FlightGear Mirage 2000-5/2000D Manual

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1 FlightGear Mirage 2000 Documentation

Welcome to the documentation of the Dassault Mirage 2000⬈ for the FlightGear⬈ open source flight simulator.

The Mirage 2000 modelled here is mainly the -5 version ("Dash 5"/"tiret cinque"). The bi-place versions 2000D/N and 2000-B are also modelled to some degree (weapons, exterior 3d), but the cockpit remains for the moment the -5 version.

The Mirage 2000 is a multi-role all-weather fighter aircraft from Dassault Aviation⬈. It is one of the best dogfighters⬈ of its generation and a far beyond visual range combat aircraft, as well as very capable in air-to-ground strikes.

1.1 This Manual

The goal of this manual is to be the most up to date source of information for pilots of this simulation model - in line with recent development of features. As such it documents how the FlightGear Mirage 2000 works - not how it works in reality!

This manual has been written in order to help you get to know the FlightGear Mirage 2000 and master flying and fighting with it. The French Delta Knife is not always easy to handle, but we hope the pages in this manual will allow you to become better at fighting with the modelled Mirage 2000 variants.

If you find rooms for improvement in this manual, then please contact us (see Section 1.6).

The old/original manual `Mirage 2000 manual.pdf` by Renaud "Wolf" Roquefort can be found in the "Docs" folder or accessed by this link. It is one of the sources of this manual and will eventually be replaced. However, it still contains information, which has not yet been migrated (e.g. engine and fuel systems, presentation of cockpit instruments, air-2-air interception procedures and combat, navigation, autopilot). When there is overlapping information, then most probably this manual is better aligned with the current version of the model in FlightGear.

1.2 Realism

1.2.1 Disclaimer

This model in all variants is an interpretation of the real Mirage 2000 based on publicly available information (see Chapter 11) without any form of involvement from the original equipment manufacturer or any other entity with knowledge of unpublished/classified material of the original aircraft or its offensive/defensive systems.

Given the lack of authoritative information on military sensitive information, the realism of this model is by nature limited. Likewise, the goal of the simulation is for pure recreational activity - and therefore the simulation sometimes deliberately reduces and other times enhances real functionality/procedures to make the model more accessible to the casual simulation pilot. A lot of functionality / characteristics are "could-be" guesses good enough for gameplay purposes.

These remarks are especially relevant for the simulation of weapons/countermeasures/damage, which - apart from the natural lack of detailed documentation - are modelled as an opt-in to the FlightGear flight simulator and lack fidelity compared to reality. The fidelity and accuracy try to mimic what "could-be" real, but in the end just try to allow some recreational but still "realistic" game-play.

As such this manual and the FlightGear model are merely free (as in beer) spare-time personal projects for entertainment in the FlightGear open source simulation community. This manual cannot be used to learn how to handle the systems of or fly the real Mirage 2000 variants.

1.2.2 Priorities

The priorities for modelling the Mirage 2000 in FlightGear are currently roughly as follows:

- Cockpit 3D modelling over exterior 3D modelling over weapons 3D modelling
- Digital displays over conventional instruments over switches
- Front seat over backseat
- M2000-5 over M2000D over M2000N/5-B
- Current latest stable FlightGear version (e.g. 2024.1.* as per year 2025) over backwards compatibility

1.2.3 Country variants

Currently there is no explicit modelling of export variants - neither in terms of 3D, specific weapons or systems, labelling of the cockpit etc. However, a larger set of liveries covering many countries and squadrons can be chosen.

1.2.4 Enhancements

If you have requests for changes / additions, which could further improve the simulation and thereby help to celebrate the Mirage 2000, then please contact us (see Section 1.6).

1.3 Other Documentation

Apart from this manual, there are other sources of documentation for the FlightGear version:

- The Mirage 200 wiki page⟋ on the official FlightGear wiki⟋ (not very well maintained).
- The main and original author of the FlightGear version has published some 5H1N0B1 YouTube videos⟋ (a bit aged).
- The excellently modelled FlightGear version of the F-16⟋ has a very well written wiki⟋, which also explains concepts (e.g. how a radar works).

RAZBAM⟋ has made a remarkable simulation of the Mirage 2000C variant for DCS⟋. There is quite some documentation for it and an active forum, but it is an earlier variant for the Mirage 2000 (C) and therefore has somewhat other capabilities and a distinctively different cockpit.

1.4 Credits

- The authors of the model: Helijah (3D), 5H1N0B1 (Weapons, Systems), Richard Harrison (FDM), Leto, Josh Davidson (FCS/FBW/Autopilot), hardball, Domokos Juttner (Rudolf), F-Sig, J Maverick 16, legoboyvdlp, onox, ravenclaw_007, Niall "Salmon" Roe, Marsdolphin, R. "Wolf" Roquefort, Rick Gruber-Riemer
- The authors of the common weapons and radar systems for OpRedFlag⟋, on which this model depends and which makes it possible, to use the plane in air and ground attack as part of military simulation in the OPRF⟋ (Open Red Flag) community.
- The authors of the FlightGear F-16⟋ are a constant source of inspiration - and the level of sophistication of the model is what the M2000 is aiming for, but maybe never will get on par with.
- Helping hands for the creation of the manual: 5H1N0B1, CUDA22, I. "Interce" Klimov, SammySkycrafts, VooDoo3, Legoboyvdlp, Rudolf, Reaper

1.5 License

This FlightGear Mirage 2000 model including its documentation is licensed with GNU GPL⟋ version 2. See the licence information⟋ in the repo.

1.6 Contact and Contributions

Please do not hesitate to contact. The more information you provide (not at least links to published pictures, information etc.), the higher the chance that improvements can be made. Doing research and finding plausible details for how to improve the simulation is time consuming and contributions are very welcome by the maintainers of this model. You do not have to be a developer to help with progress!

- The currently most active developer can be reached by e-mail at rick AT vanosten DOT net.
- The GitHub repo⤢ provides the possibility to submit issues.
- The official FlightGear Forum⤢ has a dedicated thread for the Mirage 2000⤢.
- There is also a specific Discord server⤢ dedicated to the development of this simulation.

1.7 Conventions Used in this Manual

A "⤢" at the end of a link means that the link points to a site outside of this manual - otherwise to a different area within this manual.
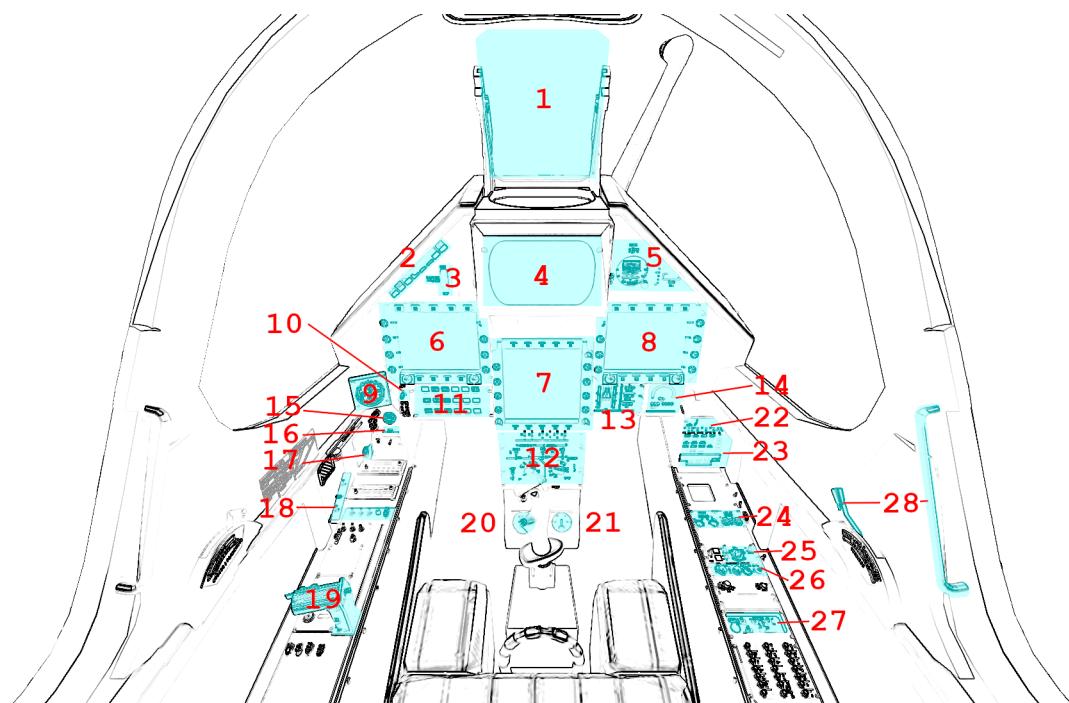
A reference to a specific asset in Chapter 11 is shown as [ref: D01], where "D01" relates to the unique identifier in front of the reference's title.

2 Presentation of the Mirage 2000 Aircraft

Apart from restricted military information: the Mirage 2000 with all its variants is very well documented in books, articles and videos. Therefore, the Mirage 2000's history, technical characteristics etc. is not repeated here. Please use some of the resources listed in Chapter 11 instead.

3 Cockpit instruments

3.1 Overview

1. Head-up display (HUD)⬈ - French: visualisation tête haute (VTH)⬈
2. Autopilot panel
3. Elevator trim
4. Head-level display - French: visualisation tête moyenne (VTM)
5. Physical flight instruments
6. Left Multi-function display (MFD)⬈ - French: écran multifonction
7. Head-down display - French: visualisation tête basse (VTB)
8. Right MFD
9. Clock
10. Master Arm switch
11. Weapon command panel
12. Transponder
13. Fuel indicator panel
14. Engine indicator panel
15. External tank jettison button
16. Gear indicator
17. Gear lever
18. Light switches
19. Throttle stick
20. Elevon angle indicator
21. Cabin altimeter (non-functional)
22. Power switches
23. Alert panel
24. ILS & TACAN panel
25. Air conditioning panel
26. Interior lighting
27. Engine control panel
28. Canopy handle & lock

Please note that this cockpit model is not complete. Only instruments that have been implemented are highlighted.

3.2 HUD [1]

Please refer to Section 7.1.

3.3 Autopilot Panel [2]

Please refer to Chapter 5.

3.4 Elevator Trim [3]

This instrument allows for the angle of the elevons to be manually offset in order to adjust the rotational angle of the aircraft along the pitch axis. It can be controlled by scrolling while hovering one's mouse over the wheel.

Please note that the influence of this instrument is rather low, and high-G manoeuvres should rely on the stick input more so than the trim.

3.5 VTM [4]

Please refer to Section 7.2.

3.6 Physical Flight Instruments [5]

These instruments serve as backup for the digital one, as well as when the left MFD is not on the `EADI` tab.

