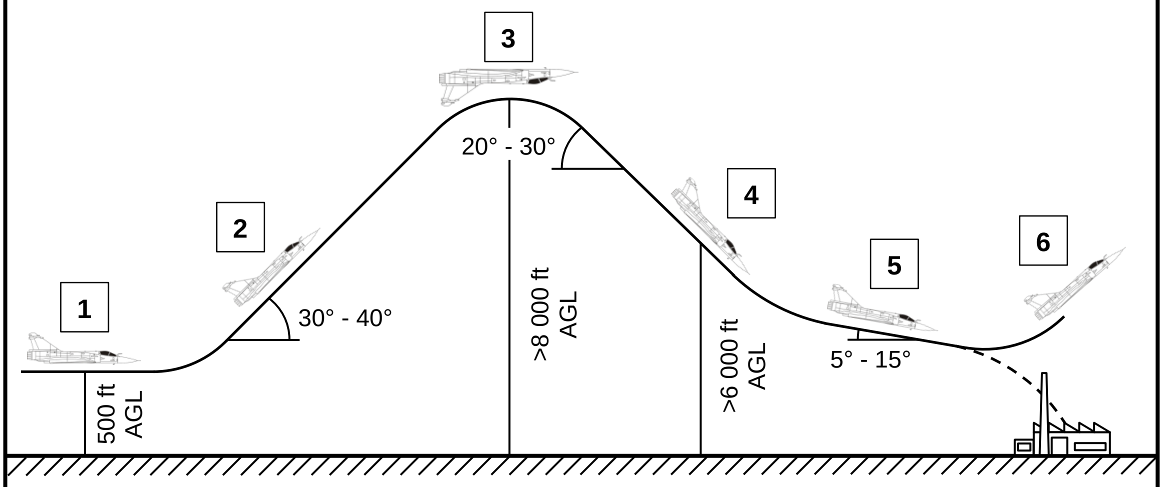
1. Starting between 10 000 ft and 40 000 ft level.
2. Execute a 20° to 30° dive toward the target.

   Keep the speed high during the dive but no faster than Mach 0.95.
3. Designate the impact point no lower than 6 000 ft AGL.
4. Pull 2G to 3G to reduce the dive to 5° to 15° while following the release symbology.
5. Once all the bombs are released, pull out of the dive and execute a sharp turn out of the target area.

DIVE DISTANCE

Altitude	Dive angle	Distance
10 000 ft	20°	4,5 nm
20 000 ft		9 nm
30 000 ft		13,5 nm
40 000 ft		18 nm
10 000 ft	30°	3 nm
20 000 ft		5,5 nm
30 000 ft		8,5 nm
40 000 ft		11,5 nm

CCPL DIVE-DIVE POP-UP



PROFILE

1. Starting around 500 ft AGL and 500 kt.
2. Execute a 30° to 40° climb, afterburner may be necessary to keep the speed high.
3. Roll over to pull into a 20° to 30° dive once above 8 000 ft AGL

   Keep the speed high during the dive but no faster than Mach 0.95.
4. Designate the impact point no lower than 6 000 ft AGL.
5. Pull 2G to 3G to reduce the dive to 5° to 15° while following the release symbology.
6. Once all the bombs are released, pull out of the dive and execute a sharp turn out of the target area.

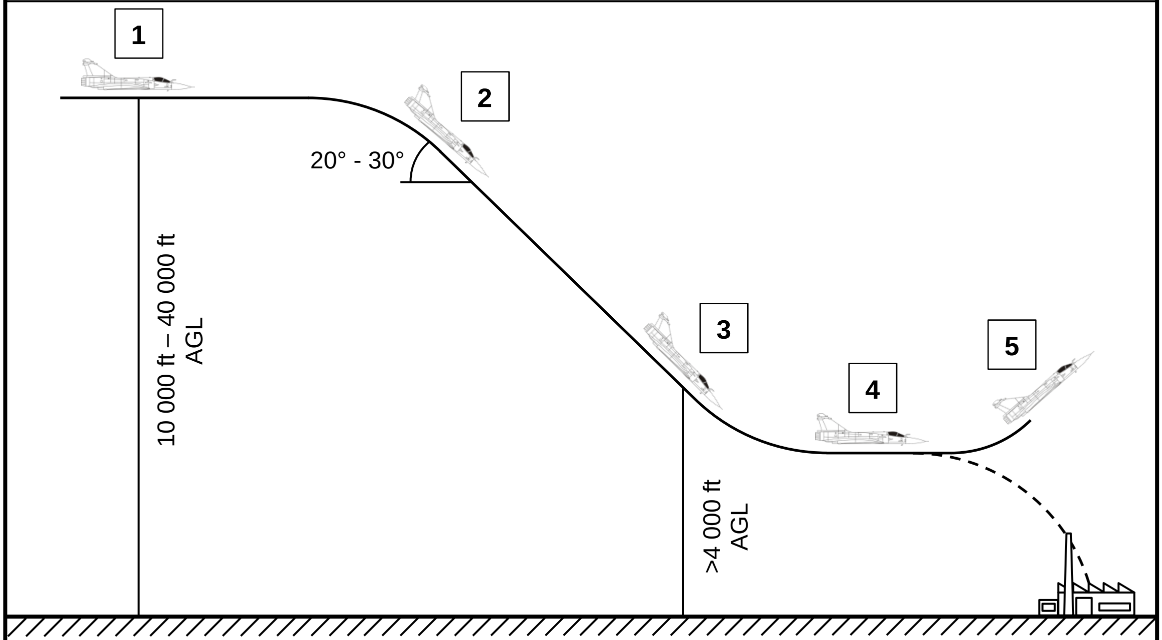
POP-UP DISTANCE

Climb angle	Dive angle	Distance
30°	20°	6,9 nm
40°		6,2 nm
30°	30°	5,5 nm
40°		5 nm

DIVE-LEVEL

Using a dive-level profile is a result in greater separation between the aircraft and the impact point. This profile offers a wide range of starting altitudes and can result in a high-altitude delivery at the cost of designation precision and bomb dispersion. This profile is the most adapted to laser guided bomb employment.

CCPL DIVE-LEVEL



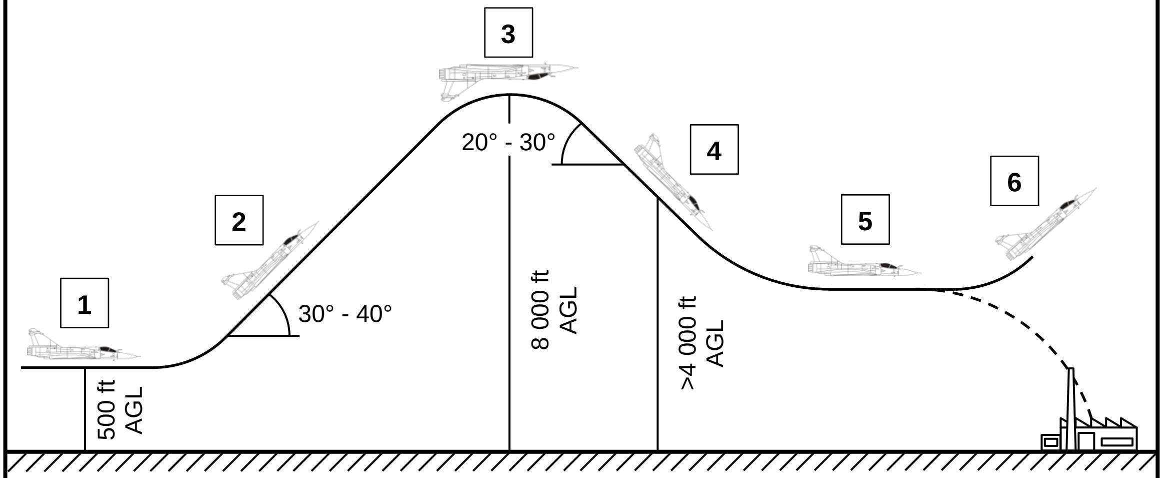
PROFILE

1. Starting between 10 000 ft and 40 000 ft level.
2. Execute a 20° to 30° dive toward the target.
   Keep the speed high during the dive but no faster than Mach 0.95.
3. Designate the impact point no lower than 4 000 ft AGL.
4. Pull 2G to 4G to level flight while following the release symbology.
5. Once all the bombs are released, execute a sharp turn out of the target area.

DIVE DISTANCE

Altitude	Dive angle	Distance
10 000 ft	20°	4,5 nm
20 000 ft		9 nm
30 000 ft		13,5 nm
40 000 ft		18 nm
10 000 ft	30°	3 nm
20 000 ft		5,5 nm
30 000 ft		8,5 nm
40 000 ft		11,5 nm

CCPL DIVE-LEVEL POP-UP



PROFILE

1. Starting around 500 ft AGL and 500 kt.
2. Execute a 30° to 40° climb, afterburner may be necessary to keep the speed high.
3. Roll over to pull into a 20° to 30° dive once above 8 000 ft AGL
   Keep the speed high during the dive but no faster than Mach 0.95.
4. Designate the impact point no lower than 4 000 ft AGL.
5. Pull 2G to 4G to level flight while following the release symbology.
6. Once all the bombs are released, execute a sharp turn out of the target area.

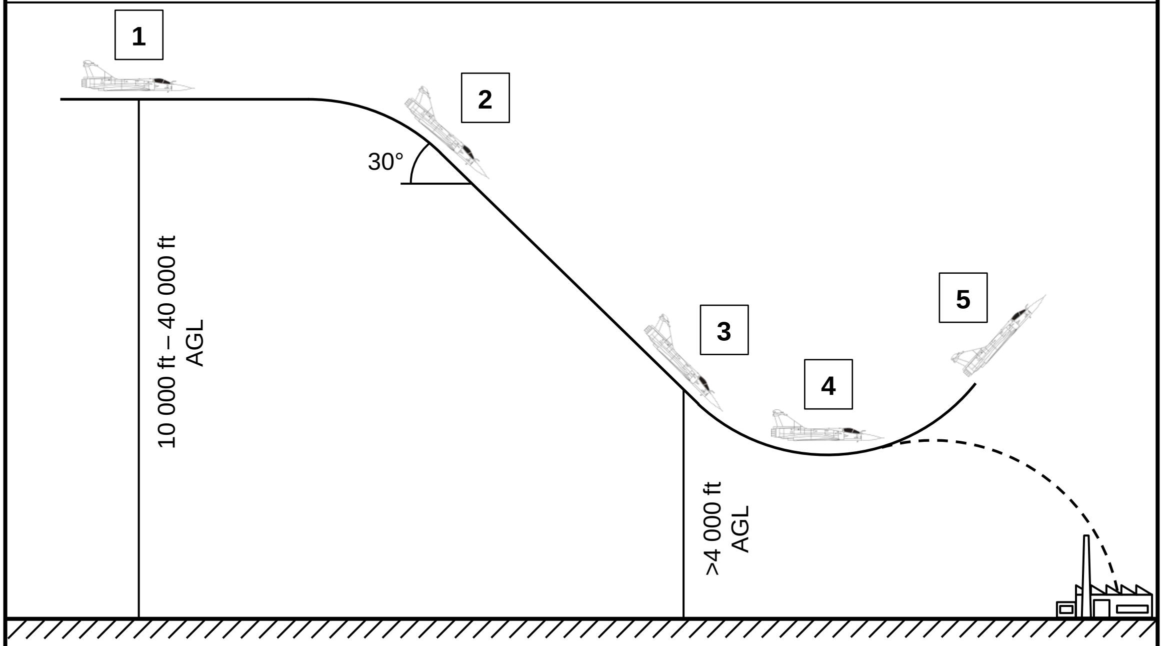
POP-UP DISTANCE

Climb angle	Dive angle	Distance
30°	20°	6,9 nm
40°		6,2 nm
30°	30°	5,5 nm
40°		5 nm

DIVE-TOSS

Using a dive-toss profile result in the fastest designation to release time and the longest separation between the aircraft and the impact point. The designation can also be safely be done at a lower altitude but its maximum altitude is lower than other profiles due to the SNA not working well with very long time of flight for the bombs. This is the most appropriate profile to use in a well defended area as it offers the quickest release time and greatest release range.

CCPL DIVE-TOSS



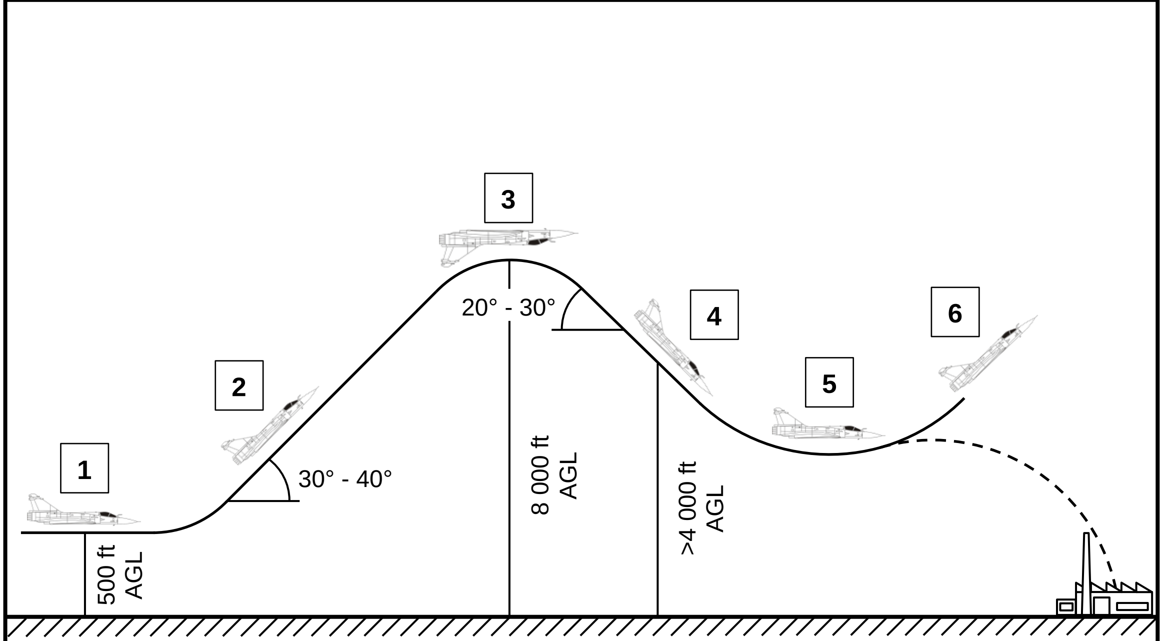
PROFILE

1. Starting between 10 000 ft and 40 000 ft level.
2. Execute a 30° dive toward the target.
   Keep the speed high during the dive but no faster than Mach 0.95.
3. Designate the impact point no lower than 4 000 ft AGL.
4. Pull 5G to 6G with the wings level.
5. Once all the bombs are released, execute a sharp turn out of the target area.

DIVE DISTANCE

Altitude	Dive angle	Distance
10 000 ft	30°	3 nm
20 000 ft		5,5 nm
30 000 ft		8,5 nm
40 000 ft		11,5 nm

CCPL DIVE-TOSS POP-UP



PROFILE

6. Starting around 500 ft AGL and 500 kt.
7. Execute a 30° to 40° climb, afterburner may be necessary to keep the speed high.
8. Roll over to pull into a 20° to 30° dive once above 8 000 ft AGL

   Keep the speed high during the dive but no faster than Mach 0.95.
9. Designate the impact point no lower than 4 000 ft AGL.
10. Pull 5G to 6G with the wings level.
11. Once all the bombs are released, execute a sharp turn out of the target area.

POP-UP DISTANCE

Climb angle	Dive angle	Distance
30°	20°	6,9 nm
40°		6,2 nm
30°	30°	5,5 nm
40°		5 nm

CCPL PI

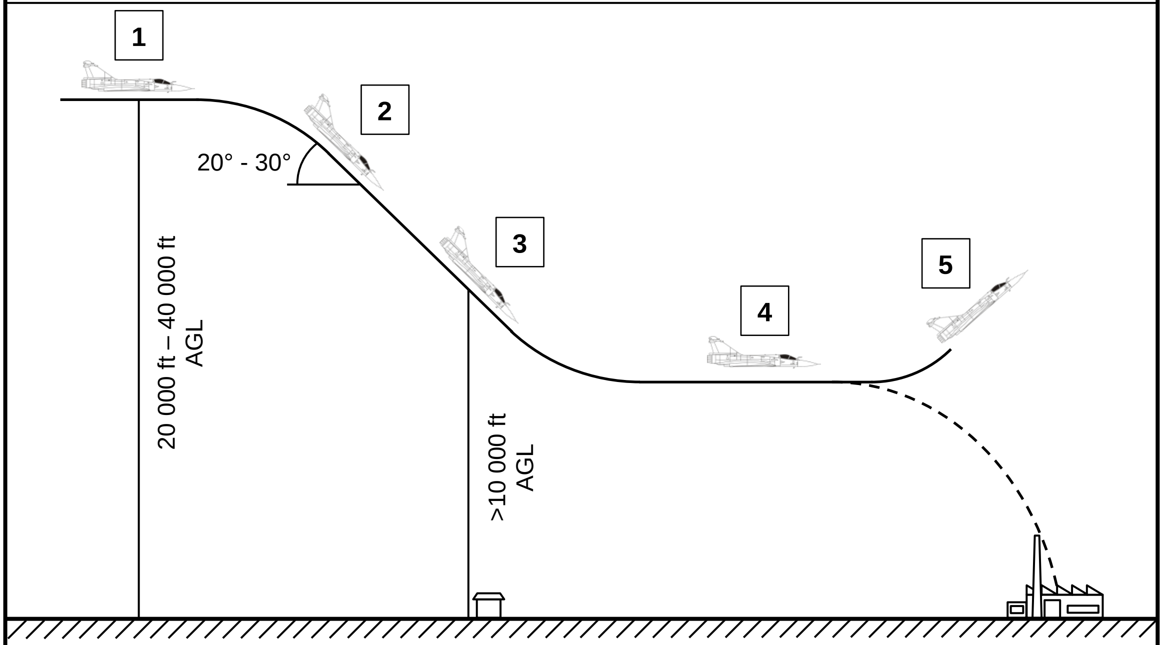
In CCPL PI 2 release profiles exist:

- LEVEL (*Palier*): The aircraft starts at medium to high altitude. The profile starts by an optional steep to shallow dive to execute a navigation fix on the PI, the pilot then returns the aircraft to level flight, overfly the PI and follow the guidance symbology until release.
- TOSS (*Ressource*): The aircraft starts at low altitude. The profile starts by an optional navigation fix on the PI while in level flight, the pilot then overflies the PI, follow the guidance symbology until the release bar is displayed and execute a maximum pull up until release.

LEVEL

Using a level profile allows for medium to high altitude delivery, which will keep the aircraft outside short range air defenses. If the release is done at high altitude, the bomb dispersion will be very high due to wind, pilot error when executing the navigation fix or while following the release symbology. INS drift is also a big accuracy factor as the desired impact point is never designated directly, without a navigation fix, the accumulated drift during the navigation phase can be as high as 1 nm/h. Even if a navigation fix is done on the PI, the INS drift accumulated between the PI and the release can be as high as 30 m/min or 100 ft/min. Due to these factors, laser guided bombs are the most appropriate weapons for this profile.

CCPL PI LEVEL



PROFILE

1. Starting between 20 000 ft and 40 000 ft level.
2. (Optional) Execute a 20° to 30° dive toward the PI.
   Keep the speed high during the dive but no faster than Mach 0.95.
3. (Optional) Designate the PI no lower than 10 000 ft AGL.
   Pull 2G to 4G to level flight.
4. Overfly the PI and follow the release symbology.
5. Once all the bombs are released, execute a sharp turn out of the target area.

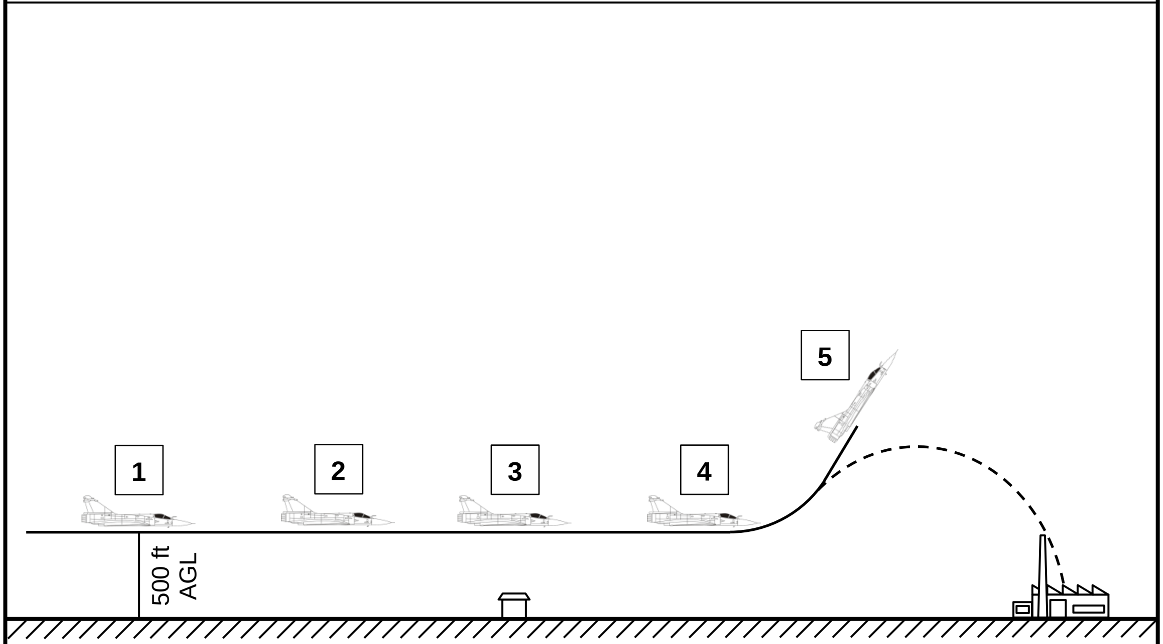
DIVE DISTANCE

Altitude	Dive angle	Distance
20 000 ft	20°	4,5 nm
30 000 ft		9 nm
40 000 ft		13,5 nm
20 000 ft	30°	18 nm
30 000 ft		3 nm
40 000 ft		5,5 nm

TOSS

Using a toss profile allows for long range, low altitude delivery, which can keep the aircraft below the minimum altitude of medium and long range air defenses as well as outside the short range air defenses. The release accuracy is mostly dependent on pilot error when executing the navigation fix or while following the release symbology. INS drift is also a big accuracy factor as the desired impact point is never designated directly, without a navigation fix, the accumulated drift during the navigation phase can be as high as 1 nm/h. Even if a navigation fix is done on the PI, the INS drift accumulated between the PI and the release can be as high as 30 m/min or 100 ft/min.

CCPL PI TOSS



PROFILE

1. Starting around 500 ft AGL and 500 kt.
2. (Optional) Designate the PI while keeping the aircraft in level flight.
3. Overfly the PI and follow the release symbology.
4. As soon as the release bar is displayed, pull 5G to 6G with the wing level.
5. Once all the bombs are released, execute a sharp turn out of the target area.

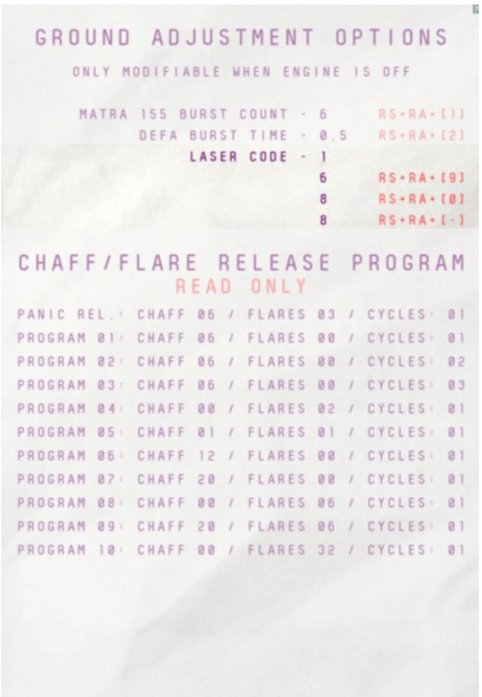
EMPLOYMENT

In order to destroy a target with low drag bombs, multiple steps have to be followed.

CCPL

LASER CODE SELECTION

If the aircraft is loaded with laser guided bombs, their laser tracking code is set on the guidance kit by the ground crew. The laser code can be visualized on the kneeboard “Ground adjustment option” page. It can be selected in the mission editor or using the kneeboard key command (right shift + right alt + 9, right shift + right alt + 0 and right shift + right alt + - by default) while on the ground with the engine off.



FUSE SELECTION

While loaded under the aircraft, bomb fuses are kept unarmed to prevent excessive collateral damage in case of jettison or involuntary release. They are armed at release when they separate from their pylon.

The armed fuse is determined by the position of the fuse selection switch on the PPA:

The switch has 3 positions:

- **INST.** (Instantané – Instantaneous): Arms the nose and tail fuse.
- **RET.** (Retardé – Retarded): Arms the tail fuse.
- **INERT.** (Inerte – Inert): No fuse is armed, the bombs won't explode.

The instantaneous fuse is more adapted to soft target like infantry and lightly armored vehicles while the retarded fuse is more adapted to hardened targets like bunkers or infrastructure.

BOMB QUANTITY SELECTION

The number of bombs released per salvo is set by using the salvo bomb quantity switch and visualized on the salvo bomb quantity display:

The switch will increase the displayed bomb quantity from 00 to 18.

The Mirage SNA is unable to determine if the selected bomb quantity is higher than the number of bombs loaded on this aircraft. In this situation the bomb will be released as if the selected number of bombs were available and the salvo will most likely land short from the target.

Selecting 00 on the salvo bomb quantity will prevent bomb release.

BOMB INTERVAL SELECTION

The interval between the bombs in a salvo is set by using the salvo bomb interval switch and visualized on the salvo bomb interval display:

The switch will increase the displayed bomb interval from 00 to 20.

The displayed interval is the distance in tens of meters between each bomb in the salvo. To obtain the salvo length, multiply the salvo bomb quantity by the salvo bomb interval quantity.

Selecting 00 on the salvo bomb quantity will revert the bomb interval to the minimum bomb release separation time of 10 ms.

If the salvo bomb quantity is set to 01, the salvo bomb interval has no effect.

WEAPON SELECTION

The low drag bombs are selected by pressing the PCA weapon selection button under the BLx window, this sets the aircraft SNA in the air-to-ground pre-selected sub-mode. In order to be able to select the bombs, the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA weapon selection button under the BLx window indicates that the BL mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: RAS then RS. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER ARM

In order to release the bombs, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the BLx window indicates that the master arm is armed, the bomb fuse is set to INST. or RET., the selected bomb quantity is at least 01 and the aircraft load factor is greater than 0.4 G.

If the SNA is in selected sub-mode, the master arm is armed, the VTH BL mode indication should be steady.

AIR-TO-GROUND SUB-MODES

Once a low drag bomb is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 BL sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to BL mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

IMPACT POINT DESIGNATION

In order to designate the impact point the SNA needs to be in air-to-ground, selected sub-mode.

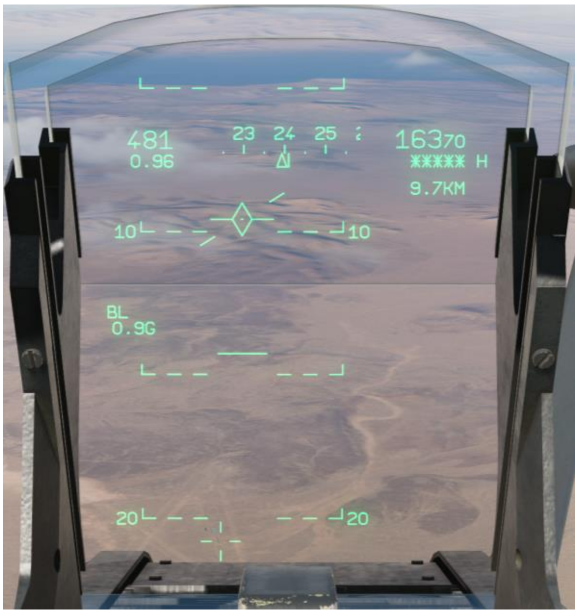
The weapon system paddle needs to be pressed when the designation diamond is over the target. The impact point can be designed as many times as desired to refine its position.

Once the impact point as been designated, the SNA is locked in the selected sub-mode, the only way to exit it is to de-select the bombs, select another weapon via the PCA or the CNM HOTAS command.

The ranging systems limitation needs to be taken into account when performing the designation. For more information, see the RADAR SECTION.

GUIDANCE SYMBOLOGY

Once the impact point is designated the roll order wings are displayed around the designation diamond.



The wings will guide the aircraft in roll to the release point. The release point location is wind correct relative to the wind the aircraft is subject to.

BOMB RELEASE

The MiCRoB second stage trigger act as a weapon release consent, it needs to be held pressed as long as the release bar is displayed on the VTH.

The release bar is displayed at the bottom of the VTH when the aircraft is in range for a 42° toss release and it climbs toward the designation diamond.

The first bomb is released when the release bar reaches the center of the designation diamond. The bar moves just above the diamond and stays displayed until the last bomb is released.

Once the last bomb is released, the impact point designation is reset and the SNA is unlocked.

FLYING THE PROFILE

The profile flown here will be CCPL dive-toss starting a 22 000 ft with a 30° dive to the target. The impact point should be designated above 15 000 ft.

Starting at 22 000 ft, fly to around 6 nm from the intended impact point.

Enter a 30° dive and press the HOTAS weapon system command forward to set the VTH to BL mode.

Place the designation diamond over the target and press the HOTAS weapon system paddle to designate the impact point.

As soon as the designation is correct, follow the roll order wings to correct the release for wind.

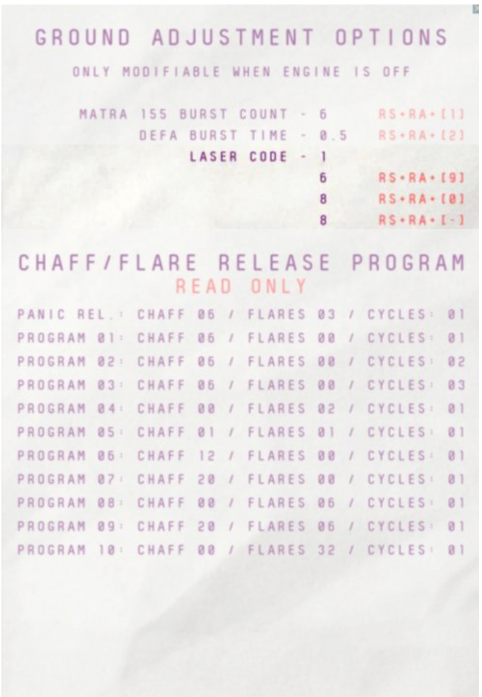
When the wings are aligned, hold the MiCRoB second stage and pull 5 G to 6 G with the wing level until the release bar is no longer displayed.

Execute a sharp turn away from the target area.

CCPL PI

LASER CODE SELECTION

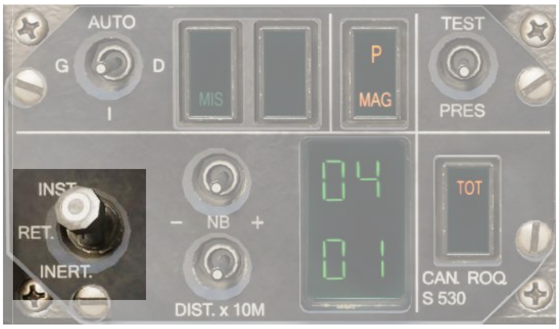
If the aircraft is loaded with laser guided bombs, their laser tracking code is set on the guidance kit by the ground crew. The laser code can be visualized on the kneeboard “Ground adjustment option” page. It can be selected in the mission editor or using the kneeboard key command (right shift + right alt + 9, right shift + right alt + 0 and right shift + right alt + - by default) while on the ground with the engine off.



FUSE SELECTION

While loaded under the aircraft, bomb fuses are kept unarmed to prevent excessive collateral damage in case of jettison or involuntary release. They are armed at release when they separate from their pylon.

The armed fuse is determined by the position of the fuse selection switch on the PPA.



The switch has 3 positions:

- **INST.** (Instantané – Instantaneous): Arms the nose and tail fuse.
- **RET.** (Retardé – Retarded): Arms the tail fuse.
- **INERT.** (Inerte – Inert): No fuse is armed, the bombs won't explode.

The instantaneous fuse is more adapted to soft target like infantry and lightly armored vehicles while the retarded fuse is more adapted to hardened targets like bunkers or infrastructure.