3.6.1 Angle of Attack (AoA) Indicator [5.1]

This gauge enables the pilot to see the angle of attack of the aircraft. One dot equals to 5° up until +15°, then 6.7° approx up until 35°. Negative AoA will not be shown.

While the onboard computer always attempts to keep the Mirage out of a stall (>25° AoA) and pulling on the stick regardless of AoA is not an issue, avoiding a tailstrike (>14° AoA) on takeoff and landing is of utmost importance. As such, should the HUD not function, this indicator will have to be taken into account on these instances.

Note that this indicator might not be visible depending on your view position. Moving your head to the side will allow you to see it.

3.6.2 Compass [5.2]

This indicator will display the current heading in degrees. Depending on the setting of the VTB, it will use either the True North or the Magnetic North.

3.6.3 Airspeed Indicator [5.3]

This indicator will display the current airspeed in knots as well as the current mach below.

3.6.4 Attitude Indicator [5.4]

3.6.5 Variometer [5.5]

This indicator will show the vertical speed of the aircraft at low values. Each horizontal bar corresponds to 500ft, with a shown range between -2,000ft/min and +2,000ft/min.

3.6.6 Altimeter [5.6]

This indicator will show the altitude above sea level, adjusted to the pressure set in the `EADI` tab of the left MFD.

3.7 Left MFD [6]

Please refer to Section 7.4.

3.8 VTB [7]

Please refer to Section 7.3.

3.9 Right MFD [8]

Please refer to Section 7.5.

3.10 Clock [9]

This clock will display the time in UTC.

3.11 Master Arm Switch [10]

This switch sets all weapon stations as well as the onboard cannon on live fire mode, and must be toggled on to fire any type of armament. It is off by default.

This switch should only be turned on in combat situations.

3.12 Weapon Command Panel [11]

[Not implemented]

3.13 IFF Transponder [12]

The Mirage 2000 IFF transponder panel includes both civil and military functionality. A Transponder⧉ assists air traffic control to identify an aircraft. See Chapter 8 for information on IFF.

According to the RAZBAM M2000 DCS manual [ref: D04] the modelled transponder is a `NRAI-7C`.

NB: the generic FlightGear civil transponder can be accessed using menu item `Radio Settings` (Key: F12) in menu `Equipment`. There is a description in an FG wiki article⧉ and it will therefore not be described further here. However, you should use the Mirage transponder panel instead of the `Radio Settings`, because the two are not fully compatible and the 3D panel does not consistently update by settings through the dialogue. If you nevertheless use the built-in dialogue, then make sure to use the "Close" button on the dialogue to close it - otherwise the `IDENT` button will remain pressed if you have pressed it.

3.13.1 Upper Part of Panel

The top left 2 wheels `Mode-1` do not work. The top 4 right wheels `Mode-3A` are used to input the civil transponder code (which corresponds to the value in the `Radio Settings`).

The `IDENT` switch is spring loaded and can be used to respond to civil interrogations.

The military interrogation switches `M-1` and `M-2` do not work.

The `M-3A` switch works for civil identification interrogation (mode A) and the `M-C` (mode C) works for civil altitude reporting interrogation. Only one of them can be active, but both can be off.

The modelled transponder NRAI-7C does not support interrogation mode⬈ S.

3.13.2 Mode-4 Subpanel

The position of the bottom left switch `Reply` determines whether the IFF interrogation functionality is powered `ON` or `OFF`.

For an interrogation to be answered, several things need to be in place:

- The `Reply` switch is `ON`.
- The selector is on either `A` or `B`. The IFF channel value for A and B are set in menu item `Mission Preplanning` accessed through menu `Mirage 2000` (if damage is on, then it can only be done on ground).
- The master selector is on `N`.

Setting the selector to `ZERO` will zero out the IFF channel A and B values. Know what you are doing, because to new values need to be input through the `Mission Preplanning` dialogue, which might not be available in flight!

According to [ref: D04] position `HOLD` "prevents the zeroizing of the MODE 4 IFF codes when the IFF transponder is turned off." This is not implemented: there is not zeroizing modelled when the aircraft looses power etc. If the selector is on `HOLD` then no response will be given.

The Audio-Out-Light switch is not implemented.

3.13.3 Master Subpanel

Changing the selector to `N` automatically sets `M-3A` if neither `M-3A` nor `M-C` is set. Changing the selector to `EMER` automatically sets `M-3A` no matter the setting for `M-3A` and `M-C`.

`N` (neutre) means that civil interrogations for `M-3A` or `M-C` are enabled, military interrogations for mode 4 are enabled and military interrogations for modes 1 & 2 are enabled (but modes 1 & 2 are not implemented).

NB: even if the selector is on `N`: an actual interrogation still needs to be replied to using the `IDENT` switch for civil inter-

rogations or the `Reply` switch for military interrogations in mode 4.

3.13.4 IFF Interrogator Panel

In the real Mirage aside the transponder panel there is also an IFF interrogator panel on the right console near the ILS & TACAN panel. This is not implemented - i.e. you cannot see it in 3D and you currently cannot interrogate other aircraft from the Mirage.

3.14 Fuel Indicator Panel [13]

Displays the remaining fuel in kg (Note that the amounts in the `Equipment -> Fuel and payload` menu are displayed in lbs, with 1 lbs = 0.45 kg or 1 kg = 2.2 lbs approximately).

`GAUGE` will be the total amount of fuel in the internal tanks (feeding system aside).

`REMAIN` will also account for the feeding line and the external tanks.

`BINGO` is a value that can be manually set in the `Mirage 2000 -> Configuration` menu. It should be set as the minimum fuel required to return to base (RTB) - having less than this will cause the fuel indicator to flash red, signalling the pilot to urgently RTB. By default, it is set at 480kg, which is a rather low value.

The white Mirage-shaped indicator on the left displays in white sections of the fuel system that are not empty, and in black if they are devoid of any fuel. The upper two rectangles account for both the forward and backward fuselage tanks of each side, and the pentagons for the wing internal tanks. When taking external tanks, they will be displayed as white disks below the aforementioned shapes.

Note that the fuel system will first attempt to empty the external tanks before using the fuel contained in the internal system. If the tanks are jettisoned, the fuel flow will automatically switch to internal tank feed.

3.15 Engine Indicator Panel [14]

This indicator will display information about the engine's speed and fuel consumption.

The top value ("N%") displays the ratio of the engine's speed to its maximum military power (i.e. without afterburners). In the idle state, it should be stable at around 47%, and at maximum military power at around 96%. Using afterburners will push this value above 100%.

The bottom left value shows the estimated fuel consumption per minute in kg. Note that this is an instantaneous estimation, which means changes in altitude, speed, etc, will affect it.

The bottom right value displays the number of engine rotations per minute (RPM).

3.16 External Tank Jettison Button [15]

Self-explanatory name. This does not jettison weapons attached to the pylons of the aircraft.

Jettisoning the tanks should only be done in dogfight situations or in case of emergency - they come from taxpayers' money, after all.

3.17 Gear Indicator [16]

Will display three green downward arrows when the gear is fully lowered. These indicators will disappear once

the gear is moving or retracted.

3.18 Gear lever [17]

Lowering the lever will lower the gear, and raising it will retract the gear. Using the `g` and `G` keys (retract and extend gear respectively) will do the same, but also switch to the `NAV` and `APP` modes respectively.

3.19 Light Switches [18]

1. Taxi/landing light. Off by default.
2. Dorsal flash lights. On by default. Should be manually turned off after startup.
3. Formation lights (stripes on the sides of the fuselage and tail). On by default.
4. Tail position lights. On by default.
5. Wing position lights. On by default.

3.20 Throttle Lever [19]

Cannot be moved via the mouse, only with `Key: PageUp` and `Key: PageDown`. Afterburners are enabled at 90% of the lever's maximum extension.

NB: this value is different in a real Mirage 2000, where it lies at 75%.

3.21 Elevon hydraulic pressure indicators [20]

Not functional.

3.22 Cabin Altitude Indicator [21]

Not functional.

3.23 Power Switches [22]

The red power switch toggles the battery on/off. The battery should be on at all times when the engine is running. Off by default.

The grey switches toggle all the alternators at once. They should be on at all times when the engine is running. Off by default.

3.24 Alert Panel [23]

[Default state of the alert panel when launching the simulation]

The warning lights should all be off in a normal situation (save for the parking brake when stopped on the ground). Depending on the severity of the warning, you might have to review the cockpit's switches, carry out an emergency landing, or eject. Their following codes are as follows:

Abbrev	Alert
BATT	Battery off
TR	Alternators off
ALT.1	Alternator 1 off
ALT.2	Alternator 2 off
OIL	Oil pressure too low
T7	N/A
CMPTR	Computer failure
RPM	RPM too high
VSD	N/A
LP	Fuel flow irregular
LLP	Left fuel pump off
RLP	Right fuel pump off
HYD.1	1st hydraulic system failure
HYD.2	2nd hydraulic system failure
EMG HYD	Emergency hydraulic system failure
EP	
BINGO	Fuel lower than `BINGO` value set
CAB P	Cabin pressure too low
TEMP	Temperature too low
OX REG	Engine oxygen flow irregularity
5mn OX	Low oxygen (5min remaining) (not implemented)
HA OX	Cockpit oxygen system failure
PITOT	Pitot tube failure
DC	N/A
CONDIT	Air conditioning failure
CONF	N/A
GAIN	N/A
SCOOP	NACA scoop failure
FLT ENV	Flight envelope failure (aircraft no longer flyable)
S CONES	Supersonic cone failure
EL B UP	N/A
AOA	Too high AoA
SLATS	Slats failure

MAN	N/A
T/O	N/A
PARK	Parking brake enabled
AP	Autopilot failure

3.25 ILS / TACAN Panel [24]

The `VOR.ILS` value can be tuned to an airport's instrumental landing system frequency in order to help with the landing. When in `APP` flying mode and if the ILS is enabled, you will be able to visualise the corresponding airport's runway in the HUD. The left knob changes the frequency by 1 MHz and the right knob by 0.05 MHz. The left knob's real function to set the system on (`M`) or off (`A`) is not implemented. Neither are the rights knob's testing functions.

Alternatively the frequency can be changed as NAV1 using the Radio Management Unit (see Section 7.4.4) or menu item `Radio Settings` (Key: `F12`) in menu `Equipment`.

The `TACAN` allows the pilot to change the numerical value of the TACAN channel. The left knob (in the centre) changes it by 10 and the right knob by 1. To switch between the `X` and `Y` band the left knob's border can be used. The TACAN operational mode cannot be changed in any way.

Alternatively the TACAN channel can be changed using the Radio Management Unit (see Section 7.4.4) or menu item `Radio Settings` (Key: `F12`) in menu `Equipment`.