BOMB QUANTITY SELECTION

The number of bombs released per salvo is set by using the salvo bomb quantity switch and visualized on the salvo bomb quantity display.

The switch will increase the displayed bomb quantity from 00 to 18.

The Mirage SNA is unable to determine if the selected bomb quantity is higher than the number of bombs loaded on this aircraft. In this situation the bomb will be released as if the selected number of bombs were available and the salvo will most likely land short from the target.

Selecting 00 on the salvo bomb quantity will prevent bomb release.

BOMB INTERVAL SELECTION

The interval between the bombs in a salvo is set by using the salvo bomb interval switch and visualized on the salvo bomb interval display.

The switch will increase the displayed bomb interval from 00 to 20.

The displayed interval is the distance in tens of meters between each bomb in the salvo. To obtain the salvo length, multiply the salvo bomb quantity by the salvo bomb interval quantity.

Selecting 00 on the salvo bomb quantity will revert the bomb interval to the minimum bomb release separation time of 10 ms.

If the salvo bomb quantity is set to 01, the salvo bomb interval has no effect.

WEAPON SELECTION

The low drag bombs are selected by pressing the PCA weapon selection button under the BLx window, this sets the aircraft SNA in the BL mode, pre-selected sub-mode. In order to be able to select the BL mode, the SNA needs to be in any other mode than air-to-air gun or MAGIC priority mode and selective jettison mode.

The S light on the PCA weapon selection button under the BLx window indicates that the BL mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

PI MODE SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the PI mode for the bombs.

With this option selected and the SNA in air-to-ground selected sub-mode, the VTH will show the BL PI mode.

If the current DEST BUT does not have a BAD set, “PI” will be displayed on the VTH and the VTH will stay in BL mode.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft’s altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

- ZBI (*Altitude barométrique* – Baro-altimetric ranging): The altitude difference between the aircraft and the impact point altitude is used to know the aircraft's altitude over the impact point. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: RAS then RS then ZBI. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER ARM

In order to release the bombs, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the BLx window indicates that the master arm is armed, the bomb fuse is set to INST. or RET., the selected bomb quantity is at least 01 and the aircraft load factor is greater than 0.4 G.

If the SNA is in selected sub-mode, the master arm is armed, the VTH BL mode indication should be steady.

AIR-TO-GROUND SUB-MODES

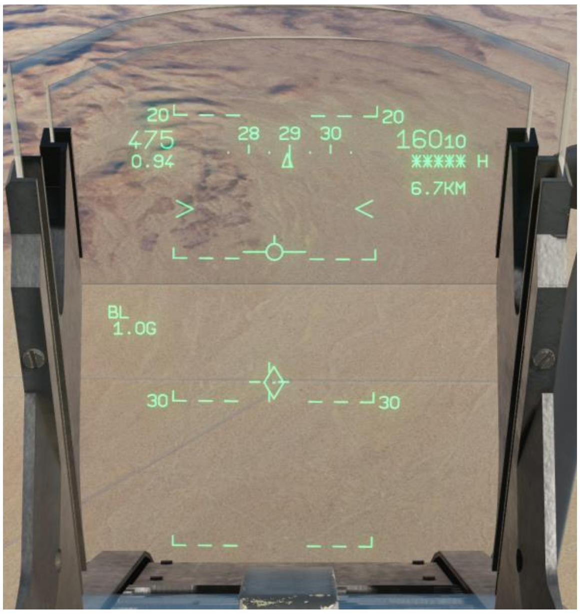
Once a low drag bomb is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 BL sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to BL mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

PI NAVIGATION FIX

In order to perform a navigation fix on the PI, the SNA needs to be in BL mode, selected sub-mode.



The weapon system paddle needs to be pressed when the designation diamond is over the PI surface feature. The PI can be designed as many times as desired to refine the navigation fix.

NOTE	Due to INS drift, the position of the PI might have drifted from its origin al position, the surface feature is what's need to be designated, not the where the INS is placing the PI.

The PI navigation fix in not necessary but will greatly improve the accuracy of the attack by reducing the accumulated INS drift.

Once the once the navigation fix has been performed, or the PI has been overflown, the SNA is locked in the selected sub-mode, the only way to exit it is to de-select the bombs or select another weapon.

The ranging systems limitation needs to be taken into account when performing the designation. For more information, see the RADAR SECTION.

GUIDANCE SYMBOLOGY

Once the once the navigation fix has been performed, or the PI has been overflown, the roll order wings are displayed around the FPM.

The wings will guide the aircraft in roll to the release point. The release point location is wind correct relative to the wind the aircraft is subject to.

BOMB RELEASE

The MiCRoB second stage trigger act as a weapon release consent, it needs to be held pressed as long as the release bar is displayed on the VTH.

The release bar is displayed at the bottom of the VTH when the aircraft is in range for a 42° toss release and it climbs toward the FPM.

The first bomb is released when the release bar reaches the center of the FPM. The bar moves just above the FPM and stays displayed until the last bomb is released.

Once the last bomb is released, the impact point designation is reset and the SNA is unlocked.

FLYING THE PROFILE

The profile flown here will be CCPL PI toss starting a 400 ft.

Starting at 400 ft, fly toward the PI.

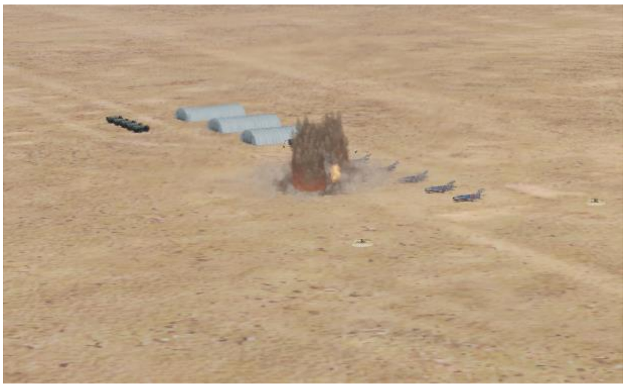
Once the PI is in sight, press the HOTAS weapon system command forward to set the VTH to BL PI mode.

Place the designation diamond over surface feature and press the HOTAS weapon system paddle to execute a navigation fix.

Once satisfied with the navigation fix, follow the roll order wings to fly to the release point.

When the wings are aligned and as soon as the release bar is displayed at the bottom of the VTH, hold the MiCRoB second stage and pull 5 G to 6 G with the wing level until the release bar is no longer displayed.

Execute a sharp turn away from the target area.



NAVIGATION FIX VALIDATION

Once the aircraft is out of the target area, the PI navigation fix can be accepted or rejected. The navigation fix can be reviewed on the PCN just like a standard overfly or radar navigation fix.

DEGRADED EMPLOYMENT

WORK IN PROGRESS

25 – 2 - HIGH DRAG BOMBS

INTRODUCTION

High drag designates all bombs that are equipped with a high drag device: Parachute, fins or ballutes. On the Mirage 2000C those bombs are released using the *Calcul continu du point d'impact* – CCPI (Continuously calculated impact point – CCIP) delivery mode: The pilot places the VTH symbology over the impact point and uses the MiCRoB trigger to release the bombs.

This delivery mode is only appropriate for level, low altitude and high-speed delivery.

Either TAS or RS ranging methods can be used depending on the terrain.

2 delivery profiles are available, the difference is in the help in finding the intended impact point that the INS will provide:

- **CCPI**: The pilot needs to acquire the intended impact point visually.
- **CCPI PI**: The position intended impact point is presented to the pilot by the INS but the pilot still needs to acquire it visually.

CCPI

When using CCPI – *Calcul continu du point d'impact* (CCIP – Continuously calculated impact point) the pilot must fly the aircraft to place the release symbology over the desired impact point.

The overfly of the target as well as low altitude required by this delivery method expose the aircraft to small arms fire and short-range air-defenses, it is important to take them into account and avoid troop concentration as much as possible.

Careful planning of the approach is also needed to reduce the time the aircraft is exposed to enemy fire.

This bomb release method inaccuracy will mainly come from pilot error at release and weapon dispersion, since the target needs to be acquired visually, INS drift is not a factor.

CCPI PI

When using CCPI PI – *Calcul continu du point d'impact point initial* (CCIP PI – Continuously calculated impact point initial point) the pilot must fly the aircraft to place the release symbology over the desired impact point but with the help of the INS: The INS will display the position of desired impact point on the VTH. The DEST BUT is the PI and its BAD is intended impact point.

The pilot must fly the aircraft to the PI and execute a navigation fix on it (optional but recommended), then fly to the impact point with the help of the VTH symbology. In this mode, the INS will only indicate the location of the intended impact point, the pilot still needs to use the aiming reticle to release the bombs on the target.

This allows for high drag bomb delivery in bad weather or in a dense area, but it requires to know the precise location of the impact point and the PI to be placed over a remarkable surface feature in order to achieve a precise navigation fix.

The overfly of the target as well as low altitude required by this delivery method expose the aircraft to small arms fire and short-range air-defenses, it is important to take them into account and avoid troop concentration as much as possible.

Careful planning of the approach is also needed to reduce the time the aircraft is exposed to enemy fire.

This delivery method accuracy is mostly the pilot aiming pilot error at release since the INS only provide an aid in locating the target. If the release is done on the intended impact point without visual acquisition, then the INS drift is the main inaccuracy factor The INS drift accumulated during the navigation to the target can be fixed by executing a navigation fix on the PI, but the drift accumulated between the PI and the impact point can’t be fixed. The INS drift rate can be as high as 30 m/min or 100 ft/min.

SYMBOLOGY

The following symbology is relative to the high drag bomb employment. It is representative the symbology displayed on the VTH and VTB with the SNA in air-to-ground selected sub-mode and a high drag bomb selected with or without PI.

For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-GROUND MODE SUB-SECTION** and **RADAR SECTION**.

VTH IN CCPI

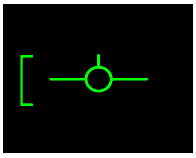
BF SUB-MODE (*Mode BF*):

Displayed when the VTH is in high drag bomb (BF – bombe freinée) air-to-ground sub-mode. Steady indicates that the bombs are ready, flashing that the master arm is off.

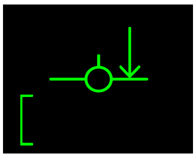
AIR-TO-GROUND RANGE (*Distance air/sol*):

Displayed when the radar has a good lock on the ground in TAS mode, indicates the slant range to the impact point. Not displayed if radar altimeter (RS) is the primary ranging sensor.

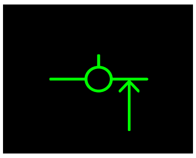
BOMB RELEASE DOMAIN AND TOO LOW/HIGH FOR BOMB DOMAIN (*Domaine de largage et domaine vers le bas/haut*):



Displayed in relation to the FPM, indicates the position of the release domain relative to the aircraft. The bracket represents the release domain relative to the aircraft altitude to the impact point as well as its vertical speed. The bottom of the bracket represents the nominal release altitude while to top of the bracket represents the maximum release altitude

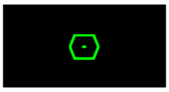


The too low/high for bomb domain arrows are displayed if the aircraft is outside the release domain and indicate the direction of the release domain.

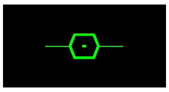


If the release domain is too far away, the bomb release domain bracket is not displayed, only the too low/high for bomb domain arrows indicate the direction of the release domain.

AIMING RETICLE AND WEAPON READY INDICATION (*Réticule de visée et indication armement prêt*):

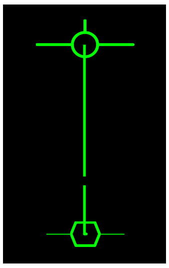


The point inside the hexagon indicates the instantaneous impact point of the first bomb in the salvo.

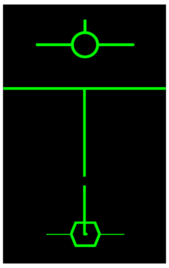


The weapon ready indication wings are displayed when the bombs are ready to release. They are absent if master arm is off, the bombs fuse is set to INERT, the selected bomb quantity is set to 00 or the aircraft load factor is under 0,5 G.

BOMB FALL LINE AND LAST BOMB INDICATOR (*Ligne de chute des bombes et trou dans la ligne de chute*):

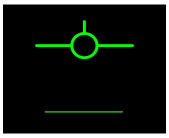


Represents the bomb ground impact line, it connects the aiming reticle to the FPM. The hole in the bomb fall line represents the impact point of the last bomb in the salvo.



The bomb fall line is not drown over the horizon line, when the FPM is above it, the bomb fall line connect to the projected FPM position on the horizon.

RELEASE BAR (*Barre de largage*):



Displayed just below the FPM on MiCRoB trigger press, it moves up to the FPM. The bombs are released when the bar reaches the FPM, it stays displayed above the FPM until the all the bombs of the bomb salvo are released.

VTH IN CCPI PI

BF SUB-MODE (*Mode BF*):

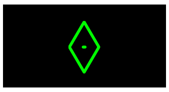
Displayed when the VTH is in high drag bomb (BF – bombe freinée) air-to-ground sub-mode. Steady indicates that the bombs are ready, flashing that the master arm is off.

AIR-TO-GROUND RANGE (*Distance air/sol*):

Displayed when the radar has a good lock on the ground in TAS mode, indicates the slant range to the ground. Not displayed if radar altimeter (RS) is the primary ranging sensor.

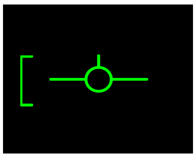
Displayed after PI designation, indicates the slant range to the impact point. Not displayed if radar altimeter (RS) is the primary ranging sensor.

DESIGNATION DIAMOND (*Réticule de désignation*):

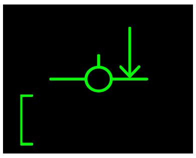


Displayed at the bottom of the VTH before PI overfly, the point inside the diamond indicates the aiming point for the PI designation.

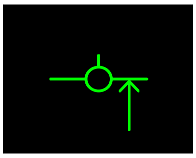
BOMB RELEASE DOMAIN AND TOO LOW/HIGH FOR BOMB DOMAIN (*Domaine de largage et domaine vers le bas/haut*):



Displayed in relation to the FPM, indicates the position of the release domain relative to the aircraft. The bracket represents the release domain relative to the aircraft altitude to the impact point as well as its vertical speed. The bottom of the bracket represents the nominal release altitude while to top of the bracket represents the maximum release altitude

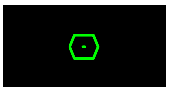


The too low/high for bomb domain arrows are displayed if the aircraft is outside the release domain and indicate the direction of the release domain.

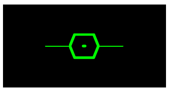


If the release domain is too far away, the bomb release domain bracket is not displayed, only the too low/high for bomb domain arrows indicate the direction of the release domain.

AIMING RETICLE AND WEAPON READY INDICATION (*Réticule de visée et indication armement prêt*):

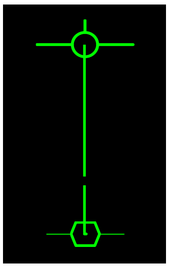


The point inside the hexagon indicates the instantaneous impact point of the first bomb in the salvo.

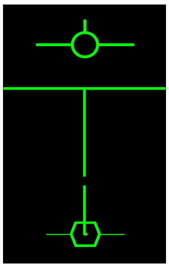


The weapon ready indication wings are displayed when the bombs are ready to release. They are absent if master arm is off, the bombs fuse is set to INERT, the selected bomb quantity is set to 00 or the aircraft load factor is under 0,5 G.

BOMB FALL LINE AND LAST BOMB INDICATOR (*Ligne de chute des bombes et trou dans la ligne de chute*):

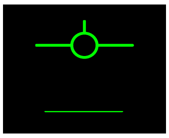


Represents the bomb ground impact line, it connects the aiming reticle to the FPM. The hole in the bomb fall line represents the impact point of the last bomb in the salvo.



The bomb fall line is not drown over the horizon line, when the FPM is above it, the bomb fall line connect to the projected FPM position on the horizon.

RELEASE BAR (*Barre de largage*):



Displayed just below the FPM on MiCRoB trigger press, it moves up to the FPM. The bombs are released when the bar reaches the FPM, it stays displayed above the FPM until the all the bombs of the bomb salvo are released.

VTB

RADAR ALTITUDE (*Hauteur radiosonde*):

Displayed if the radar is in air-to-ground mode, indicates the altitude above the ground in feet. Moved at the center of the VTB, just under the aircraft model.
Displayed in red if the radar altitude is under the selected minimum altitude.