3.26 Air Conditioning Panel [25]

The `COND` switch toggles the air conditioning inside the cabin. Off by default.

The knob to its right allows the pilot to set the desired air temperature of the air conditioning. Pointing the hand of the knob towards upper half will make use of the automatic temperature regulation system, while the lower half will switch to manual control of the temperature of the airflow (and is not advised). Each movement of the hand (in-sim) will offset the temperature by 1.33°C from the default temperature (22°C AUTO). Turning the knob to the right makes the temperature cooler, and to the left makes it warmer. It is advised to set the temperature to around 17-18°C AUTO.

The `DESEMB` switch toggles the windshield fog removal (French: désembuage). Off by default. It is highly advised to turn it on for medium-to-high-altitude flights.

3.27 Interior Lighting Panel [26]

Controls the cockpit lights.

3.28 Engine Control Panel [27]

[Default state of the engine control panel when launching the simulation]

Panel used for starting up the engine.

In order of the startup sequence:

1. Engine cut-off switch. Enabled by default.
2. Cover of the cutoff switch. Closing it disables the cutoff switch. Open by default.
3. Left fuel pump switch. Off by default.
4. Right fuel pump switch. Off by default.

5. Startup mode switch. Off by default.

6. Pump BP switch. Off by default.

7. Starter button cover. Closed by default.

8. Starter button. Pressing it for a few seconds gives the engine the necessary rotational speed to keep turning on its own.

3.29 Canopy Handle & Lock [28]

Clicking the canopy handle will switch between almost closed and fully opened states. When the canopy is almost closed, clicking the locking lever will fully close and secure the canopy. The canopy is fully opened by default.

Pressing d twice equates to clicking the canopy handle and the locking lever (and thus closes the canopy from the default state, or opens it completely if it is closed).

4 Flying

4.1 Operations

4.1.1 Start-up

When your aircraft is cold and dark before start-up, the external generator and fuel truck are connected to your aircraft, and protections (in red) will be on your aircraft, as well as chocks. They will disappear automatically as you start up. With the } key, you can auto-start your aircraft.

4.1.2 Taxi

The Mirage can taxi at relatively high speeds, usually below 40kts, but you shouldn't go faster than 20kts when turning. Even if the track width is larger than usual, you should always stay at safe speeds.

The front gear can turn 90° to the left and to the right, so a turn radius of 3 meters is reachable. You might need to add thrust, as it is difficult to move with the front gear almost entirely turned. Do not push on the rudder pedals too much when braking, otherwise the aircraft may fall on one side or another if you turn too tight.

The taxi lights have an angle of about 30 degrees in front of the aircraft and are not attached to the moving part of the front gear, so they will always light in front.

4.1.3 Take-off

Line up on the best runway for the current weather conditions and ask for clearance. Once the clearance is given and after releasing the parking brake, spool up while keeping the pedal brakes enabled. Then, throttle up to 99% RPM (military power) for long runways, 100%+ (with afterburners) for short runways or with heavy loadout. Rotation speed is at 120 knots when using a clean loadout, 140 knots if with payload. After this, bring the inverted "T" in the HUD under the line of horizon and you should be able to lift off at 170-190 knots, depending on your loadout. Do not exceed 14° nose angle or you will tail-strike. Even though the Mirage is airborne, you might feel that the plane with high nose angle "floats" over the runway until reaching well beyond 200 knots. Raise the gears with key g or by clicking the red gear lever.

The Mirage needs long runway distances to take off, as it hasn't got a separate horizontal tail stabilizer/elevator. Because of the elevons' position (trailing edge of the wing), they create a considerable loss of lift when they are moved up to rotate, so higher rotation speeds are needed. Also, the delta wing is often called "flying airbrake", as they generate lots of drag at high angles of attack, like at take-off. This is why high speeds and long runways are needed.

4.1.4 Initial Climb

After taking off, retract the landing gear before reaching 280kts (maximum gear extension speed). You are advised to follow the runway heading until you are at an acceptable speed (approximatively 200 knots), but if you used reheat and you are not heavy, you can turn as soon as you are at 200 knots. However, you have to watch your speed so you don't

stall - at this altitude, a stall doesn't forgive.

After having chosen the correct heading and having attained 250 knots, you can commence your climb with full military power, at the beginning around 2,000 feet per minute to gain speed, and when you have reached your optimal climb speed you may pull the nose up to climb at a rate of 4,000 feet per minute. Remember that if you are faster, you will have an lower angle of attack and will thus drag less, and your elevons will not need to be pulled fully up (and thus will not create too much additional loss of lift), so it is advised to speed up before climbing too fast.

4.1.5 Climb

The Mirage can climb exceedingly fast, with a maximum climb rate of 6,000 feet per minute. With full tanks and air-policing⁄ loadout, it is able to climb with full military power at a rate between 4,000 feet and 6,000 feet without bleeding speed (between 250 and 300 knots). With full afterburners and in the same conditions, the climb rate can go up to 12,000 feet, still in zero/zero conditions. If going vertical with full afterburners and a base speed of 400 knots, you can reach 20,000 feet before having to push the nose back down. This is the fastest way of climbing.

4.1.6 Cruise

The Mirage 2000 normally cruises between angels 35 and angels 40 (35,000 - 40,000 feet), and this is the best altitude for Mach 2+ flights. It can also go above 50,000 feet (the pilot would need special equipment - not simulated yet), and up to 80,000 feet, but with difficulties. The optimal cruise altitude is 36,000 feet.

While it has a bi-sonic flight possibility, it consumes lots of fuel. It is thus advised to stay sub-sonic during cruise flights, without using afterburners. With cargo loadout and without using afterburners, the Mirage can fly for more than two hours. For long cruises, it is advised to use the navigation, altitude and speed autopilots.

4.1.7 Visual Landing

Lower the gears when you are below 195 knots, then approach the runway at 175 knots (for 15% fuel left; add 5 knots every 20% additional fuel). If by night, put the landing lights on. On final approach, hold an angle of attack of between 6 and 9 degrees. When passing the runway threshold, flare and bring the aircraft to an angle of attack of 12 degrees. You should land at 145 knots (for 15% fuel left; add 5 knots every 20% additional fuel). When touching down, wait for the aircraft to slow down to 135 knots and apply pedal brakes. Use the brake parachute (key o to deploy) if necessary (heavy loadout or short runway) - and then release when not needed any more (same key o).

The easiest way to get approach and touchdown right is placing the inverted "T" at the bottom of the HUD on the runway threshold and regulate speed with throttle, such that the flightpath marker is on top of the inverted "T". When at speeds below 200 and high angles of attack⁄ you have to be ready to apply a considerable amount of throttle to keep a steady decent rate!

Air breaking using a high angle of attack when landed is normal procedure. However, do not tilt the aircraft at more than the inverted "T" cue in the HUD on the line of horizon. NB: it is by procedure forbidden to aerobrake below 100 kts - even though it might be possible: you have to get weight on the nose wheel. The reason for this required procedure is that depending on speed, configuration, weight distribution (e.g. fuel) etc. it might suddenly not be possible anymore to bring the nose down given loss of effectiveness of the elevons vs. drag forces vs. weight forces.

Note that nose-wheel steering will engage below 40kts (in-sim). As such, make sure your rudder is more or less straightened up when arriving on ground.

4.1.8 Navigation

To switch between displaying heading in true North vs. magnetic North, use the second button from right on the lower button row of the VTB.

4.1.9 Miscellaneous

- When heavily loaded, the fly-by-wire system (FBW)⁄ should be set correctly to lower allowable flight limits in order to save the structure: `Mirage2000=>Options=>` `Change A/A to CHARGES`.
- Afterburners engage when throttle moves past 85% in real-life, 90% in-sim.
- The 1700l and 2200l droppable tanks are not supersonic, but the 1300l is.

4.2 Flight Modes

There are 4 flight modes:

- Take-off (`key: f`)
- Approach (`key: F`)
- Navigation (`key: h`)
- Attack (`key: H`)

The main difference between the flight modes for now is the view position and zoom. When you lower gear, then you get automatically into `Approach` mode - after gear up you end in mode `Navigation`. Toggling the master arm switches between modes `Attack` and `Navigation`.

4.3 In Cockpit Views

In order to see the MFDs and the VTB better as well as seeing better the gauges on each side of the VTM, you can use key bindings:

- `Key: n`: view left MFD and VTB
- `Key: N`: view right MDF and VTB
- `Key: ctrl-n`: reset the view to the position of the current flight mode

5 The Autopilot system

5.1 Autopilot Panel

The autopilot allows the onboard computer to control the aircraft without constant input from the pilot.

Clicking one of the switches equals to toggling the mode and eventually disabling other incompatible modes. An enabled mode will be lit up or blinking, but they will only be active if the `AP` switch is also lit up.

Only the `Stby` button being lit up by default (the autopilot is not enabled on startup).

While the autopilot panel allows the pilot to toggle its different modes, the details of each parameter have to be set either on the ILS/TACAN panel, on the left MFD, or in the `Autopilot -> Route manager` built-in FlightGear menu.

Details about the autopilot's enabled modes, registered altitude, heading, next waypoint, and speed can all be found in the `EADI` tab of the left MFD. The active pitch and roll control modes will be shown in white near the top of the `EADI`.

Note that the switches might not all be visible depending on your viewpoint. You can move your head by using `Key: shift, right mouse button` and dragging your mouse across the screen. To reset it, you can use one of the flight mode keys (see Flight Modes section).

5.2 Autopilot Switches and Modes

5.2.1 AP (Active Autopilot)

This switch acts as the main toggle for the autopilot.

If `AP` and `Stby` are the only two modes active, the onboard computer will attempt maintain the current pitch & roll

angle of the aircraft once the stick is released to its central position, but will not override the pilot's input.

When other modes are enabled, having the `AP` switch enabled will make them actively guide the aircraft. When in active guidance modes (`VS`, `ALT`, `HDG`, `LNAV`, `APP`).

If switched on, a white `AP1` sign will appear at the top of the `EADI` tab of the left MFD.

5.2.2 Stby (Standby)

Default state. Clicking it immediately disables all enabled modes except pitch and roll stabilisation (see previous section).

These modes appear as `PTCH` and `ROLL` in the `EADI`.

5.2.3 Vs (Vertical Speed)

Enabling this mode registers the current vertical speed (visible in both the physical variometer and the EADI tab of the left MFD) and attempts to keep it constant at this value. This value will be remembered but not displayed.

The vertical speed will only be registered once the mode is activated, i.e. once both the `AP` switch and the `Vs` switch are simultaneously active.

Note that the throttle is not controlled by this autopilot mode, and the aircraft might stall if you do not pay attention to your speed if this mode is active at high vertical speeds or low throttle input.

This mode is incompatible with `ALT`, `TF` and `APP` modes.