RADAR MODE (*Mode radar*):

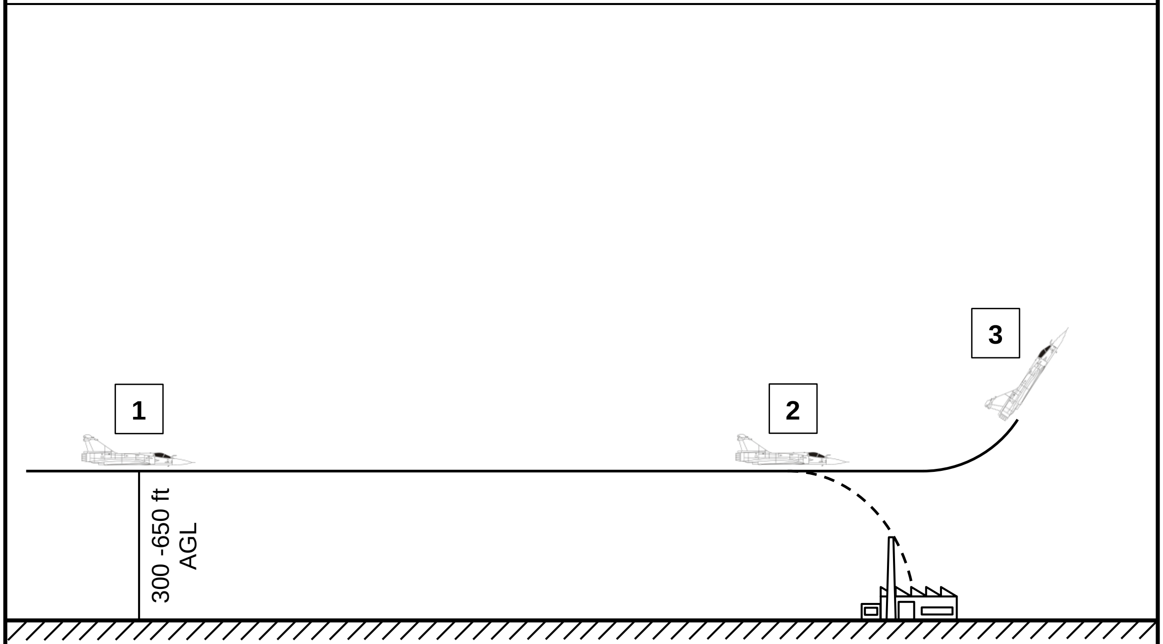
Indicates that the radar is in TAS mode.
Flashes to indicate that the radar pre-heating sequence is still ongoing.

PROFILES

CCPI

In CCPI, only 1 profile exists: The aircraft starts low altitude, the pilot flies the aircraft to place the aiming reticle over the intended impact point and releases the bombs. If the bombs are released in a salvo, the pilot needs to place the intended impact point between the aiming reticle and the last bomb indicator.

CCPI



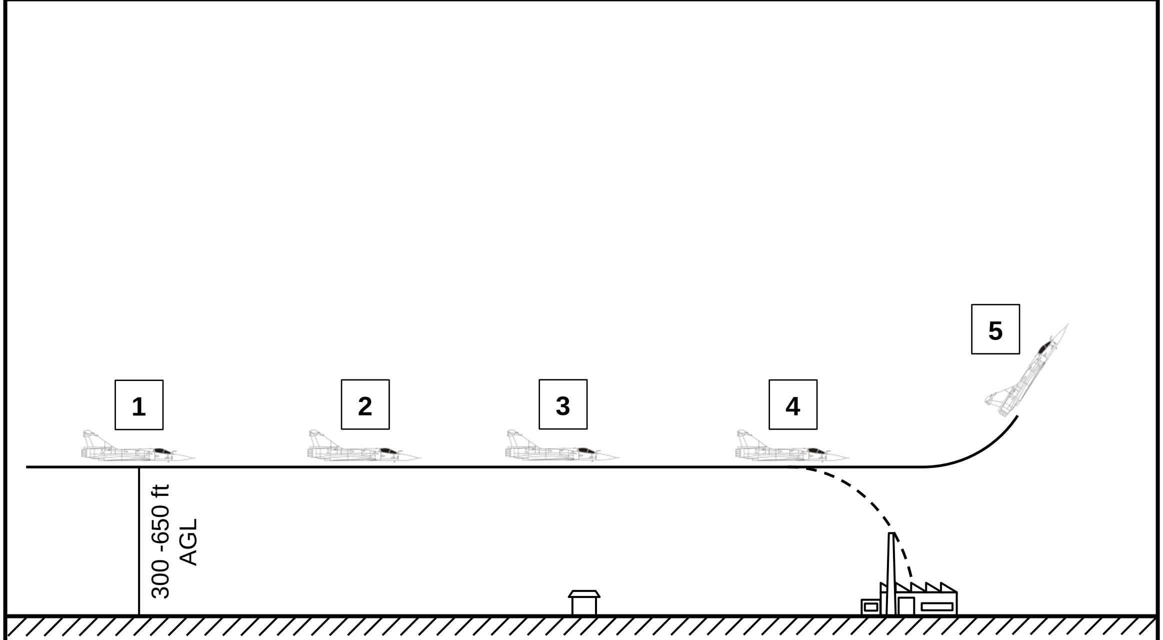
PROFILE

1. Starting around 300 ft and no more than 650 ft AGL and 500 kt.
2. Place the aiming reticle over the intended impact point.
3. Once all the bombs are released, execute a sharp turn out of the target area.

CCPI PI

In CCPI PI, only 1 profile exists: The aircraft starts low altitude, the pilot executes an optional navigation fix on the PI, overfly the PI and then follow the navigation symbology toward the intended impact point. The pilot then needs to place the intended impact point between the aiming reticle and the last bomb indicator.

CCPI PI



PROFILE

1. Starting around 300 ft and no more than 650 ft AGL and 500 kt.
2. (Optional) Designate the PI while keeping the aircraft in level flight.
3. Overfly the PI and follow the release symbology.
4. Place the aiming reticle over the intended impact point.
5. Once all the bombs are released, execute a sharp turn out of the target area.

EMPLOYMENT

In order to destroy a target with high drag bombs, multiple steps have to be followed.

CCPI

FUSE SELECTION

While loaded under the aircraft, bomb fuses are kept unarmed to prevent excessive collateral damage in case of jettison or involuntary release. They are armed at release when they separate from their pylon.

The armed fuse is determined by the position of the fuse selection switch on the PPA:

The switch has 3 positions:

- **INST.** (*Instantané* – Instantaneous):
  - Mark-82 Snakeye and Mark-82 Air: Arms the nose and tail fuse.
  - BAP-100: Arms the retarded fuse.
  - BLG-66: Selects the short dispersion area.
- **RET.** (*Retardé* – Retarded):
  - Mark-82 Snakeye and Mark-82 Air: Arms the tail fuse.
  - BAP-100: Arms the retarded fuse.
  - BLG-66: Selects the long dispersion area.
- **INERT.** (*Inerte* – Inert): No fuse is armed, the bombs won't explode.

For the Mark-82s, the instantaneous fuse is more adapted to soft target like infantry and lightly armored vehicles while the retarded fuse is more adapted to hardened targets like bunkers or infrastructure.

For the BLG-66, the only difference is the length and concentration of the pattern.

For the BAP-100, there is no difference between the 2 fuse options.

BOMB QUANTITY SELECTION

The number of bombs released per salvo is set by using the salvo bomb quantity switch and visualized on the salvo bomb quantity display:

The switch will increase the displayed bomb quantity from 00 to 18.

The Mirage SNA is unable to determine if the selected bomb quantity is higher than the number of bombs loaded on this aircraft. In this situation the bomb will be released as if the selected number of bombs were available and the salvo will most likely land short from the target.

Selecting 00 on the salvo bomb quantity will prevent bomb release.

BOMB INTERVAL SELECTION

The interval between the bombs in a salvo is set by using the salvo bomb interval switch and visualized on the salvo bomb interval display:

The switch will increase the displayed bomb interval from 00 to 20.

The displayed interval is the distance in tens of meters between each bomb in the salvo. To obtain the salvo length, multiply the salvo bomb quantity by the salvo bomb interval quantity.

Selecting 00 on the salvo bomb quantity will revert the bomb interval to the minimum bomb release separation time of 10 ms.

If the salvo bomb quantity is set to 01, the salvo bomb interval has no effect.

WEAPON SELECTION

The low drag bombs are selected by pressing the PCA weapon selection button under the BFx window this sets the aircraft SNA in the air-to-ground pre-selected sub-mode. In order to be able to select the bombs the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA weapon selection button under the BFx window indicates that the BF mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: RAS then RS. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER ARM

In order to release the bombs, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the BFx window indicates that the master arm is armed, the bomb fuse is set to INST. or RET., the selected bomb quantity is at least 01 and the aircraft load factor is greater than 0.4 G.

If the SNA is in selected sub-mode, the master arm is armed, the VTH BF mode indication should be steady.

AIR-TO-GROUND SUB-MODES

Once a low drag bomb is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 BF sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to BF mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

AIMING

In order to drop the high drag bombs on the target, the aircraft needs to be maneuvered to place the target between the aiming reticle and last bomb impact point.

If the last bomb impact point is not visible in the bomb fall line due to the bomb salvo being too short, the target needs to be placed under the aiming reticle.

BOMB RELEASE

Pressing the MiCRoB second stage trigger designates the position of the aiming reticle as the first bomb impact point. The bomb will start to release after a short delay:

- Mark-82s, BLG-66: 0,3 seconds.
- BAP-100: 2 seconds.

The release bar is displayed just under the FPM and climbs toward it. The first bomb is release when the release bar reaches the center of the FPM.

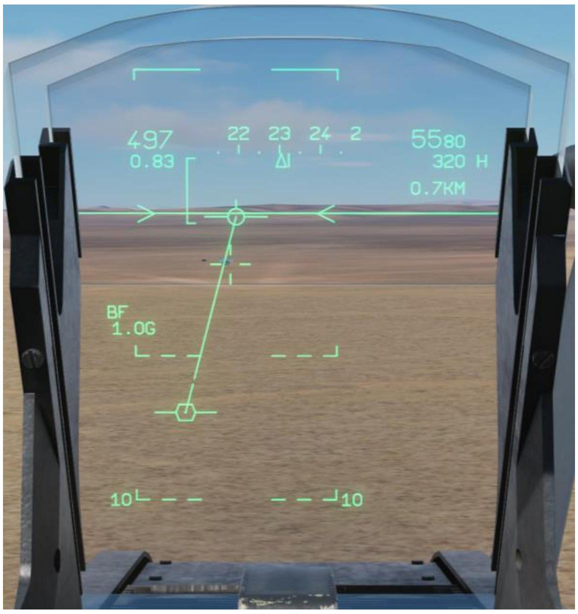
After the first bomb is released, the release bar moves just above the FPM and stays displayed until the last bomb is released.

FLYING THE PROFILE

The profile flown here will be CCPI starting a 350 ft and 500 kt.

Starting at 350 ft and 500 kt, fly toward the target.

Once the target is in sight, press the HOTAS weapon system command forward to set the VTH to BF mode.



Press and hold the MiCRoB second stage when the target is between the aiming reticle and the last bomb impact point.

Hold the MiCRoB until the release bar is no longer displayed.

Execute a sharp turn away from the target area.

CCPI PI

FUSE SELECTION

While loaded under the aircraft, bomb fuses are kept unarmed to prevent excessive collateral damage in case of jettison or involuntary release. They are armed at release when they separate from their pylon.

The armed fuse is determined by the position of the fuse selection switch on the PPA.

The switch has 3 positions:

- **INST.** (Instantané – Instantaneous): Arms the nose and tail fuse.
- **RET.** (Retardé – Retarded): Arms the tail fuse.
- **INERT.** (Inerte – Inert): No fuse is armed, the bombs won't explode.

The instantaneous fuse is more adapted to soft target like infantry and lightly armored vehicles while the retarded fuse is more adapted to hardened targets like bunkers or infrastructure.

BOMB QUANTITY SELECTION

The number of bombs released per salvo is set by using the salvo bomb quantity switch and visualized on the salvo bomb quantity display.

The switch will increase the displayed bomb quantity from 00 to 18.

The Mirage SNA is unable to determine if the selected bomb quantity is higher than the number of bombs loaded on this aircraft. In this situation the bomb will be released as if the selected number of bombs were available and the salvo will most likely land short from the target.

Selecting 00 on the salvo bomb quantity will prevent bomb release.

BOMB INTERVAL SELECTION

The interval between the bombs in a salvo is set by using the salvo bomb interval switch and visualized on the salvo bomb interval display.

The switch will increase the displayed bomb interval from 00 to 20.

The displayed interval is the distance in tens of meters between each bomb in the salvo. To obtain the salvo length, multiply the salvo bomb quantity by the salvo bomb interval quantity.

Selecting 00 on the salvo bomb quantity will revert the bomb interval to the minimum bomb release separation time of 10 ms.

If the salvo bomb quantity is set to 01, the salvo bomb interval has no effect.

WEAPON SELECTION

The low drag bombs are selected by pressing the PCA weapon selection button under the BFx window this sets the aircraft SNA in the air-to-ground pre-selected sub-mode. In order to be able to select the bombs the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA weapon selection button under the BLx window indicates that the BL mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

PI MODE SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the PI mode for the bombs.

With this option selected and the SNA in air-to-ground selected sub-mode, the VTH will show the BL PI mode.

If the current DEST BUT does not have a BAD set, “PI” will be displayed on the VTH and the VTH will stay in BL mode.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft’s altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

- ZBI (*Altitude barométrique* – Baro-altimetric ranging): The altitude difference between the aircraft and the impact point altitude is used to know the aircraft's altitude over the impact point. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: RAS then RS then ZBI. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER ARM

In order to release the bombs, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the BFx window indicates that the master arm is armed, the bomb fuse is set to INST. or RET., the selected bomb quantity is at least 01 and the aircraft load factor is greater than 0.4 G.

If the SNA is in selected sub-mode, the master arm is armed, the VTH BF mode indication should be steady.

AIR-TO-GROUND SUB-MODES

Once a low drag bomb is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 BL sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to BL mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

PI Navigation Fix

In order to perform a navigation fix on the PI, the SNA needs to be in air-to-ground selected sub-mode.

The weapon system paddle needs to be pressed when the designation diamond is over the PI surface feature. The PI can be designed as many times as desired to refine the navigation fix.

NOTE	Due to INS drift, the position of the PI might have drifted from its origin al position, the surface feature is what's need to be designated, not the where the INS is placing the PI.

The PI navigation fix in not necessary but will greatly improve the accuracy of the attack by reducing the accumulated INS drift.

Once the once the navigation fix has been performed, or the PI has been overflown, the SNA is locked in the selected sub-mode, the only way to exit it is to de-select the bombs or select another weapon.

The ranging systems limitation needs to be taken into account when performing the designation. For more information, see the Radar section.

GUIDANCE SYMBOLOGY

Once the once the navigation fix has been performed, or the PI has been overflown, the heading error indicator indicates the direction of the intended impact point.

The heading error indicator will guide the aircraft toward the impact point until 10 nm, bellow that, the BUT position indicator displays the position of the intended impact point.

AIMING

In order to drop the high drag bombs on the target, the aircraft needs to be maneuvered to place the target between the aiming reticle and last bomb impact point.

If the last bomb impact point is not visible in the bomb fall line due to the bomb salvo being too short, the target needs to be placed under the aiming reticle.

BOMB RELEASE

Pressing the MiCRoB second stage trigger designates the position of the aiming reticle as the first bomb impact point. The bomb will start to release after a short delay:

- Mark-82s, BLG-66: 0,3 seconds.
- BAP-100: 2 seconds.

The release bar is displayed just under the FPM and climbs toward it. The first bomb is release when the release bar reaches the center of the FPM.

After the first bomb is released, the release bar moves just above the FPM and stays displayed until the last bomb is released.

FLYING THE PROFILE

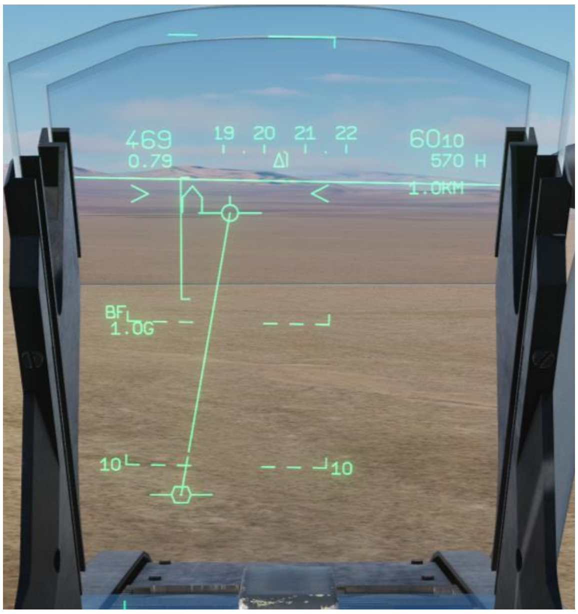
The profile flown here will be CCPI PI starting a 400 ft and 500 kt.