This mode appears as `VS` in the `EADI`.

5.2.4 Alt (Altitude)

This switch controls two modes: altitude above sea level (ASL) and altitude above ground level (AGL), also called terrain following mode (TF). The switch will be lit in ASL mode, and blink in TF mode. Alternating between the two can be done by clicking the switch, with ASL being enabled first if the switch is off.

Double-clicking the `Alt` switch will register the current altitude (either ASL or AGL depending on the mode), which will be visible at the top right corner of the EADI.

The ASL mode will attempt to maintain the aircraft at the altitude set, or climb/descend towards it at a low vertical speed (ca. 450ft/min). It is recommended to use the `Vs` mode for faster changes in altitude. This mode will lock the manual pitch and yaw input of the aircraft, but will only control the pitch.

The TF mode will only function below 10,000ft and if aircraft is close to horizontal and will not override the pilot's input. It will also attempt to follow the terrain based on the feed of the radar. To adjust the smoothness of the aircraft's trajectory and the range of the terrain taken into account, you can move the `AP TF smooth` and `Predictions` sliders in the `Mirage 2000 -> Configuration` menu respectively.

These modes are incompatible with the `VS` and `APP` modes.

The ASL and AGL modes appear as `ALT` and `TF` in the `EADI`.

5.2.5 Hdg (Heading)

This mode will override the roll axis and lock the pitch axis of the aircraft. Once enabled, the aircraft will attempt to stabilise or turn itself towards the heading bug set in the `EHSI` tab of the left MFD (bottom left knob). This direction will be visible both on the `EHSI` in pink, and in the HUD as a downwards triangle on the compass.

This mode is incompatible with `LNAV` and `APP` modes.

This mode appears as `HDG` in the `EADI`.

5.2.6 Nav (Navigation Source)

This mode will override the roll axis and lock the pitch axis of the aircraft. Once enabled, the aircraft will attempt to follow the navigation source (`NAV1`, `NAV2`, `TACAN` or `FMS`) set in the `EHSI` page of the left MFD. Depending on the NAVSRC mode, it can be configured on the `RMU` page or in the `Autopilot -> Route manager` menu). The selected direction will be shown by the blue arrow on the `EHSI`, as well as the numerical value at the bottom right of the same page. For more details, please refer to the `EHSI` section of this guide.

This mode is incompatible with `HDG` and `APP` modes.

This mode appears as `LNAV` in the `EADI`.

5.2.7 App (ILS Approach)

Switches to instrumental landing system approach by overriding the pitch and roll axes of the aircraft. It will not, however, control its throttle. It will use the frequency set in the `VOR.ILS` panel or the `RMU` tab of the left MFD.

This mode is only applicable if the aircraft is decently well aligned with the runway to begin with. It will disengage at around 100ft AGL.

This mode is incompatible with the `VS`, `ALT`, `TF`, `HDG` and `LNAV` modes.

This mode appears as `APP` in the `EADI`.

5.2.8 Spd (Speed)

This is an in-sim switch only, and does not exist on actual Mirage 2000s. It overrides the pilot's throttle input in order to maintain the airspeed set in the `EADI` tab of the left MFD.

Note that once disabled, the pilot has to move the throttle in order to unlock it again.

This mode is not shown as enabled or otherwise in the `EADI`.

5.2.9 Note: Autopilot glitches

Please note that when activating the `VS`, `ALT`, `LNAV` or `APP` modes with too much G-load or AoA, the nose might start bobbing up and down violently. This is an in-sim issue that has not been solved yet. Should this happen to you, disable the autopilot, stabilise the aircraft, then enable it again.

6 The Radar System

6.1 The Real Radar RDY

The -5 version of the Mirage 2000 is equipped with the RDY (Radar Doppler Modèle Y - Radar Doppler Multitarget), which can be used in air-to-air and air-to-ground tasks. See descriptions in the English Wikipedia⧉ and radartutorial.eu⧉.

6.2 The Modelled Radar

The modelled radar is a copy of the FlightGear F-16 Flight Control Radar⧉, because it is already nicely modelled and the F-16 radar most probably is quite similar to the RDY-versions.

Note In reality the different versions of the Mirage 2000 have different radars and different radar modes, but this is not modelled.

6.2.1 Radar Range

The radar range can be increased by using `Key: R` - and decreased by using `Key: E`. Each key press is a factor 2 (e.g. from 20 nm to 40 nm)

For air-to-air combat the range is up to 160 nm (depending on the mode), for ground and sea modes it is up to 80 nm (for ground auto 40 nm).

When the radar mode changes (either by actively changing the radar mode or as a consequence of e.g. selecting a target), the range can change automatically.

6.2.2 Radar Modes

The radar has a set of modes and sub-modes (see the description in FlightGear F-16 Fire-Control Radar⧉ - bearing in mind that the displays are different in the M2000 and not all functionality is the same):

- **CRM**: Combined Radar Mode

- RWS: Range while Search
- TWS: Track while Search
- LRS: Long Range Search
- VS: Velocity Search

- **ACM**: Air combat Mode
  - ACM-20: 30 by 20 degrees HUD field of view
  - ACM-60: 10 by 60 degrees HUD field of view
  - ACM-BORE: boresight

- **SEA**: Sea Navigation
- **GM**: Ground Mapping
- **GMT**: Ground Moving Target

To change between main modes use `Key: Q` - to change between sub-modes use `Key: ctrl-q`.

6.2.3 Selecting Targets

When in TWS mode the next target can be selected using `Key: y` (can be used several times to cycle between targets). To deselect the current target use `Key: ctrl-y`.
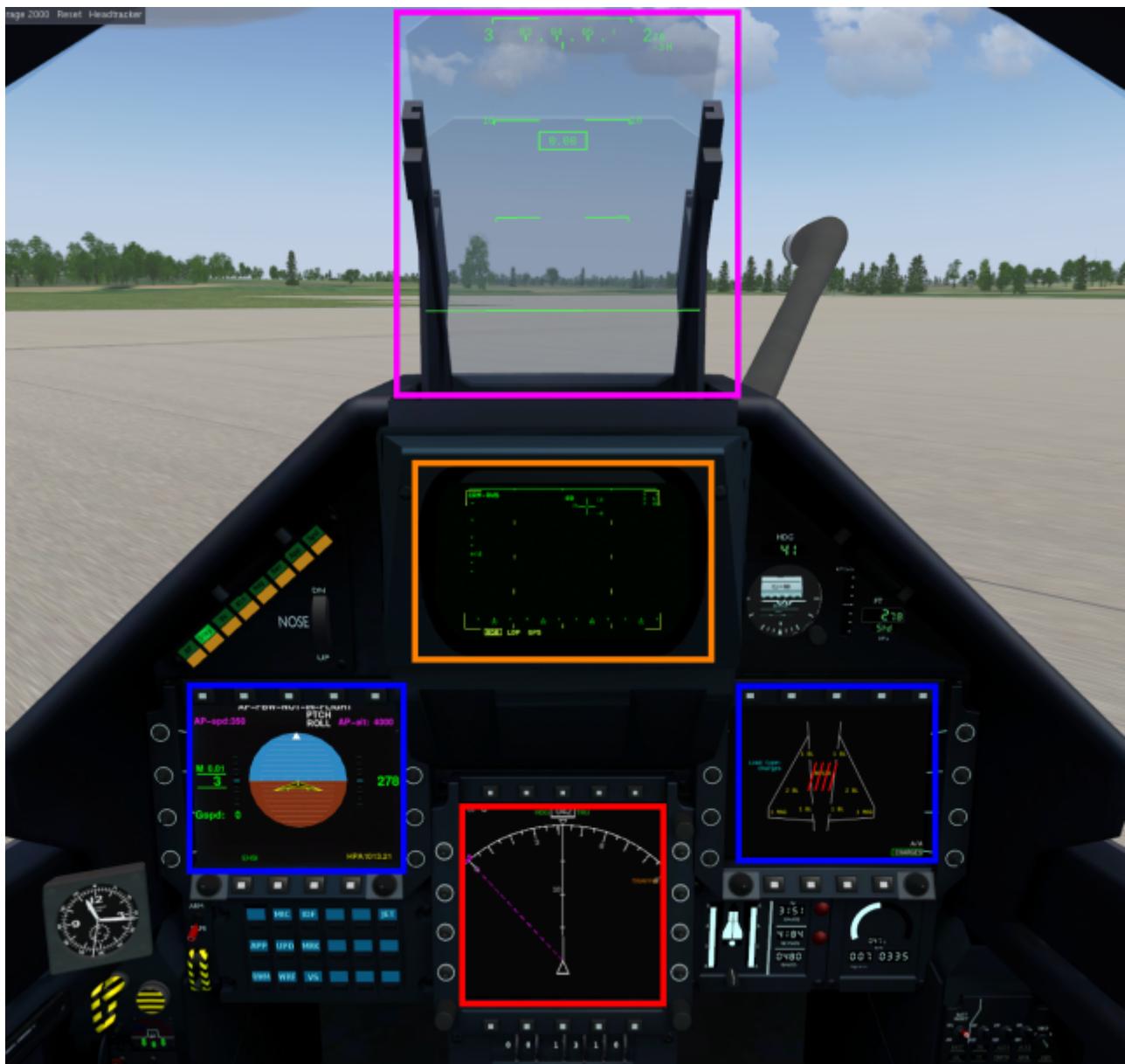
In other modes use the arrows on your keyboard (`Key: ⇐, ⇒, ⇑, ⇓`) to move the cursor on the VTM. Use `Key: l` (small L) to designate a target. You can also bind the cursor movement to your joystick of throttle like the following example (for vertical you just use the `cursor-slew-y property`):

```
<axis>
    <name>Hat Switch Front Horizontal</name>
    <desc>Slew cursor left/right</desc>
    <number>
        <windows>6</windows>
    </number>
    <binding>
        <command>property-scale</command>
        <property>controls/displays/cursor-slew-x</property>
        <power>1</power>
    </binding>
</axis>
```

7 The Mirage 2000-5 Display Systems

The Mirage 2000-5 has its name from the fact that it has 5 main displays:

- Pink - Head-up display (HUD)⬈ - French: visualisation tête haute (VTH)⬈
- Amber - Head-level display - French: visualisation tête moyenne (VTM)
- Red - Head-down display - French: visualisation tête basse (VTB)
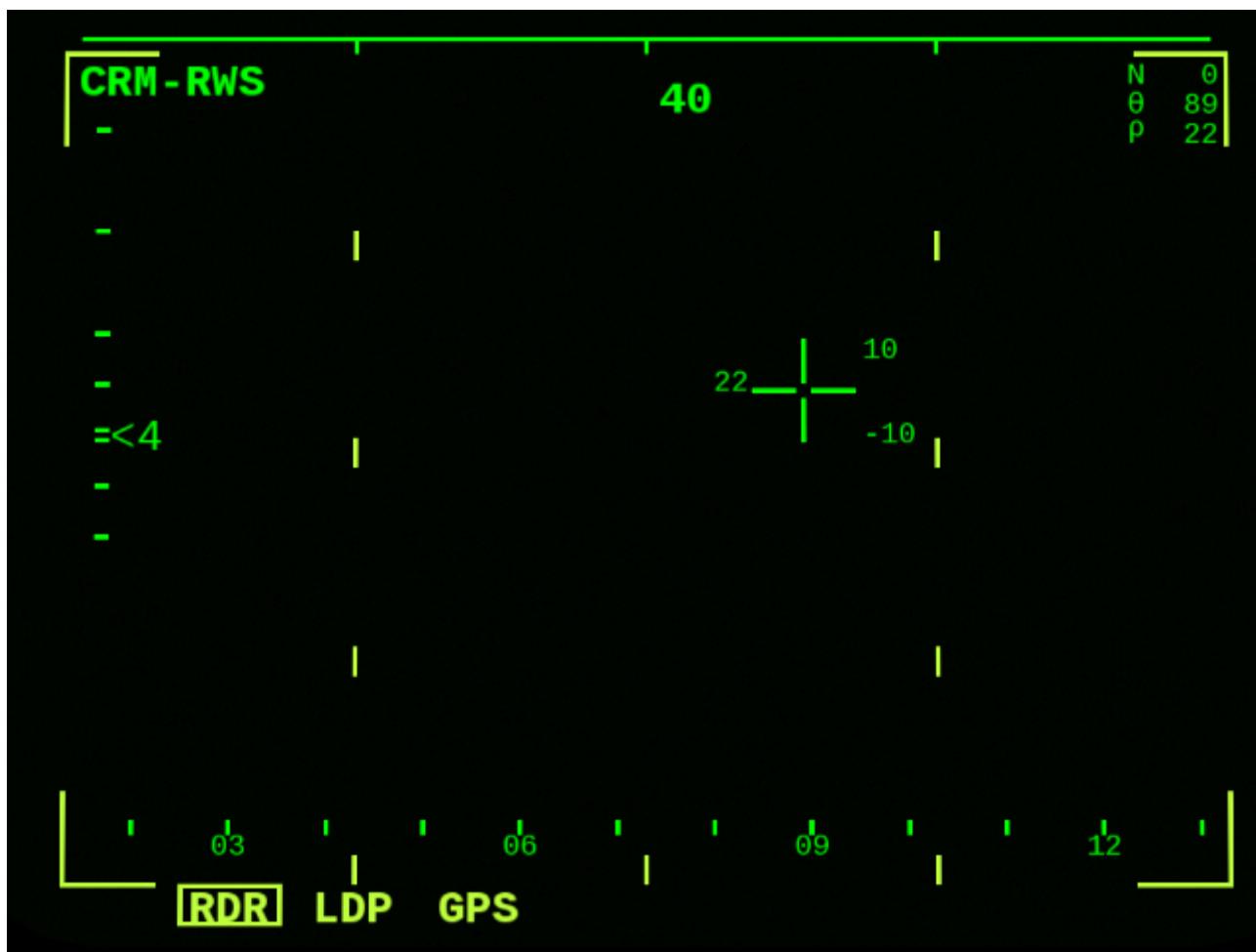- Blue - Left and right Multi-function display (MFD)⬈ - French: écran multifonction

7.1 HUD

Not yet described. Some description of information displayed is included in other sections.

7.2 VTM

This is a specialty of the Mirage 2000-5. Being positioned just below the HUD, this screen allows the pilot to see radar related information without moving the head. Like the HUD the VTM's focal point is perceived to be at infinity.

Most radar pictures are displayed in a B-scope (see picture above), the sea and ground radar modes are displayed as Plan Position Indicator - cf. Radar Displays⬈ on Wikipedia.

The top left corner shows the radar main mode (Key: Q to cycle) and the radar sub-mode (Key: ctrl-q to cycle). In the top middle the radar range in nm is displayed (Key: R to increase, Key: E to decrease). The box in the top right corner shows data from the cursor: Θ shows the the heading of the cursor, P shows the distance of the cursor on the radar.

The cursor can be moved with arrow keys on the keyboard or using a binding to a joystick. On the left side of the cursor the radar distance is shown, on the left side the top and bottom altitudes being scanned by the radar (in ft).

At the bottom of the screen there is a heading scale (showing true of magnetic North depending on the setting done on the VTB). At the bottom on the left the three main weapon guidance modes are displayed: radar (RDR), laser designation point (LDP), GPS. The currently used guidance mode is displayed inside a box and can be changed using Key: M.

The scale on the left side shows the radar antenna elevation / radar pitch. The number shows the number of bars (vertical scanning of the radar). The antenna elevation can be changed (Key: i for up, Key: I (capital i) for down, Key: Y for level).

7.2.1 Air-to-Air

A flying target is shown as an open rectangle with a line showing the direction the target is flying at (the longer the line, the faster).

In TWS mode a target can be selected using Key: y (and deselected with Key: ctrl-y). When the target is selected, then the display is changed to a small cross (still with a line indicating the direction) and the targets identifier is displayed in the lower right corner.
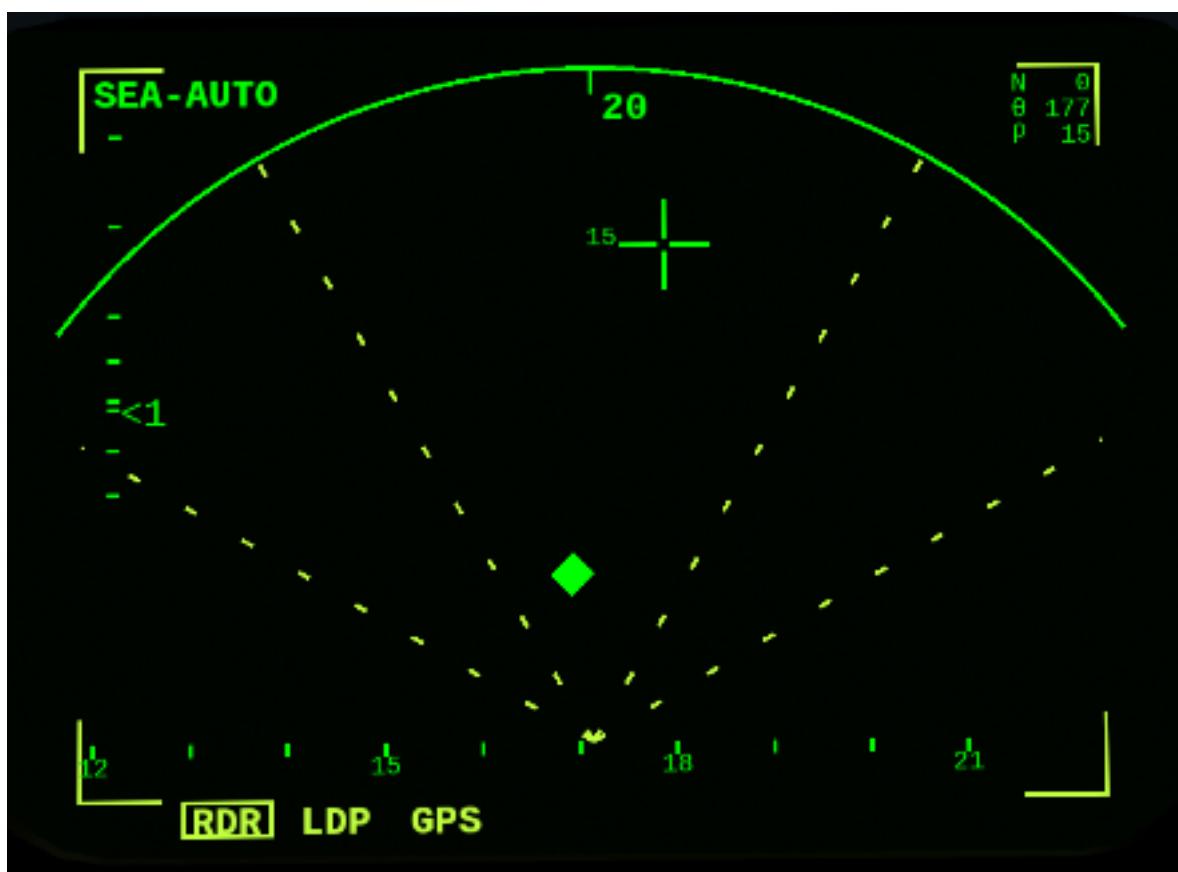

To select a target in another air-2-air or air-2-ground or air-2-see mode, the cursor must be moved over the middle of the target and then designated using Key: l (small L).

7.2.2 Air-to-Sea

Like all ground modes the radar picture is displayed as PPI.

In air-2-sea mode the target is selected and designated using the cursor. A not designated target is shown as a diamond.

When selected the target is shown as a cross. There is no information about direction / speed displayed.

7.2.3 Air-to-Ground
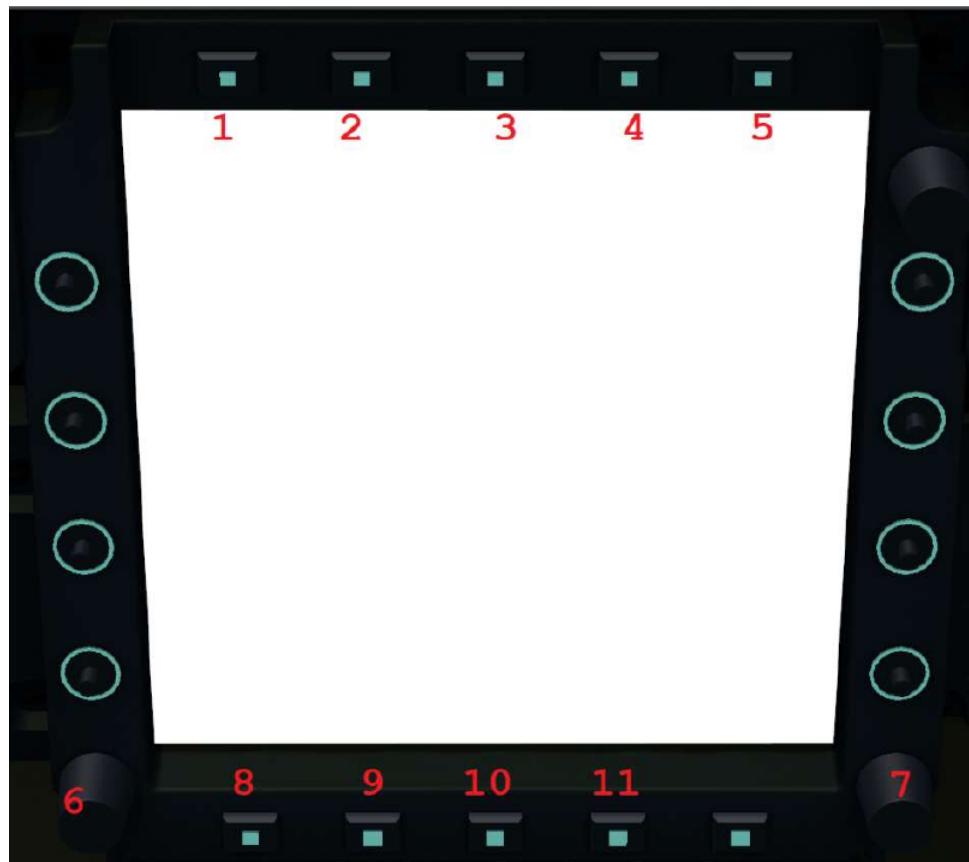
The following picture shows a few targets in ground mode (like for sea targets they are displayed as diamonds). Notice that the antenna elevation has been lowered a few degrees (radar pitch scale at left side) and one of the targets (boxed) has been designated using the laser - and therefore the LDP guidance mode is highlighted.

7.3 VTB

The head-down display is currently basically a copy of a Navigation Display you would find in an Airbus - and thus not yet implemented as per the original.

The buttons around the screen influence settings as follows:

1. Show/hide airports
2. Show/hide waypoint data
3. Show/hide waypoints
4. Show/hide position points
5. Show/hide weather data
6. On/off button
7. Set range in nautical miles (distances: 10; 20; 40; 80; 160; 320)
8. Cycle pages: PLAN, VOR, APP, MAP
9. Toggle liquid crystal display/cathode ray tube display (does not really do anything)
10. Toggle centre ND
11. Toggle true/magnetic heading

7.4 Left MFD

To change the currently displayed page, use the left button on the button row at the bottom of the screen.

The different pages of this MFD are the EADI (electronic attitude direction indicator), the EHSI (electronic horizontal situation indicator), the EICAS (engine indicating and crew alerting system) and the RMU (radio management unit).

7.4.1 Electronic Attitude Direction Indicator (EADI)

1. Autopilot speed adjustment knob (+/- 5kts)

2. Autopilot desired speed

3. Autopilot status indicator (AP1/blank, PTCH/VS/ALT/TF, ROLL/HDG/LNAV)

4. Autopilot desired altitude (ASL or AGL for ALT/TF autopilot modes respectively)

5. Autopilot altitude adjustment knob (+/- 50ft)

6. Airspeed in mach and kts

7. Ground speed in kts

8. Attitude indicator

9. ASL Altimeter in ft (green number) and variometer in ft/min (in red). The green arrow's extention is proportional to the vertical speed of the aircraft.

10. Switch to `EHSI` page

11. Set QNH (+/- 0.34HPa)

If applicable, the name of the route's next waypoint or target airport will be shown below the attitude indicator.

7.4.2 Electronic Horizontal Situation Indicator (EHSI)

1. Red arrow status, cycles through hidden, `NAV1`, `TACAN`, `ADF2`. Hidden by default.

2. Yellow arrow status, cycles through hidden, `NAV2`, `ADF1`. Hidden by default.

3. Toggle the visibility of the atmospheric conditions (wind orientation, speed in kts, outside air temperature in °C, dewpoint in °C). They are shown in bright green at the top right of the screen. The wind's direction is also shown in relation to the aircraft with the small bright green compass.

4. Horizontal situation indicator. It displays in bright green triangles the orientation of the aircraft (0°, 45°, 90°, etc).

5. Heading bug adjustment knob (+/- 1°). It is displayed as a white dented rectangle on the rim of the compass.

6. Switch to the `EICAS` page

7. Cycle between autopilot navigation sources: `NAV1`, `NAV2`, `TACAN` (all three set in the `RMU` page of this same MFD)

and `FMS` (route set in `Autopilot -> Route manager`). The selected source and evental additional information will be displayed in blue text. This also controls the blue arrow's status.

8. Navigation heading adjustment knob (+/- 1°). Only applicable if `NAV1` and/or `NAV2` do not have a valid navigation frequency set.

7.4.3 Engine Indicating and Crew Alerting System (EICAS)

1. Ratio of the engine's speed to its maximum military power

2. Numerical value of the aforementioned ratio. Note that it is in 1/10,000 and not in %.

3. Outside air temperature in °C

4. Internal turbine temperature

5. Throttle (green range only)

6. Fuel consumption in kg/min

7. Oil temperature in °C and oil pressure

8. Hydraulic system pressure

9. Switch to the `RMU` page

7.4.4 Radio Management Unit (RMU)

1. Cycle through and the available channels on the left-hand side of the page (None, `COMM1`, `COMM2`, `NAV1`, `NAV2`). Having one channel selected will enable the pilot to edit its parameters.

2. Swap the active and inactive frequencies of the selected left-hand side channel

3. Knob to adjust the selected left-hand side inactive channel's frequency (+/- 1 MHz)

4. Knob to adjust the selected left-hand side inactive channel's frequency (+/- 0.05 MHz)

5. Swap the active and inactive frequencies of the selected right-hand side channel

6. Cycle through and the available channels on the left-hand side of the page (None, `ADF1`, `ADF2`, `TACAN`).

7. Knob to adjust the selected left-hand side inactive channel's frequency (+/- 10 kHz) if ADF is selected, otherwise adjust the TACAN channel (+/- 1)

8. Knob to adjust the selected left-hand side inactive channel's frequency (+/- 1 kHz) or switch the TACAN mode (X

/Y)

9. Switch to the `EADI` page

7.5 Right MFD

To change the currently displayed page, use the middle button on the button row at the top of the screen. The text below the button shows the next screen.

Use the mouse wheel to push the toggles on the left and right side of the MFD up and down. Only those toggles work, which have a text associated on the screen.

You can also change the view with `Key: N` to better see the right MFD (and the VTB). Use `Key: ctrl-n` to go back to the default view.
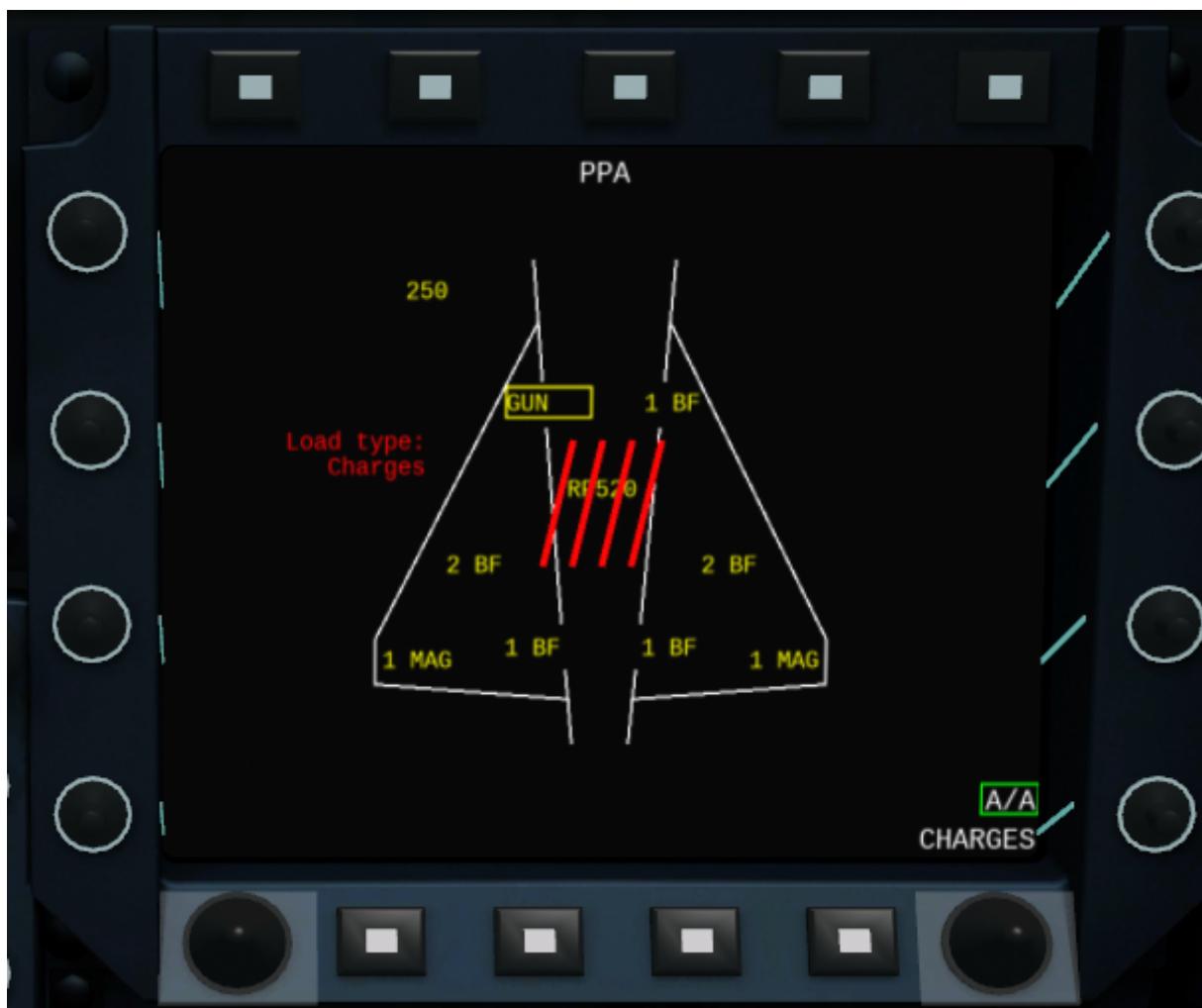
NB: you cannot display pages from the right MFD on the left MFD or the VTB.

7.5.1 Store Management system (SMS)

The SMS page shows the currently loaded weapons incl. external tanks. A few things to note on the picture below:
- The red text on the left indicates that the load type for the Flight Control System should be changed given the heavy load of bombs. That can be done with the toggle at the bottom left.
- A gun is loaded (CC422 gun pod on a M2000D) and therefore at the top to the left you can see the remaining bullet count. If the page would be displayed in a M2000-5, then "CAN" would be displayed each of the 2 cannons.
- The currently selected store will have a yellow rectangle border. You can only select weapons (using `Key: w`) and only the first available weapon of the same type.
- The red stripes in the middle indicate that there is weight on wheels.
- At the top of the page below the middle button you can read "PPA" - which will be the next page displayed.

The abbreviations used for the stores are available in the weapons overview table in Section 10.1 (a number in front of the abbreviations means the number of this weapon at the station).