Starting at 400 ft and 500 kt, fly toward the PI.

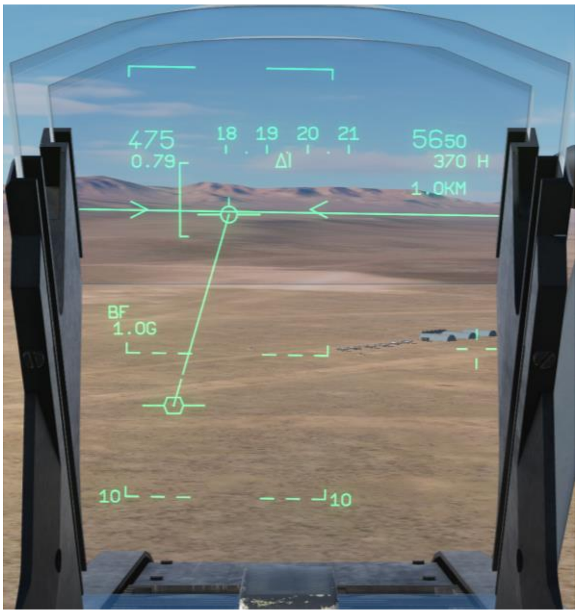
Once the PI is in sight, press the HOTAS weapon system command forward to set the VTH to BF PI mode.

Place the designation diamond over surface feature and press the HOTAS weapon system paddle to execute a navigation fix.

Once satisfied with the navigation fix, follow the heading error indicator toward the intended impact point.



Press and hold the MiCRoB second stage when the target is between the aiming reticle and the last bomb impact point.



Hold the MiCRoB until the release bar is no longer displayed.

Execute a sharp turn away from the target area.

NAVIGATION FIX VALIDATION

Once the aircraft is out of the target area, the PI navigation fix can be accepted or rejected. The navigation fix can be reviewed on the PCN just like a standard overfly or radar navigation fix.

DEGRADED EMPLOYMENT

WORK IN PROGRESS

25 – 3 - ROCKETS AND GUNS

INTRODUCTION

Since rockets and guns operate in the same way, they share the same delivery mode: *Calcul continu du point d'impact* – CCPI (Continuously calculated impact point – CCIP) delivery mode: The pilot places the VTH symbology over the impact point and uses the MiCRoB trigger to fire the rockets or guns.

This delivery mode differs from high drag bombs CCPI in the way the symbology is presented to the pilot, and in the domain of employment: Rocket and guns CCPI is to be used in a dive at low altitude.

The overfly of the target as well as low altitude required by this delivery method expose the aircraft to small arms fire and short-range air-defenses, it is important to take them into account and avoid troop concentration as much as possible.

Careful planning of the approach is also needed to reduce the time the aircraft is exposed to enemy fire.

The rockets and guns delivery method inaccuracy will mainly come from pilot error at release and weapon dispersion. Since the target needs to be acquired visually, INS drift is not a factor.

Either TAS or RS ranging methods can be used depending on the terrain.

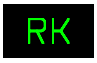
SYMBOLOGY

The following symbology is relative to the rocket and air-to-ground guns employment. It is representative the symbology displayed on the VTH and VTB with the SNA in air-to-ground selected sub-mode and the rockets or air-to-ground guns selected.

For more information on the VTH and VTB symbology, see the **HEAD-UP DISPLAY AIR-TO-GROUND MODE SUB-SECTION** and **RADAR SECTION**.

VTH

RK AND CAS SUB-MODE (*Mode RK et CAS*):



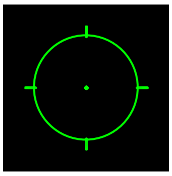
Displayed when the VTH is in rocket (RK – *roquette*) air-to-ground sub-mode. Steady indicates that the rockets are ready, flashing that the master arm is off.

Displayed when the VTH is in air-to-ground gun (CAS – *canon air-sol*) sub-mode. Steady indicates that the rockets are ready, flashing that the master arm is off.

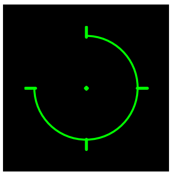
AIR-TO-GROUND RANGE (*Distance air/sol*):

Displayed when the radar has a good lock on the ground in TAS mode, indicates the slant range to the impact point. Not displayed if radar altimeter (RS) is the primary ranging sensor.

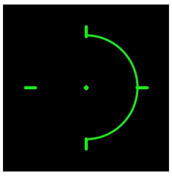
GUNS/ROCKET FIRE DOMAIN AND AIMING RETICLE (*Domaine de tir et réticule de tir canons/roquettes*):



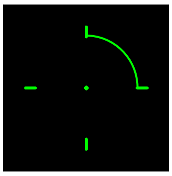
The point inside the circle indicates the instantaneous impact point for the rockets or guns.
The circle represents the firing domain for the rockets or guns. A full circle indicate that the aircraft is out of range.



The circle starts to unwinds counter-clockwise when the aircraft enters the firing domain for the weapon: 2700 m for the rockets, 2400 m for the guns.
The 9 o'clock position indicates the maximum range for the selected weapon: 2400 m for the rockets and 1800 m for the guns.

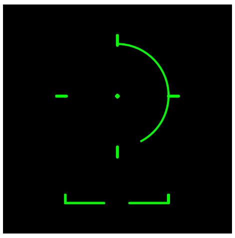


The 6 o'clock position indicates the optimum range for the selected weapon: 1800 m for the rockets and 1200 m for the guns.

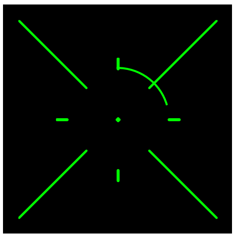


The 3 o'clock position indicates the minimum range for the selected weapon: 1200 m for the rockets and 600 m for the guns.

SAFETY BAR AND SAFETY CROSS (*Bare de sécuritée et croix de sécuritée*):



The safety bar is displayed at the bottom of the VTH when the aircraft approach the weapon blast zone or the safety height, it moves up to the aiming reticle. It represents the remaining time before the pilot needs to execute a 5G pull out of the blast zone and above the ground safety height.



The safety cross is displayed when the safety bar reaches the designation diamond, it indicates that the pilot needs to execute an immediate 5G pull to stay out of the weapon blast zone and above the ground safety height.

VTB

RADAR ALTITUDE (*Hauteur radiosonde*):

Displayed if the radar is in air-to-ground mode, indicates the altitude above the ground in feet. Moved at the center of the VTB, just under the aircraft model.
Displayed in red if the radar altitude is under the selected minimum

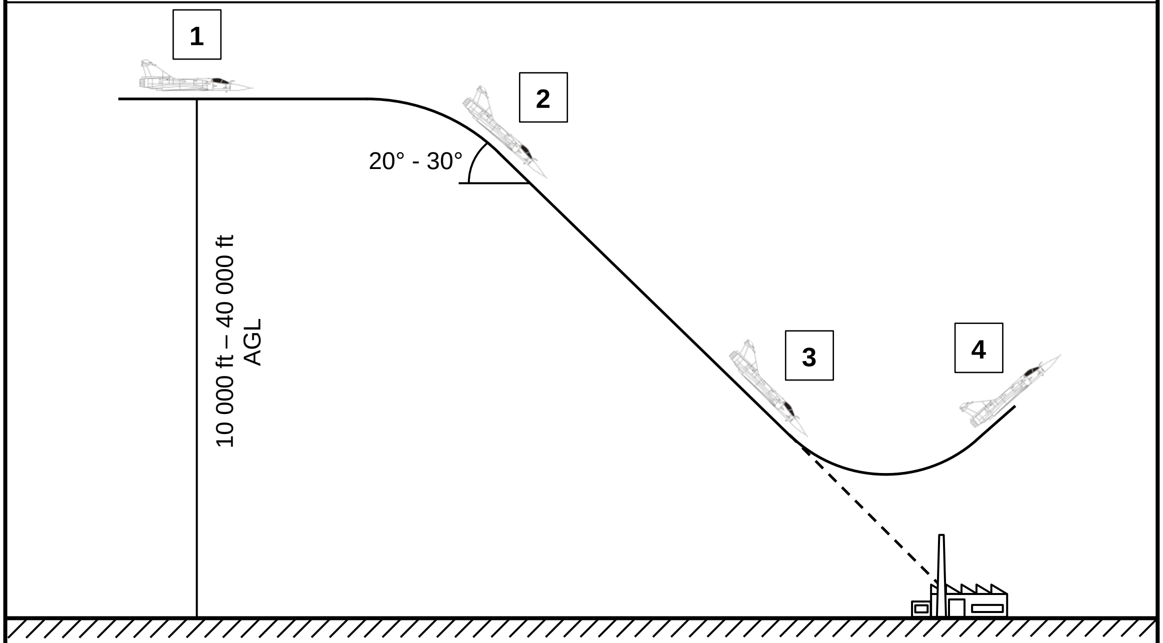
RADAR MODE (*Mode radar*):

Indicates that the radar is in TAS mode.
Flashes to indicate that the radar pre-heating sequence is still ongoing.

PROFILES

The rockets and guns profiles are exactly the same, the only difference is the firing range.

CCPL DIVE-DIVE



PROFILE

1. Starting between 10 000 ft and 40 000 ft level.
2. Execute a 20° to 30° dive toward the target.

   Keep the speed high during the dive but no faster than Mach 0.95.
3. Fire the rockets or guns between the maximum and minimum range.
4. Before entering the blast area, pull out of the dive and execute a sharp turn out of the target area.

DIVE DISTANCE

Altitude	Dive angle	Distance
10 000 ft	20°	4,5 nm
20 000 ft		9 nm
30 000 ft		13,5 nm
40 000 ft		18 nm
10 000 ft	30°	3 nm
20 000 ft		5,5 nm
30 000 ft		8,5 nm
40 000 ft		11,5 nm

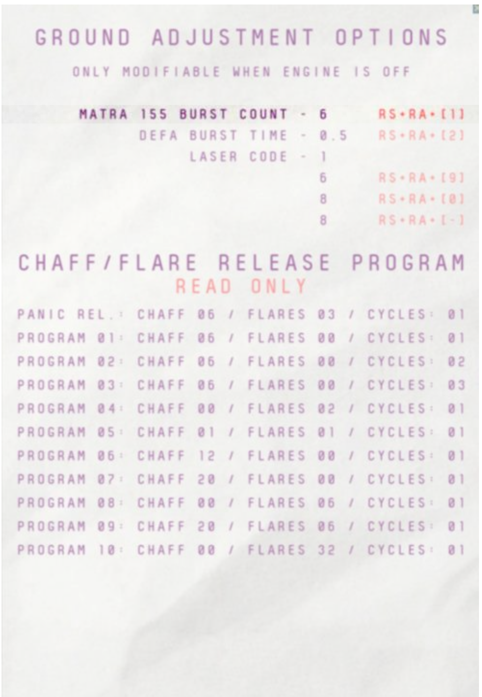
EMPLOYMENT

In order to destroy a target rockets or the guns, multiple steps have to be followed.

ROCKETS

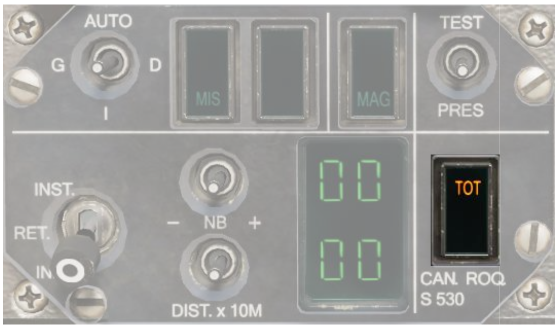
SALVO QUANTITY

The rocket salvo quantity is set on the pods by the ground crew. The salvo quantity can be visualized on the kneeboard "Ground adjustment option" page. It can be selected in the mission editor or using the kneeboard key command (right shift + right alt + 1 by default) while on the ground with the engine off.



SALVO SETTING

The salvo firing for the rockets is set using the weapon salvo selection button on the PPA.



2 yellow lights display the selected mode:

- TOT (*Total*): The rockets fire as long as the trigger is pressed.
- PAR (*Partiel* – Partial): The rockets fire in salvo of 1, 3 or 6 rockets.

WEAPON SELECTION

The rockets are selected by pressing the PCA weapon selection button under the RK or RKF window, this sets the aircraft SNA in the air-to-ground pre-selected sub-mode. In order to be able to select the bombs, the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA weapon selection button under the RK or RKF window indicates that the RK mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

PYLON SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. If the aircraft is loaded with the rocket pods of the same type on the inboard and outboard wing pylons, these options allow the selection of the pylons to be fired.

2 options are selectable:

- EXT (*Exterieur* – Outboard): The outboard pylons are selected for firing.
- INT (*Intérieur* – Inboard): The inboard pylons are selected for firing.

The pylon selection is initialized at inboard. Both pylons can be selected at the same time and at least 1 needs to be selected.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow to select the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: RAS then RS. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER ARM

In order to fire the rockets, the master arm switch needs to be in the armed position.

The P light on the PCA weapon selection button under the RK or RKF window indicates that the master arm is armed.

If the SNA is in selected sub-mode, the master arm is armed, the VTH RK mode indication should be steady.

AIR-TO-GROUND SUB-MODES

Once a low drag bomb is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 RK sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to RK mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

AIMING

In order to fire the rockets on the target, the aircraft needs to be maneuvered to place the target under the aiming reticle.

EMPLOYMENT DOMAIN

In order to fire the rocket in the best condition, they need to be fired at the correct range. The rocket employment domain is displayed around the impact point and indicate the position of the aircraft relative to the rocket firing domain:

- A full circle indicates that the target is out of range.
- The circle starts to unwinds counter-clockwise when the aircraft enters the rockets firing domain: 2700 meters.
- The 9 o'clock position indicate the maximum range: 2400 meters.
- The 6 o'clock position indicate the optimum range: 1800 meters.
- The 3 o'clock position indicate the minimum range: 1200 meters.

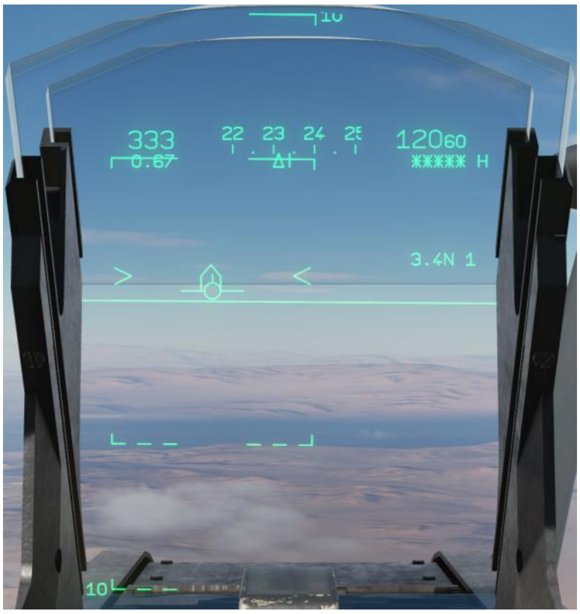
ROCKET FIRING

Pressing the MiCRoB second stage trigger instantly fires the rockets according to the PCA salvo selection and the rocket pod salvo setting.

FLYING THE PROFILE

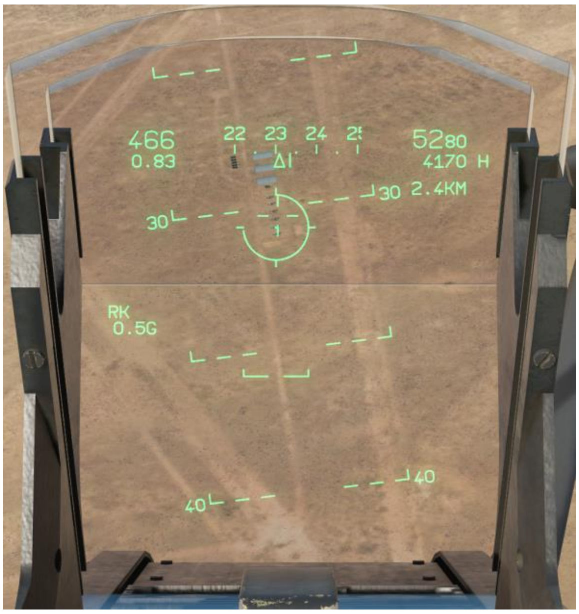
The profile flown here will be CCPI starting a 12 000 ft with a 30° dive to the target.

Starting at 12 000 ft, fly to around 3,5 nm from the target.

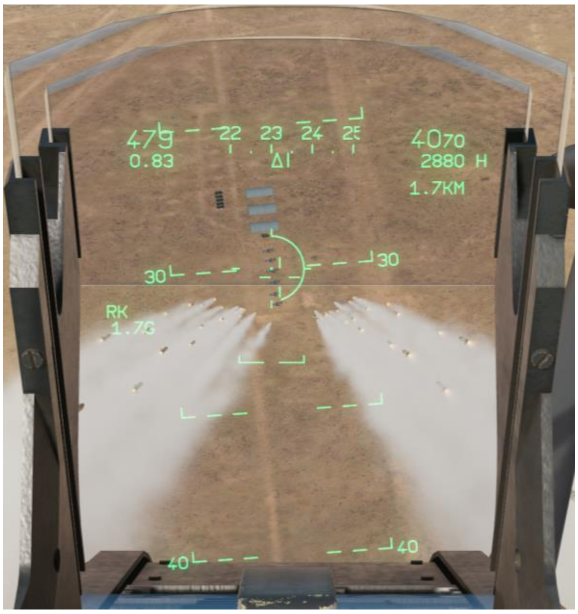


Enter a 30° dive and press the HOTAS weapon system command forward to set the VTH to RK mode.

Place the aiming reticle over the target and wait for the employment domain circle to reach the maximum range position.



Between the maximum and minimum range, press the MiCRoB second stage to fire the rockets.

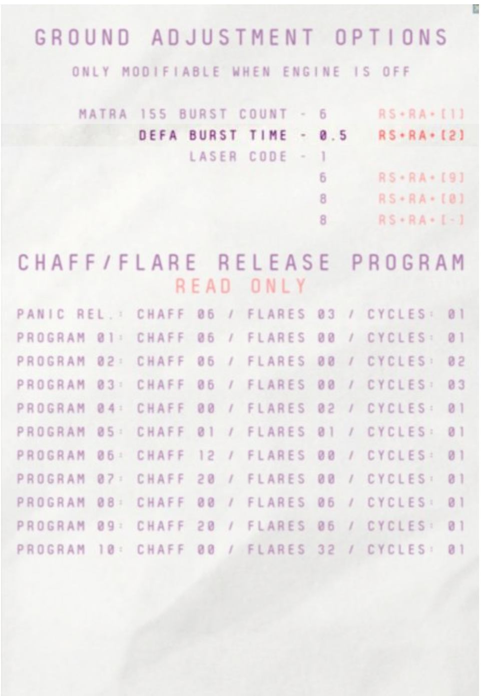


Execute a sharp turn away from the target area.

GUNS

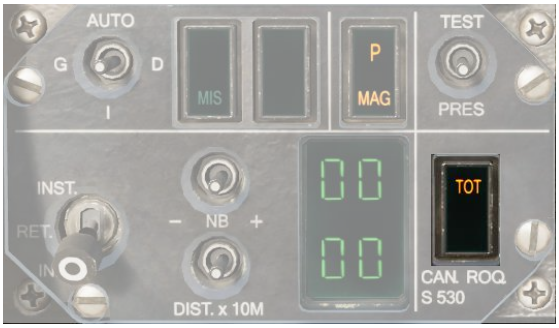
SALVO DURATION

The gun salvo duration is set by the ground crew. The salvo duration can be visualized on the kneeboard “Ground adjustment option” page. It can be selected in the mission editor or using the kneeboard key command (right shift + right alt + 2 by default) while on the ground with the engine off.



SALVO SETTING

The salvo firing or the guns is set using the weapon salvo selection button on the PPA.



2 yellow lights display the selected mode:

- TOT (*Total*): The guns fire as long as the trigger is pressed.
- PAR (*Partiel* – Partial): The guns fire in salvo of 0,5 or 1 second.

WEAPON SELECTION

The air-to-ground guns are selected by pressing the PCA CAS selection button, this sets the aircraft SNA in the air-to-ground pre-selected sub-mode. In order to be able to select the bombs, the HOTAS CNM command needs to be in the N (*neutre* – neutral) position and the selective jettison switch in the N position.

The S light on the PCA CAS selection button indicates that the CAS mode is selected.

As the SNA is in air-to-ground pre-selected sub-mode, the PCA top row displays the weapons options and the VTH will stay in NAV mode.

FIRING RATE SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow the selection of the guns firing rate.

2 options are selectable:

- LEN (*Lent* – Low): 1200 round/min.
- RAP (*Rapide* – High): 1800 round/min.

The firing rate is initialized at high. Low firing rate is preferred when using the guns in air-to-ground.

RANGING SENSOR SELECTION

If the SNA is in air-to-ground pre-selected or selected sub-mode, the PCA top row displays the weapons options. These options allow the selection of the ranging sensor used to determine the slant range to the desingated impact point.

2 sensors are available:

- TAS (*Télémétrie air-sol* – Radar ranging): The radar is used to determine the distance to the impact point.
- RS (*Radio-sonde* – Radar altimeter): The radar altimeter is used to determine the aircraft's altitude over the ground. This information coupled with the aircraft attitude is then used to determine the range to the impact point.

2 ranging sensors can be selected at one time, priority order is the following: TAS then RS. If the priority sensor is unable to provide the slant range the information from the second sensor is used.

MASTER AND GUN ARM

In order to fire the gun, the master arm and the gun safety switches need to be in the armed position.

The P light on the PCA CAS selection button indicates that the master arm and gun safety are armed and the SNA is in air-to-ground selected mode.

If the SNA is in selected sub-mode, the master arm and gun safety are armed, the VTH CAS mode indication should be steady.

AIR-TO-GROUND SUB-MODES

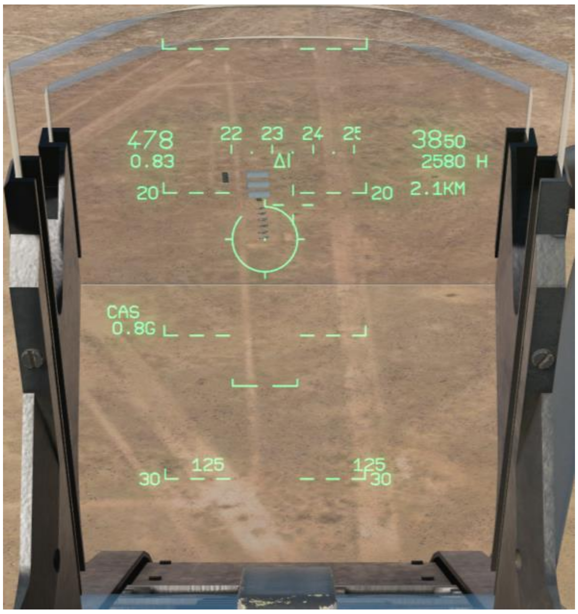
Once the air-to-ground gun is selected on the PCA, the HOTAS weapon system forward and aft commands are used to switch between the 3 CAS sub-modes:

- **Forward**: Sets the SNA to selected sub-mode. The VTH is set to CAS mode and the PCA top row displays weapon options.
- **Aft**: If the SNA is in pre-selected or selected sub-mode, sets the SNA to memorized sub-mode. The VTH is set to NAV mode and the PCA top row displays weapon options.
  If the SNA is in memorized sub-mode, sets the SNA to pre-selected mode. The VTH is set to NAV mode and the PCA top row displays NAV options.

For more information about the SNA air-to-ground sub-modes and the HOTAS weapon system command, see the NAVIGATION AND WEAPON SYSTEM HOTAS SNA COMMANDS SUB-SECTION.

AIMING

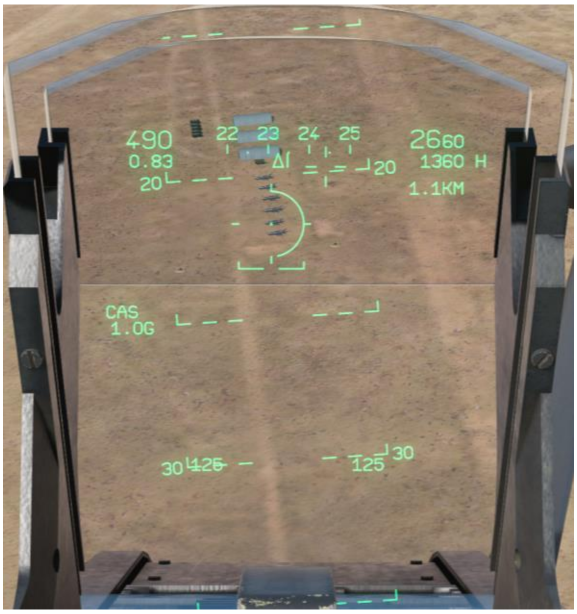
In order to fire the guns on the target, the aircraft needs to be maneuvered to place the target under the aiming reticle.



EMPLOYMENT DOMAIN

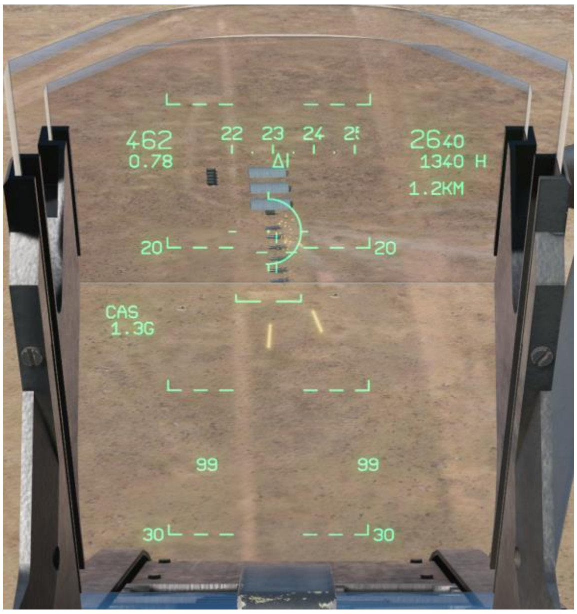
In order to fire the guns in the best condition, they need to be fired at the correct range. The guns employment domain is displayed around the impact point and indicate the position of the aircraft relative to the air-to-ground guns firing domain.

- A full circle indicates that the target is out of range.
- The circle starts to unwinds counter-clockwise when the aircraft enters the air-to-ground guns firing domain: 2100 meters.
- The 9 o’clock position indicate the maximum range: 1800 meters.
- The 6 o’clock position indicate the optimum range: 1200 meters.
- The 3 o’clock position indicate the minimum range: 600 meters.



GUNS FIRING

Pressing the MiCRoB second stage trigger instantly fires the guns according to the PCA salvo and firing rate selection.



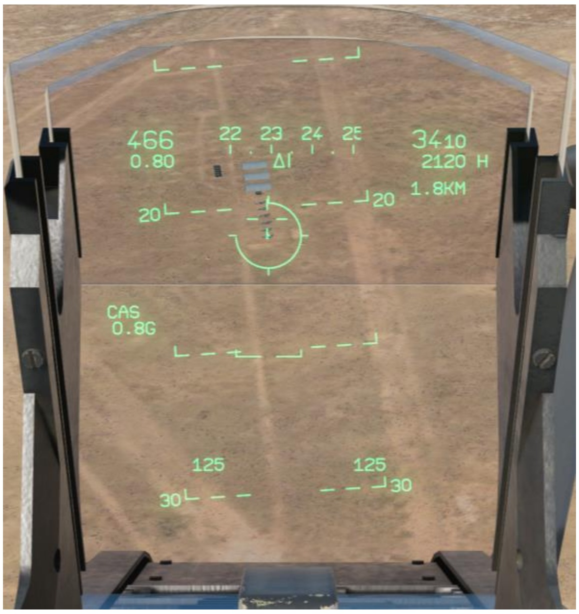
FLYING THE PROFILE

The profile flown here will be CCPI starting a 12 000 ft with a 20° dive to the target.

Starting at 12 000 ft, fly to around 5,5 nm from the target.

Enter a 20° dive and press the HOTAS weapon system command forward to set the VTH to CAS mode.

Place the aiming reticle over the target and wait for the employment domain circle to reach the maximum range position.



Between the maximum and minimum range, press the MiCRoB second stage to fire the guns.

Execute a sharp turn away from the target area.

DEGRADED EMPLOYMENT

WORK IN PROGRESS

26 - AIRCRAFT PROCEDURES

26 – 1 - PILOT MEMO

STANDARD CONFIGURATIONS

CONFIGURATION	DETAILED PAYLOAD
Clean aircraft	Full internal fuel, gun ammo, drag chute and countermeasure (no éclair pod)
Standard air-to-air	Clean + 2 Super 530, 2 MAGIC II and 1 RPL-522
Standard air-to-ground	Clean + 2 MAGIC II, 4 Mk-82 and 2 RPL-541/542 OR Clean + 2 MAGIC II, 2 GBU-12 and 2 RPL-541/542

TAKE-OFF – ISA METEOROLOGICAL CONDITIONS

CONFIGURATION	FUEL (t)	GROSS WEIGHT (t)	EXPECTED JX	VMAXRTO (kt)	VR (kt)	VLOF (kt)
Clean aircraft	**3.1**	**11.0**	**0.68**	**145**	**120**	**155**
Standard air-to-air	**4.1**	**13.2**	**0.55**	**140**	**125**	**155**
Standard air-to-ground	**6.3**	**16.0 or 15.7**	**0.44 – 0.46**	**130**	**150**	**175**

Remarks: Vmaxrto is the go/no-go speed, the max speed up to which it is still possible to reject take-off. Above Vmaxrto the pilot must either take off or eject.

Vmaxrto is not called V1 because it may occur above Vr. Vmaxrto values above assume a dry standard NATO runway (2400m) without brake chute use.

CLIMB – BEST EFFICIENCY

		ECONOMIC (MIL THRUST)		HIGH PERFORMANCE (MAX AB THRUST)	
CONFIGURATION	**CLIMB UP TO**	**BEST CAS (kt)**	**BEST MACH**	**BEST CAS (kt)**	**BEST MACH**
Clean aircraft	**FL 400**	**500**	**0.90**	**600**	**0.95**
Standard air-to-air	**FL 350**	**460**	**0.85**	**550**	**0.90**
Standard air-to-ground	**FL 300**	**440**	**0.80**	**550**	**0.90**

Remarks: use best CAS (IAS) until best Mach is reached; then use best Mach for the remaining of the climb.

For MIL climb, cut AB off at 300kt after take-off (AB is mandatory for all take offs with this aircraft, as per SOPs/safety consideration)

LANDING – REMAINING FUEL/MLW

	MAXIMUM REMAINING FUEL (t)	
CONFIGURATION	**FOR NORMAL MLW**	**FOR UPRATED MLW**
Clean aircraft	**2.05**	**4.45**
Standard air-to-air	**0.85**	**3.25**
Standard air-to-air (all missiles shot)	**1.57**	**3.97**
Standard air-to-ground (4 Mk-82)	**< 0.5 (min. res.)**	**2.6**
Standard air-to-ground (2 GBU-12)	**0.5 (min. res.)**	**2.9**
Standard air-to-ground (all bombs released)	**1.1**	**3.5**

Remarks: uprated MLW is a non-standard procedure which should be avoided to minimize risks and aircraft wear (structural, gear, brakes, tyres...)

When an uprated MLW landing has to be performed, it REQUIRES extra precautions: gentle sink rate at touch down, long runway, parachute use mandatory if > 1t over normal MLW... etc.

26 – 2 - CHECKLISTS

Below you will find the procedures that must be followed before and after a flight. The procedures listed here are a subset of the ones followed by the pilots of the actual aircraft.