7.5.2 Poste de Préparation Armement (PPA)

The PPA is a weapons configuration panel. In the middle of the screen it shows the selected weapon plus the remaining number of this type.

At the top of the page a reminder for the pilot is displayed: "Damage: Off" means that the OPRF damage has not been enabled and therefore weapons will not generate damage when they hit something.

The displayed menus depend on the chosen weapon and sometimes on previously chosen menu items (e.g. the ripple distance is only shown, if ripple mode is set to more than 1).

7.5.3 Radar Warning Receiver (RWR)

The radar warning receiver (RWR⟋) screen is actually a combination of a RWR display and a counter-measures dispenser display.

On the left side of the screen there are 2 menu items for the RWR:

- Separation: whether the symbols should be dispersed a bit to make them more readable (but this changes the relative bearing).
- Unknown: whether to show radar sources, which cannot be interpreted.
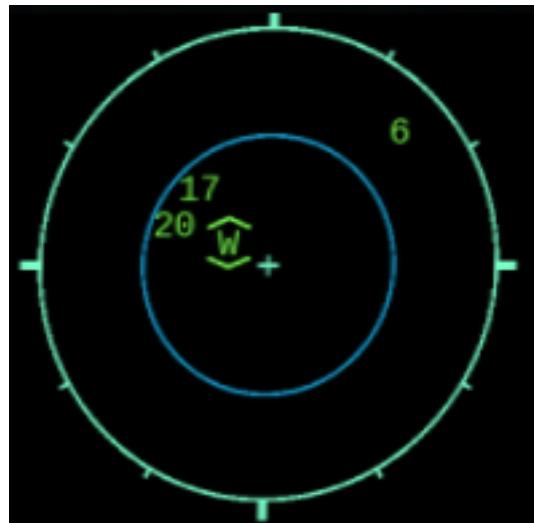
RWR

The RWR displays a maximum of 12 threats. High level threats (e.g. with an STT lock or actively guiding a missile) are

displayed within the blue centre ring. Lower level threats are displayed closer to the outer ring. I.e. the distance from centre is an interpretation of threat and not a real distance. The position is a top-down view around your aircraft (nose towards up/North).

Different types of threats are displayed with different symbols according to USA/NATO standards (i.e. not according to French symbology at the moment). U is for unknown threat, S is for surveillance aircraft (e.g. AWACS⬈ - which typically cannot shoot), and AI is for aircraft which have not yet been classified in OPRF.

If there is a chevron below the symbol, then the threat has a radar lock on you. If there is a hat on top of the symbol, then the threat is either source to an active missile or guiding a semi-active missile.
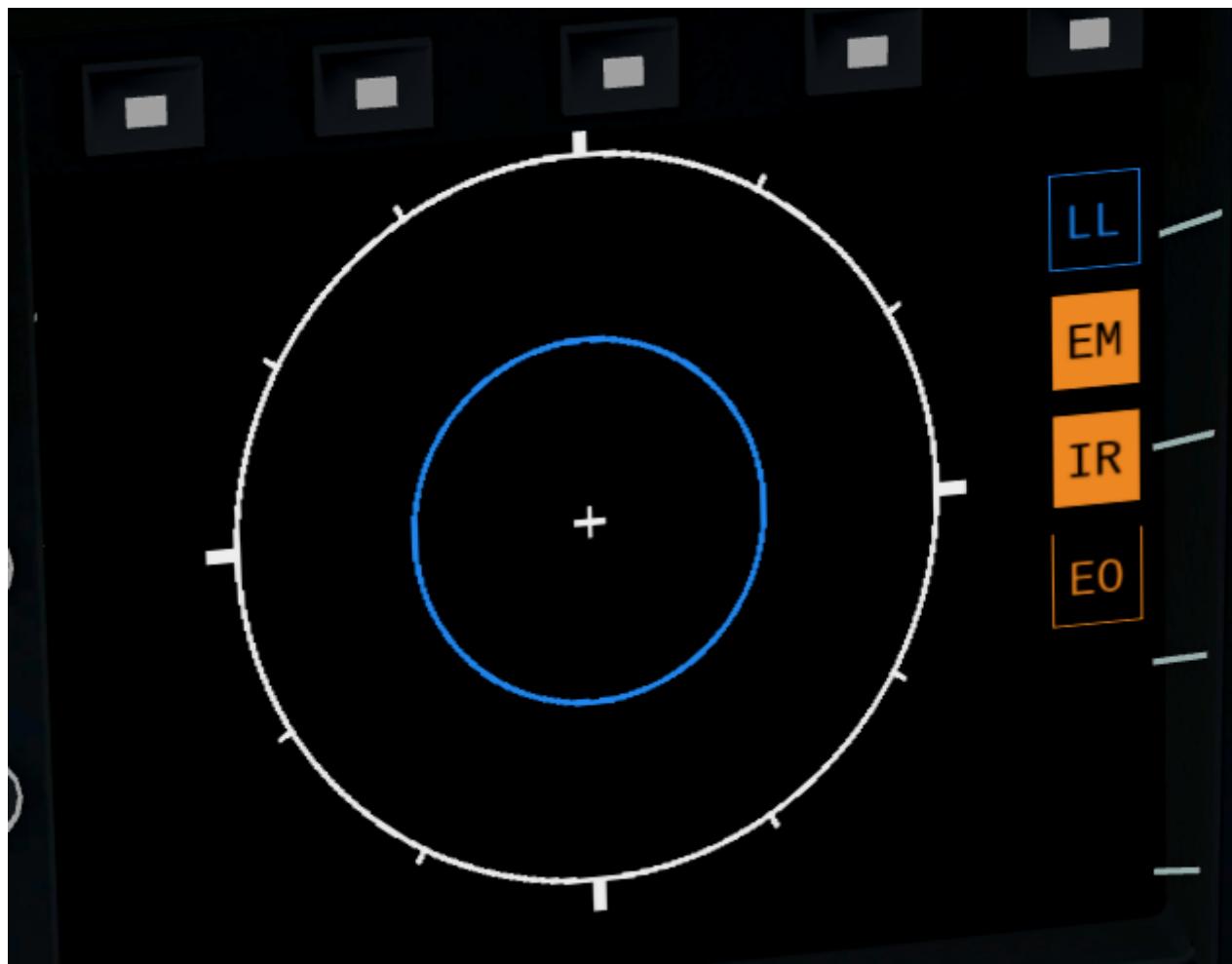
Only one missile in the air can be displayed - even though several might be in the air at the same time. The missile is shown with the symbol W close to the centre - again the distance is not the real distance and only the bearing relative to your aircraft is shown. If a missile is in the air, then the related threats are blinking once per second.

In addition to the visual indications there are sounds (refreshed every 0.5 seconds):

- A new threat has been detected: continuous 1 kHz tone for 0.5 seconds.

- A new radar lock (STT) has been detected: 1 kHz tone chopped at 25Hz for 0.5 seconds.

- A semi-active missile is being supported: 1 kHz tone chopped at 25Hz for 0.5 seconds repeating after 0.5 seconds of silence.

- An active radar missile is in the air: continuous 1 kHz tone chopped at 25Hz until the missile is not detected any more.

Counter-Measures Dispenser Display

At the right side of the RWR there are 4 indicators for dispensed counter-measures (flares and chaff). It is a "could-be" interpretation of the decoy dispenser lights on the right top of the M2000-C canopy.

- `LL` = decoy dispenser (Lance-Leurres) - blue: blinks when counter-measures are being dispensed.
- `EM` = chaff (Électro-magnétique) - amber: blinks when remaining quantity is at or below 20. Steady light when remaining quantity is at 0 (empty).
- `IR` = flares (Infrarouges) - amber: blinks when remaining quantity is at or below 20. Steady light when remaining quantity is at 0 (empty).
- `EO` = electro-optical (Électro-optique) - amber: not simulated.

The total quantity of counter-measures simulated is 120. 2 are dispensed every second. No difference is made between flares and chaff in the simulation. Use `Key: q` to start dispensing and `Key: q` to stop dispensing.

7.5.4 Map

The map page is a temporary replacement for a real implementation in the VTB. Using the lower right toggle you can zoom and and out of the map.

The map is based OpenStreetMap⬈ and shows only the position of one's own aircraft in the middle.

Depending on the network connection it might take a while for parts of the map (tiles) to load. Once loaded the tiles get cached and should therefore be available further on.

8 IFF

An Identification Friend or Foe⬦ system is for combat scenarios. Despite the name, IFF can only positively identify friendly aircraft, it cannot identify foes. An enemy aircraft is undistinguishable from e.g. a civilian aircraft, or an aircraft with a non-functioning IFF system.

IFF interrogations from elsewhere towards your aircraft is supported (i.e. others can tell whether you are a friend of foe). See Section 3.13 for a description of the cockpit instruments.

IFF interrogations from your aircraft towards other aircraft is not yet modelled (i.e. you cannot tell friends from foes).

The Mirage 2000 supports 2 IFF channels. According to [ref: D04] the IFF code gets automatically switched at midnight from A to B. This is not modelled.

The IFF channel codes are set in menu item `Mission Preplanning` accessed through menu `Mirage 2000` (if damage is on, then it can only be done on ground!).

9 Link 16

Link 16 (aka. data link)⬦ is not implemented.

10 Weapons and Armament

10.1 Overview of Available Weapons
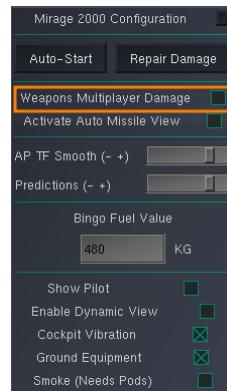
The abbreviation column refers to the abbreviations used in the SMS page (see Section 7.5.1).

Abbrev	Weapon
CAN	30mm Cannon (internal) with DEFA⬈ 554
GUN	CC422 (gun pod⬈) with DEFA 553
MAG	Matra R550 Magic 2⬈
SUP	Matra Super 530D⬈
IR	MICA⬈ IR
EM	MICA EM
AM39	AM.39 Exocet⬈
AS37A	AS-37 Armat (Martel⬈)
AS30L	AS-30L⬈
APACH	APACHE⬈
SCALP	SCALP-EG⬈
ASMP	ASMP-A⬈
G12	GBU-12⬈
G24	GBU-24⬈
BL	SAMP Mk-82⬈ (FR: bombe lisse)
BF	SAMP Mk-82 Snake Eye (FR: bombe freinée)
RP520	1300 l drop tank⬈
RP540	2000 l drop tank
RP500	1700 l drop tank
PDLCT	PDLCT⬈ targeting pod (TGP)
SMOKE	Smoke Pod

10.2 MP Damage

You can only damage other aircraft or MP enabled assets if (a) you have MP damage on and (b) MP damage is on in the target!