PREFLIGHT

LEFT CONSOLE

	DESCRIPTION	POSITION
1	FBW channel 5 switch	Off (cover closed)
2	FBW and AP test switches	Off (cover closed
3	Emergency afterburner cutoff switch	Off (cover closed)
4	Emergency oil switch	Off (cover closed)
5	Engine computer re-arming and emergency switch	Norm (cover closed)
6	External fuel tank dump button	Cover closed
7	Radar ground emission switch	Off
8	Emergency trim	N
9	Aircraft sound configuration panel	As desired
10	Inflight restart magnetic switch	Off
11	Throttle	Stop position
12	Radar power mode knob	A
13	Emergency fuel switch	Auto
14	Swoops operation switch	Auto
15	Inlet cones operation switch	Auto
16	Slats position switch	Auto
17	External light switches	A
18	Brake system switch	1 (cover closed)
19	Recorder switch	A
20	Landing and taxi light switch	A
21	Police light switch	Off
22	V/UHF radio operation mode switch	0
23	UHF radio operation mode switch	AR

LEFT WALL

	DESCRIPTION	POSITION
24	Inflight refueling switch	Arrêt
25	Brake chute lever	Forward
26	Canopy fracture lever	Rearward

LEFT VERTICAL PANEL

	DESCRIPTION	POSITION
27	Gear handle	Down
28	Emergency FBW gain switch	Norm (cover closed)
29	FBW mode switch	As desired
30	Gun safety switch	Safe (cover closed)
31	Emergency gear handle	Normal (vertical position)

FRONT DASH

	DESCRIPTION	POSITION
32	Selective jettison switch	Off (cover closed)
33	Master arm switch	Off
34	Backup attitude indicator	Caged
35	Spin switch	Norm
36	Main attitude indicator pole switch	N
37	VTB power switch	A
38	VTH power switch	A
39	PCTH radar altimeter switch	A
40	PPA fuse switch	INERT.
41	Feeder tanks intercom control	Closed (vertical)

RIGHT VERTICAL PANEL

	DESCRIPTION	POSITION
42	Battery switch	A
43	Transformer-rectifier switch	M
44	Alternator 1 switch	M
45	Alternator 2 switch	M
46	QRA switch	Off

RIGHT WALL

	DESCRIPTION	POSITION
47	Canopy lever	Open

RIGHT CONSOLE

	DESCRIPTION	POSITION
48	Electric pump switch	Off
49	Warning sound switch	Off
50	Pitot heat switch	Off (cover open)
51	IFF interrogation mode selector	Off
52	Jammer operation mode switch	VEI.
53	Countermeasure power and test switches	A
54	Decoy dispenser program selector	A
55	Decoy dispenser operation mode switch	A.
56	VOR power switch	A
57	TACAN mode switch	Off
58	Emergency attitude and heading switch	A
59	PSM mode selector knob	AR
60	PSM operational mode selector knob	N
61	Starter fuel pump switch	Off (left)
62	Ignition/ventilation switch	G or D
63	Boost fuel pump switches	Off (left)
64	Fuel shut-off valve switch	Closed (left and cover open)

NOTES

RAMP-START WITH GROUND POWER

	DESCRIPTION	POSITION
1	Battery switch	M
2	V/UHF radio operation mode switch	FF
3	UHF radio operation mode switch	M
4	External lights switches	Navigation to FORT
5	Ground power	Connect
6	INS	Start the normal alignment
7	Emergency attitude and heading switch	AUTO and uncage the back-up attitude indicator
8	VTH power switch	M
9	PCTH radar altimeter switch	M and set the altitude display selector switch as desired
10	VTB power switch	M
11	DETOT fuel amount	Set
12	Lights test switch	1 and 2
13	Electric pump switch	TEST then A
14	INS	Wait for alignment then set to NAV
15	Canopy	Closed and secured (canopy lever forward)
16	Fuel shut-off valve switch	Open (cover closed)
17	Boost fuel pump switches	M
18	Starter button cover	Open and starter fuel pump to on
19	Start button	Press and hold for 1 second then close the starter button cover
20	Throttle	Once RPM reaches 10%, idle position
21	Alarm panel	Once RPM reaches 48%, check **HUILE** and **T7** off
22	Alarm panel	Check **HYD.1** and **HYD.2** off
23	Ground power	Disconnect and check **ALT.1** and **ALT.2** off
24	Emergency pump switch	Auto, check **HYDS** off
25	IFF master mode knob	SBY
26	Radar power mode knob	SIL

27	CDVE and PA tests	Execute short tests
28	External light switches	Anti-collision to FORT, formation as desired
29	Controls	Wipe
30	Air-brakes	Test and check configuration panel
31	Slat position switch	SORTIS then AUTO
32	Pitot heat switch	On (cover closed)
33	Warning sound switch	On
34	Alarm panel	All lights off

NOTES

RAMP-START WITHOUT GROUND POWER

	Description	Position
1	Battery	ON
2	Radios (both)	ON & Set
3	If MP flight, Radio Check	DONE
4	F2 view external preflight check - Payload & skin	DONE - CHECKED
5	Altimeter Pressure setting	SET to QFE (or QNH)
6	Alarm panel and Fire Warning Lights	TEST
7	IFF	SET (as briefed)
8	Emergency Hydraulic pump	TEST then OFF
9	FS emergency/parking brake pressure	CHECK > 80b (EP if req.)
10	"Ready for start-up"	Radio CALL (Leader/ATC)

NOTES

ENGINE START SEQUENCE (NO GROUND POWER)

	Description	Position
1	Parking Brake	SET
2	NAV and ANTICOL Strob lights	ON
3	Throttle	CHECK STOP
4	RPM and CALC warning/caution lights	CHECK Both OFF
5	MASTER WARNING/CAUTION - PANNE/PANNE	ACKNOWLEDGED - Indicat. OFF
6	Canopy	CLOSED or AJAR
7	Fuel Shut-Off Valve Switch	OPEN & Cover CLOSED
8	Ignition/Vent selector	G or D as requ. (odd/even day)
9	Starting fuel pump 'POMPE DEM' - BP warning light	ON - warning OFF
10	Starter button	PRESS 1 SEC.
11	When RPM 'N' > 10%, Throttle	IDLE
12	When RPM 'N' = Idle (~48%), HUILE and T7 warning lights	CHECK Both OFF
13	T7 temperature	CHECK < 950Â°C
/!\	If any incident occurs during start sequence, or Tt7 peaks > 950°C:	ABORT START UP
14	Alternators switches - ALT.1 & ALT.2 cautions lights	ONLINE - cautions OFF
15	Normal electric converter - TR caution light	ON - caution OFF
16	Fuel pumps “G” & “D” - BP.G & BP.D caution lights	ON - cautions OFF
17	HYD pressure gauge - HYD.1 & HYD.2 caution lights	CHECK - cautions OFF
18	Emergency Hydraulic pump - HYD.S warning light	AUTO - warning OFF

NOTES

POST ENGINE START SEQUENCE (NO GROUND POWER)

	Description	Position
1	P MIS & P MAG (when appropriate)	Blinking - STOP if req.
2	HDD (Radar display)	ON
3	Payload	CHECK (PRES switch)
4	A/A-CHARGES Switch - CONF caution light	SET - OFF
5	INS (PSM panel)	SET to VEILLE
6	00 PREP WPT Position & Altitude	SET Proper Values
7	INS (PSM panel)	SET to ALN
8	INS Alignment	START (VAL button)
9	Fuel Panel Qty & Xfeed closed - BINGO value	CHECK - INSERTED
10	Radar main switch	PCH
11	Radar Warm-Up (HDD)	CHECK 'P' Blinking
12	HUD	ON
13	Defensive suite (incl. Eclair) & IFF Interrogator	SET (Pilot's discretion)
14	VOR/ILS	SET & ON
15	TACAN	SET & A/A or T/R
16	CAP/HORIZON GCS switch (right console)	CGM+H.SEC (middle position)
17	Auxiliary Attitude Indicator	UNCAGED - No Flag
18	INS Waypoints 01 to 20 (depending on mission)	ENTER and/or CHECK
19	INS Alignment	CHECK Completed ('PRET' light)
20	INS (PSM panel)	SET to NAV
21	ANEMO heater switch - ANEMO caution light	ON - caution OFF
22	Flight Controls - Controls Surfaces	TEST - Check
23	AP BIT test	DONE & Green Result
24	FBW short ('C') BIT test	DONE & Green Result
25	SEC CALC & SEC CARB emergency modes tests	DONE & Passed OK
26	Airbrakes and Slats extension	TEST
27	Secondary brakes circuit & Antiskid loss	TEST
28	"Ready for taxi"	Radio CALL (Leader/ATC)

TAXIING

	Description	Position
1	Parking Brake	RELEASE
2	PARK caution light	CHECK Off
3	Warning Sounds switch	ON
4	Caution/Warning Lights panel*	CHECK All Off
5	NWS	ACTIVATE
6	DIRAV advisory light	ON
7	NWS Travel	CHECK
8	Landing lights	TAXI
9	Formation lights	As req.
10	Radio-altimeter	ON ('SEL H')
11	Radio-altimeter warning value ('HG')	SET

* The CAB warning light, indicating that the canopy is open, may remain lit at this stage.

You can now increase throttle until the aircraft rolls out. Do not exceed 20 knots ground speed

NOTES

TAKE-OFF

	Description	Position
1	Canopy	Down and locked
2	CAB warning light	Off
3	Caution/Warning Lights panel	All Off
4	Landing Lights	Landing
5	Take Off parameters (speeds & expected Jx)	Review & Memorize
6	Throttle	Max afterburner
7	PC advisory light	On
8	At 80kt	Check Jx
8	Rotate at Vr speed	Place horizon on the rotation pitch marker in the HUD.
9	Retract and stow landing gear	Before 260 Knots.

NOTES

LANDING

	Description	Position
1	Landing Gear Down	Below 230 knots
2	Landing Gear warning lights	Green
3	Anti-Skid	Check
4	HUD	APP Mode
4	Landing Lights	On
6	AOA final approach	14º
7	Brake chute (after nose gear is on the ground)	As required
8	Wheel brakes	Below 130 knots*
9	NWS	Below 40 knots

* Whenever possible, use wheel brakes only when speed is below 100kt, to lessen brakes wear.

NOTES

Runway Vacated

	Description	Position
1	Landing Lights	Taxi
2	IFF	Off
3	VOR/ILS	Off
4	TACAN	Off
5	IFF interrogator, Countermeasures Panel & ÉCLAIR control box	All Off
6	ANÉMO heater switch	Off
7	Warning Sounds switch	Off

Parking

	Description	Position
1	External power supply	Connected
2	HUD and HDD	Off
3	INS	Off
4	Radio Altimeter	Off
5	CAP/HORIZON GCS switch (right console)	Off
6	Auxiliary Attitude Indicator	Caged
4	Engine	Stop button
5	When engine has stopped: Fuel pumps G and D	Off
6	Fuel Shut-Off Valve Switch	Closed (cover open)
7	All air conditioning equipment	Off
8	All external lights	Off
9	Radios (V/UHF and UHF)	Off
11	BATT switch	Off

NOTES

27 - CAMPAIGN

27 – 1 - CAMPAIGN NOTES

INTRODUCTION

Welcome to the official campaign for the M-2000C. Below you will find some background information, basic facts about the campaign, things you should know and remember while playing the campaign to make most of it and finally the credits part with big thank you for all the voice actors and beta testers who helped to make these 13 missions what they are in their final form.

THE STORY SO FAR

8 AUGUST 2008

Short and intensive armed conflict starts first in the Georgian breakaway territory of South Ossetia, and then within a few days is being brought by Russian troops at the soil of Georgia proper.

12 AUGUST 2008

A ceasefire between Russia and Georgia is signed under the auspices of EU, led by the French Presidency. A six point peace plan is adopted, envisaging non use of force, cessation of hostilities, granting of access to humanitarian aid, return of Georgian troops to usual quarters, withdrawal of Russian forces and opening of international discussions of the modalities of security and stability of South Ossetia and Abkhazia. UN is set to formalise the deal. EU call for international peacekeeping mission is rejected by Russia.

15 AUGUST 2008

Russian forces bomb the highway connecting eastern and western Georgia, destroy the railway bridge at Kaspi, a lifeline to Georgia's economy. Moreover, the Russian air force unleashes a series of air raids on Borjomi National Park, using fire bombs to inflict serious damage on what is regarded as a national treasure. Georgian government protest in the UN Security Council. Special resolution condemning Russian actions is vetoed by Moscow. France, feeling especially responsible for maintaining the ceasefire, sends a strongly worded warning to Russia.

31 AUGUST 2008

Russian troops begin erecting fences and checkpoints at the ABL with South Ossetia and Abkhazia. Georgians protest again, but UNSC has no room of maneuver as it is blocked by Moscow. France warns Russia for the second time, and is backed by all EU-countries. NATO issues a strong statement, calling for immediate fulfilment of the 6-point plan.

10 September 2008

US and France agree on the details of their next pilot exchange programme and decide that the training will take place in Georgia, as a sign of good will for the authorities and a warning to Russia. 2 USAF pilots will be flying Mirage-2000C's as part of 12-ship squadron sent to Georgia during a deployment planned to start in January 2009. Americans provide AWACS, C&C and transport planes.

11 November 2008

Exchange of fire between Georgian soldiers and Russians in Orsantia, part of Georgia proper annexed and still controlled by the Russians. Russian jets overfly Georgia on numerous occasions, dropping several bombs and destroying a pipeline from Turkey. Ankara calls for establishing a "no-fly" zone over Georgia and breakaway territories for Russian planes. This issue is raised at the extraordinary NATO meeting, but no decisions are taken.

December 2008

Russian planes enter air space over South Ossetia and Abkhazia numerous times, although they are no longer stationed in Abkhazian bases. They also fly over Georgia proper. NATO issues another warning, UNSC remains blocked.

20 January 2009

2/5 Squadron arrives in Georgia together with two US pilots taking part in the exchange program.

25 January 2009

Today.

Campaign

The campaign puts you in the role of one of two US exchange pilots attached to French 002.05 Squadron. You arrive in Georgia after the familiarisation training and you are to go through more advanced exercise session in Vaziani, while flying missions in support of the NATO operations there.

The campaign is roughly divided in two parts. First one is more focused on honing your skills and expanding on the things you have learned in the dedicated training missions (it is strongly advised that you fly these first). Therefore you can expect to get additional information on systems that were already covered as well as on new aspects of flying the M-2000C. As the campaign progresses, the storyline evolves with it and slowly changes focus from training to more substantial duties.

DIFFICULTY

The campaign is not excessively difficult if you talk about number of enemy assets and tasks that are given to the player. However, it is very complex and will require good preparation from your side, including reading the briefings, taking notes, listening to the comms and following orders. Below you will find several pointers that you should treat really seriously.

1. RADIO COMMS

The campaign uses an advanced radio system which means that you need to be tuned to correct channel / frequency in order to hear other flights and assets. For that, it is ESSENTIAL THAT YOU TURN EASY COMMUNICATIONS OFF, otherwise some of the missions will not be playable.

Equally important, you should always pay attention to and follow your AMC calls on changing radio frequencies, consult the notepad available as part of mission briefing package (you will find it in the kneeboard as well) and always remember to check if you are on correct radio channel for the thing you want to accomplish. For instance, you may want to jump from your element frequency to another channel to contact AWACS to get bearings to the enemy, but then you should remember to switch back to the element, otherwise you won't hear your wingman. I can't stress enough how important the radio discipline will be for accomplishing the missions.

2. FLIGHT PLANS AND ORDERS

The campaign is quite complex and contains thousands of triggers, some of which are linked to the location in which the player currently is. Therefore it is very important that you keep to the given flight plans and - as much as possible - to the fragged speeds. There are rare points in which you may even break a mission if you don't follow these. So try to keep to the briefed parameters, just as you would be expected to do in real life. Read carefully the FRAGO, briefing, notes and study the map. If you do all these things, you will be OK.

3. INSTRUCTIONS

You will get a lot of information and instructions. If you have trouble understanding something, I would suggest to use an active pause and then read the message that someone (usually your Flight Lead / Instructor Pilot) wants to convey to you. This campaign will require you to focus on what is happening around you and what is being said, as it will be important for completing the missions!

4. INS ALIGNMENT

All the missions will start on the ground and will require a full INS alignment. In most it won't be important how much time you spend on the ground, but at least two (M11 i 13) do take into account the timing. Therefore I would recommend not to disable the need for ground alignment in the options menu.

5. COMPLETING MISSIONS

In order to progress the campaign you not only need to fulfil at least part of the objectives, you also need to land at one of two airports listed in the briefing - your home base (Vaziani) or the backup one, which depends on the area in which most of the given sortie will take place. So if you eject or land somewhere else, you will be forced to repeat the mission. When you land, you will also be given a specific parking spot - if you taxi there you will get extra points, though this is purely optional.

6. AI DURING TAXI AND FORMATION FLYING

This campaign will quite often put you in the role of a wingman, which means that you will be required to fly in formation with your lead. A word of advice - despite hours spent on fine-tuning the AI behaviour it can be quite erratic, especially just after take off and during the taxi. When taxiing behind number 1 don't come too close to him, as he might just stop moving. If your IP stops during the taxi and refuses to enter the runway (a rare occurence) try to turn around or take one of the side taxiways, that should make him going. If you loose sight of the Instructor Pilot, use radar or F10 map to locate him. Sometimes you won't be required to stay in formation, this will be noted in the briefing or told during the flight.

Also, in very rare and exceptional situations, it may happen that the unpredictable AI behaviour could ruin a mission. Don't say you haven't been warned.

7. SUPPORT AND FEEDBACK

Finally if you have any problems or feedback or if you just want to share your thoughts about the campaign (which is strongly encouraged) please do so at the DEDICATED PART OF THE RAZBAM'S M-2000C EAGLE DYNAMICS FORUMS. Constructive criticism will be appreciated (praises even more so :)

27 – 2 - CREDITS AND THANKS

First and foremost, huge thanks to the voice actors who did an outstanding job recording a total of around 1200 lines:

Nicholas “Doughboy” Barnwell (the Player’s voice, there was tons of recording there), Patrick Kasperczyk (one of the Instructor Pilots and all voiceovers for the training missions), Olivier Raunier (Berger 1-1, for his creative approach to voice acting and great mission ideas) and his wife, Kandy Sigritz - Raunier, Haley Flight (Athena and Artemis voices), John 'Brixmis' and Sharon Dixon (for Rover, Zeus, Prowler and Vaziani Ground voice, briefings proofreading, training missions testing, great spirit and support throughout the campaign), Greg “Teeter” Smiddy (the second US pilot and a RAZBAM dev), as well as other voice actors, for their work and support in mission testing:

gabuzomeu, Philippe Gleize, Simon Pacotte, Maxime C., Nicolas Gutierrez, HiCKS, Equinox Echo, Ookami Daisuke, Adrien Margiotta, Corsair, VJS-161, Daniel Mikuś, Darkfire, Yurgon, Bryce Jackin, Kerlix, Jack Flash, Zilch, Apache500, Ivan Petrovic, Datek, alieneye.

Also, huge thanks to the beta testers:

Gliptal (for insane amount of work put into this, including corrections to the briefings and tracking down even the smallest bugs), Sryan (who was a spiritus movens for adding M13 to the already finished campaign and had very valuable input in other missions as well), Yurgon (usual precision in finding even the smallest bugs), as well as Catseye, Divadov, Helljumper, JughedJones, The Almighty Snark, Typhoon, [E69]Zaz0 and others.

28 - ANNEXES

ABBREVIATIONS

	DCS MIRAGE-2000C COCKPIT FRENCH/ENGLISH LEXICON BY JEFX	
Word/abbr.	**Français**	**English**
A	Arrêt (voir AR)	Off
530	Matra Super 530D	Matra Super 530D
3M	Mains sur Manche et Manette	HOTAS
AF	Aérofreins	Airbrakes
ALCM	Alignement sur Cap Mémorisé	Memory INS Alignment
ALL	Allègement	Symbology Dectlutter Switch (HUD)
ALN	Alignement	Alignment (yellow: INS is aligning)
ANEMO	Anémomètre	Pitot Heat Switch
APP	Approche	Approach Mode
AR	Arrêt	Off
ARME	Armé	Armed (Mater Arm On)
ATT.	Atterrissage	Landing (lights)
AU.	Automatique	Automatic
AV	Groupe Avant	Forward Fuselage Fuel Tanks
AV SON	Avertisseur Sonore	Audio Warning switch
B	B-Scope (Écran radar)	B-Scope (Radar display)
BAD	But Additionnel	Offset point
BALAYAGE	Angle de Balayage du Radar	Radar Scan Azimuth Selector
BANQUETTES	Banquettes	Lateral Consoles
BD	Bas-Droit	Low Right
BF	Mode Air-Sol pour Bombes Freinées	CCIP A/G Mode (for High Drag Bombs)
BF	Bombes Freinées	High Drag Bombs
BF1	Mark 82 Snake-Eye, Bombe Freinée (500 Lbs)	Mark 82-SE High Drag Bomb (500 Lbs)
BF4	BLG-66 Bélouga, Bombe à Fragmentation	BLG-66 Bélouga Unguided Low drag Cluster Bomb
BFR	Basse Fréquence	Low Frequency

BIP	BIP (signal audio...)	BEEP! IRL signal sent by the pilot to confirm gear is down
BL	Bombes Lisses	Free Fall Bombs
BL	Mode Air-Sol pour Bombes Lisses	CCRP A/G Mode (for Free Fall Bombs)
BL1	Mark 82, Bombe Lisse (500 Lbs)	Mark 82 Bomb (500 Lbs)
BLANC	Blanc	White (Cockpit Flood Light)
BP	Basse Pression	Low Pressure Boost Pumps
BR	Brouilleur	Radar Jammer (ECM)
CALC	Calculateur (pour le moteur)	Engine Computer
CAN	Canon (30 mm. Revolver x 2)	Cannon (30 mm. revolver cannon x 2, 125 rounds each)
CAN.	Canon	Guns
CAP SEC	Cap Secondaire	Secondary HSI/ADI
CARB	Carburant	Fuel
CAS	Canon Air-Sol	Air-to-ground canon
CCLT	Calcul Continu de la Ligne de Traceurs	Continuous Computation of tracer line (HUD GUN mode)
CCPI	Calcul Continu du Point d'Impact	CCIP (continuously Computed Impact Point)
CCPL	Calcul Continu du Point de Largage	CCRP (Continuously Computed Release Point)
CDVE	Commandes de Vol Électriques	FBW
Cm	Cap Magnétique	Magnetic Heading (Inertial)
CME	Contre-mesures	Countermeasures
CNM	Canon Neutre Magic	Cannon, Neutral, Magic
COUPURE	Coupure Post-Combustion	Afterburner Shutdown
CP/PD	Cap de Piste (vrai), Pente Désirée (au but)	Runway Heading/Glide Slope
CROSS	Crosse	Tail Hook
Cv	Cap Vrai	True Heading (Inertial)
D	Droite	Right
D/RLT	Distance/Relèvement	Distance/Bearing
D2M	Détecteur de Départ de Missile	IR Missile Launch Detector
DA.	Détecteur d'Alertes	RWR

DEC	Déclinaison magnétique	Magnetic Variation
Defa 554	Canons 30 mm (x2)	30 mm Canons (x2)
DEMAR	Démarrage	Start-up
DESCENTE	Descente (Verrière)	Down (Canopy)
DESEMB	Désembuage	Defogging switch
DEST	Destination	Destination
DETOT.	Détotalisateur de carburant	Total Fuel Quantity (Kg)
DIRA	Dirigeabilité Roue Avant	NWS
DIST	Distance	Bomb Drop Interval
DV/FV	Direction du Vent/Force du Vent	Wind Direction/Wind Speed
ÉCLAIR	Module additionnel de Lance-Leurres	Additionnal Chaff and Flares Dispenser Pod
EF1	GBU-12 (500Lbs) Bombe à guidage laser	GBU-12 (500Lbs) Laser Guided Bomb
EF1	GBU-16 (1000 Lbs) Bombe à guidage laser	GBU-16 (1000Lbs) Laser Guided Bomb
EF1	GBU-24 (2000 Lbs) Bombe à guidage laser	GBU-24 (2000Lbs) Laser Guided Bomb
EFF	Effacement	Erase
EM	Électromagnétiques (Contremesures)	chaff
EM	Émission	On (Radar)
ENC	Enchaînement	Waypoint automatic change
ENT	Entrelacée	Interleaved
ENV	Envergure (sélecteur en mètres)	Target Wingspan Selector (in meters)
EP	Électropompe	Emergency Hydraulic Pump
EXT	Extérieur	Outer wing rocket pods (if installed)
FAIB	Faible	Low (lights intensity)
FEUX	Feux (FEUX FORMAT = Feux de Formation)	Ligths (Formation Lights)
FORT	Fort	High (lights intensity)
FRAGILISA-TION	Fragilisation	Jettison (canopy)
FREINS	Freins Anti-dérapage	Anti-Skid Brake Switch
G	Gauche	Left

G	Guard (radio)	Guard (radio)
GAIN CDVE	Gain Commandes de Vol Électriques	FBW Gain Mode
H	Hauteur (sur VTH)	Height (Radar Altimeter on HUD)
HAUSSE	Hausse (Canon)	Auxilliary Gunsight
HFR	Haute Fréquence	High Frequency
HG	Haut-Gauche	High Left
HUILE	Huile	Oil
IDN	Indicateur de Navigation	HSI (Horizontal Situation Indicator)
INERT	Inerte	Disarmed (Bombs)
INS	Insérer	Insert
INST	Instantané	Instantaneous (No delay)
INT	Intérieur	Inner wing rocket pods (if installed)
IR	Contremesures Infrarouges	Flares
JAUG.	Jauge de Carburant	Internal Fuel Quantity (Kg)
JOUR	Jour	Day
L G (AP)	Localiser, Glide Slope, Pilote Automatique	Localiser and Glise Slope AP (ILS)
L/G	Latitude/Longitude (BUT)	Lat/Long (Waypoint)
LEN	Lent (1200 rounds per minute GUNS only)	Slow, (1200 rounds/min. GUNS only) best for Ground Atk.
LL	Lance-Leurres	Decoy Dispenser
LOX	Liquid Oxygen	Oxygen Quantity (Liters)
LUM	Luminosité	Brightness
LUMI	Luminosité	Brightness
M	Marche	On
M	Manuel (Mode radio)	Manual (radio mode)
M91	(M91, M92, M93) Points de Dest. Marqués	Markpoints (Max 3)
MAG	MATRA R550 MAGIC II IR MISSILES	MATRA R550 MAGIC II IR MISSILES
MAGNETO	Magnétophone	Video Recorder
MIP	Module d'Insertion de Paramètres	Data Cartridge Insertion Module (not functional)

MIS	Missiles Super 530D	Missiles Super 530D
MISS	Missiles	Missiles Magic II and S-530D
MRQ	Marquage	Mark point
N	Normal	Normal
N.DEG.	Dégradé (INS)	INS Degraded, needs alignment
NAV	Navigation	Navigation
NB	Nombre	Number (selected Quatity per trigger)
NUIT	Nuit	Night
OBL	Recalage Oblique de la Centrale	Radar INS Calibration
OBUS	Obus (cartouches du canon)	Rounds (Gun)
OUVERTURE	Ouverture (Verrière)	Open (Canopy)
P	Prêt	Ready
P	Pré-sélection (Mode radio)	Preset mode (radio)
P CH	Préchauffe	Radar Warm-up
PA	Pilote Automatique	Autopilot
PANNE	Panne	Failure (Main Caution Panel)
PAR	Partiel	(Fires a single 530D, Rockets and Gun Burst mode)
PC	Post-Combustion	Afterburners
PCA	Poste de Commande Armements	Weapons Management Panel
PCM	Priorité Contremesures	Jammer Priority mode (override own radar)
PCN	Poste de Commande Navigation	Navigation Control Panel
PELLES	Pelles	Engine Scoops
PHARES	Phares	Lights (external)
PI	Point Initial	IP (displays only if offset point set+BAD depressed on PCN)
PIC	Poursuite sur Informations Continues	STT
PID	Poursuite sur Informations Discontinues	TWS
PL de BORD	Planche de Bord (Tableau de Bord)	Main Instrument Panel
POL	Police	Police mode

PPA	Poste de Préparation Armements	Weapons Configuration Panel
PPI	Plan Position Indicateur	Plan Position Indicator (Polar radar display)
PRED	Prédéfini (GUN HUD mode)	Preset Gun Hud Mode)
PREP	Préparer	Prepare
PRES	Présentation (armement sur VTB)	Presentation (displayed on HDD)
PRET	Prêt	Ready (green) INS is ready
PSM	Poste de Sélecteur de Mode (Navigation)	Mode Selector Panel
PTF, C/C	Sélecteur de Programmes du module ÉCLAIR	ÉCLAIR Program Selector (not Functional)
RALL VOL	Rallumage en vol	Engine Air Relight/Restart
RAP	Rapide (1800 rounds per minute, GUNS only)	Fast (1800 rounds per minute, Guns only, AA engagements)
RAVIT.	Ravitaillement	Refueling (in flight)
RD/TD	Route Désirée/Temps Désiré	Selected Bearing/Selected Time (RD not functional)
RDI	Radar Doppler à Impulsions	Pulse Doppler Radar
RDO	Ralliement Désignation Objectif	Target Pursuit Mode (auto. entered when locking target)
REC	Recalage	INS Position Update
REMANENCE	Rémanence (Radar)	Persistence (Radar screen) (not functional)
RENTRES	Rentrés	Retracted
RET	Retardé	Delayed
RK	Roquettes	Rockets
RK3	MATRA LRF4 Roquettes 68 mm.(18)	Matra LRF4 Rockets Pod (18)
RL	Réservoir Largable	External Fuel Tanks
ROQ	Roquettes	Rockets
ROUL.	Roulage	Taxi (lights)
RP	Réservoir Pendulaire RPL 522 1300 Litres	External Fuel Tank (Center line) 1300 liters
RP	Réservoir Pendulaire RPL 541 2000 Litres	External Fuel Tanks (Under Wing) 2000 liters
RPL 522	Réservoir Pendulaire (Central)	Centerline Fuel Tank (1300 Kg)

RPL 541	Réservoirs Pendulaires (voilure x 2)	Under-wing Fuel Tank (2000 Kg)
RS	Radio-Sonde	Uses the radar altimeter to calculate slant range to target
RVT J	Ravitaillement en vol (Jour)	In Flight Air refuelling (Day)
RVT N	Ravitaillement en vol (Nuit)	In Flight Air refuelling (Night)
RVT VOL	Ravitaillement en Vol	Air-Refuelling
S	Selectionné	Selected
S.A.	Semi-Automatique	Semi-Automatic
SABRE	Brouilleur (voir BR)	Radar Jammer,ECM (see BR)
SEC	Secours	Emergency mode
SEL	Selective Jettison	Selective Jettison
SELH	Selection de la Hauteur	Selected Height Range
SERPAM	Serpam Enregistreur de Vol	Flight Recorder (not functional)
SERVAL	Détecteur d'Alertes (voir DA.)	RWR (see DA.)
SIL	Silence	Radio Squelch- Radar on Standby
SORTIS	Sortis	Extended
SOURIS	Souris	Inlet Cones
SPAD	Système Perfectionné Anti-Dérapant	Anti-Skid System
SPIRALE	Lance-Leurres (voir LL)	Chaff and Flares Dispenser (see LL)
STS	Status	Status
SVI	Spirale Viseur	HUD close combat mode only for 530D missile
TAC	Tacan	Tacan Navigation
TAF	Téléaffichage	(not functional)
TAS	Télémétrie Air-Sol	Radar slant range to target
TIR	Tirez	SHOOT
TOP	Signal, départ du Chrono (mode TD)	Timer Start Button for TD (Selected Time) Mode
TOT	Total	Fires both 530D, keeps firing gun and Rockets
TR	Transfo-Redresseur	Inverter Transformer
TR/VS	Temps Restant/Vitesse Sol	Remaining Time/Ground Speed

TRIM DIRECT.	Trim de Direction	Rudder Trim
UNI	Unité de Navigation Inertielle	Inertial Navigation System (INS)
V	Voilure (Carburant)	Wing Fuel Tanks
VAD	Vecteur Additionnel	Offset to Tacan
VAL	Validation	INS Validation Switch
VEI	Veille	Standby
VENT	Ventilation	Dry Crank
VERRIÈRE	Verrière	Canopy
VERROUIL-LAGE	Verrouillage	Lock
VIDE VITE	Vide vite (carburant)	(External Tanks) Fuel Dump
VOYANTS	Voyants (illumination)	Annunciators (Light intensity)
VR	Vitesse de rapprochement	Closure speed
VRIL	Vrille	Spin (FBW Limiter Override Switch)
VTB	Visualisation Tête Basse	Heands-down Display (HDD)
VTH	Visualisation Tête Haute	Head-up Display (HUD)
ZB	Axe Z (Altitude Barométrique sur VTH)	Barometric Altimeter (on HUD)
ΔALT	Altitude (BAD: But Additionnel)	Offset Point by Altitude difference
ΔL/ΔG	Latitude/Longitude (BAD: But Additionnel)	Offset Point by LAT/LONG difference
ρ/θ	Polar Rho/Tetha (BAD:Distance/Relèvement)	Offset Point by Distance and Bearing
		V. 1.3 November 2019