To enable or disable MP damage you have to be on the ground and use the configuration through menu item `Mirage 2000 -> Configuration`.

When damage is on, some features are enabled/disabled automatically to make aerial combat more realistic:

- Black-out/red-out is enabled

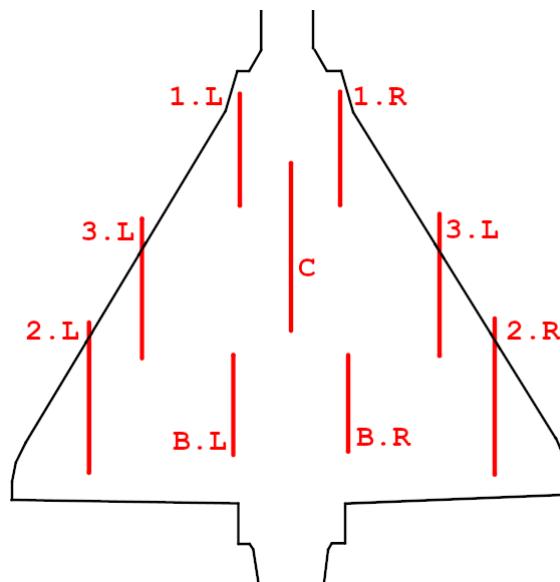- Simulation rate is set to normal
- Emergency altitude increase is disabled
- Fuel and payload dialogue will not be available in air
- Mission Preplanning dialogue will not be available in air
- Map traffic is disabled
- MP pilot list is disabled

10.3 Adding/Removing Weapons

There are 9 weapon stations. The numbering of weapon stations is as follows:
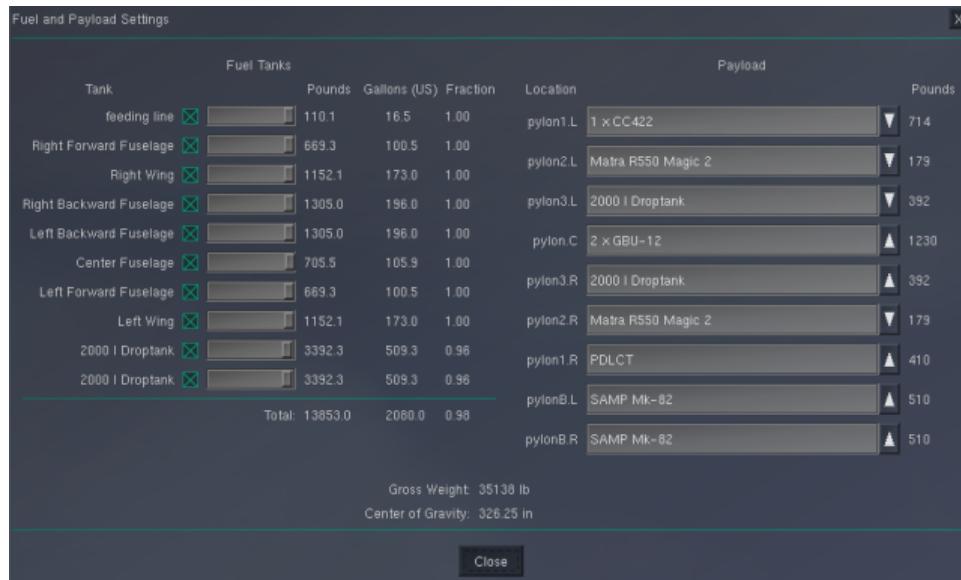
Depending on the aircraft version and the weapon station, possible weapon systems or external fuel tanks may vary. The available payload for each weapon station is as follows:

Payload	2.L	3.L	B.L	1.L	C	1.R	B.R	3.R	2.R
RPL-541/542 (2000L fuel tank)		5BD						5BD	
RPL-501/502 (1700L fuel tank)		5BD						5BD	
RPL-522 (1300L fuel tank)					5BD				
Matra Super 530D			5			5			
Matra R550 Magic II	5BD								5BD
MBDA MICA IR	5B								5B
MBDA MICA EM			5B	5B		5B	5B		
AS30 Laser		D						D	
AS37 Armat		5						5	
AM39 Exocet		5BD						5BD	
SCALP					5BD				
APACHE					5BD				
GBU-12 Paveway II			D	D		D	D		
2x GBU-12 Paveway II					5BD				
GBU-24					5BD				
SAMP Mk-82			5BD	5BD		5BD	5BD		
SAMP Mk-82SE			5BD	5BD		5BD	5BD		
2x SAMP Mk-82		5BD			5BD			5BD	
2x SAMP Mk-82SE		5BD			5BD			5BD	
PDLCT (targeting pod)						5BD			
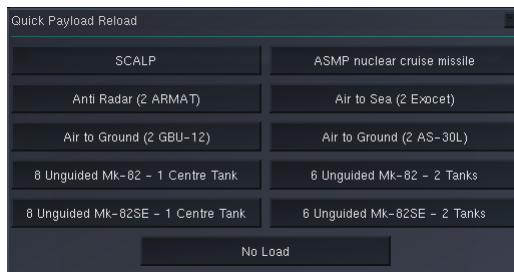
CC422 (gun pod)			D					
Smoke pod (white)	5BD							5BD
ASMP-A				N				

Key: 5 refers to the 2000-5, B to the 2000-5B, D to the 2000D/N and N to the 2000N.

Apart from the available weapons per station no additional restrictions are imposed w.r.t. the combination of weapons. Pictures of real aircraft show that quite some variance is in action. However, it of course makes sense to e.g. have a pod installed if you need laser guidance - or that the weights on both sides of the fuselage are in balance.

To make loading weapons easier, a set of typical loads for a given variant is available in menu item `Mirage 2000 -> Payload Selection`. Using either of them will also replenish the DEFA cannon as well as the onboard chaffs and flares.

NB: you cannot change your payload when MP Damage is on and your aircraft is moving!

10.4 Selecting and Configuring the Active Weapon

The active weapon is selected using `Key: w` to cycle through the available mounted weapons. The stores management system (see Section 7.5.1) shows the available and active weapons. Depending on the active weapon some configurations can be done through the weapons configuration panel (see Section 7.5.2).

10.5 Ground Attack

10.5.1 Basic Keys

- `Key: m`: toggle master arm
- `Key: w`: cycle through weapons
- `Key: ctrl-w`: toggle between CCIP and CCRP

- `Key: M`: cycle through weapon guidance modes (e.g. LDP for laser guided ammunition)
- `Key: ctrl-l` (small L): Fast snipe and designate clicked target for laser

10.5.2 Aiming Modes

CCIP

A Constantly Computed Impact Point (CCIP) is in the Mirage shown as a line from the flight path indicator (top) to the impact point (bottom). When the impact point is just above the target, then you release the bomb(s). This shot will not have a good accuracy, because the airplane is slightly banked to the right - for a good shot the airplane should be horizontal.

If you use a standard Mk82 bomb, then you need to start a steep dive (ca. 40 degs) from at least 10'000 ft above the target to have enough time for aiming and for the bomb to get armed. Using the Snake-Eye retarding device (Mk82SE) you can fly pretty low without a deep dive - given enough speed.

CCRP

The Constantly Computed Release Point (CCRP) requires a target to have been designated - either with the cursor in ground attack radar mode or using a laser or GPS coordinates.

The following picture shows CCRP guidance for a laser guided GBU12 bomb a few seconds before the ideal release point. The diamond at the top shows with its wings that the pilot should navigate the airplane a bit to the right.

The short horizontal line below the diamond moves up from below the closer the release point is. On the right hand side the distance to the release point (not to the target) is shown.
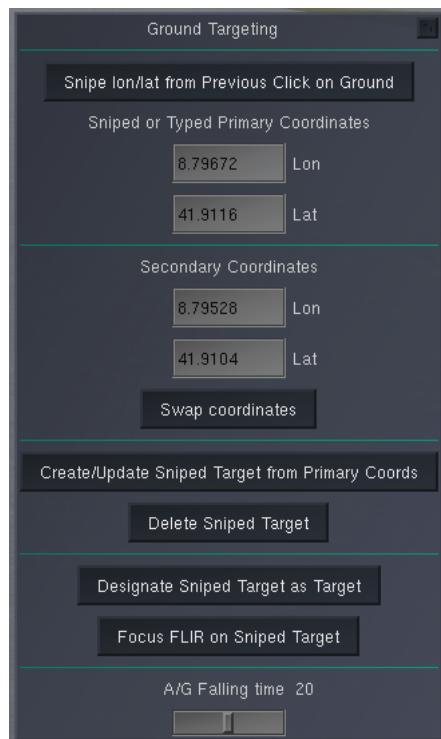

The next picture shows a similar situation, but this time the weapon is a dumb free-fall bomb and the target has been designated using the ground radar.

Laser or GPS Designation

In the `Mirage 2000` menu there is a menu point `Ground Targeting`, which will display the following dialogue:

Ground Targeting

Snipe lon/lat from Previous Click on Ground

Sniped or Typed Primary Coordinates

8.79672 | Lon

41.9116 | Lat

Secondary Coordinates

8.79528 | Lon

41.9104 | Lat

Swap coordinates

Create/Update Sniped Target from Primary Coords

Delete Sniped Target

Designate Sniped Target as Target

Focus FLIR on Sniped Target

A/G Falling time 20

It is important to do all steps sequentially!

You can acquire coordinates in two ways: either write the lon and lat directly into the fields - or click on the ground where you want to pick the coordinate and then press the top button (it will be disabled if no laser designation pod has been added to the airplane).

Always the primary coordinates will be used to create/update targets, but a secondary pair can be input as well. A button can swap the primary and secondary coordinates.

A sniped target (simulating what would be done with a laser) can be created with a button based on the primary coordinates. NB: the view can temporarily be changed automatically, such that the coordinate including its elevation above sea level can be fetched behind the scenes).

The target can then be designated using another button.

Alternatively, using Key: `ctrl-l` you can fast snipe and designate the clicked target for laser.

A FLIR view (Key: `F6`) can be activated and the button `Focus FLIR on Sniped Target` will then point the laser to the sniped coordinates. Thereby the coordinate can be improved by clicking exactly on the target through the FLIR and then updating the target.

10.5.3 Weapon Specific Stuff

MK-82 / MK-82SE and GBU-12/GBU-24

On the PPA the following settings can be done:

- Change between `CCIP` and `CCRP`.
- The number of bombs to ripple (min = 1, max = 18, 0 is not available). You should not ripple GBU's.
- The distance in metres between rippled bombs (min = 5, 10, 20, 30, …, max = 200).
- The fuze selector can be set to either `RET.` (retardé/delayed fuze), or `INST.` (instantaneous fuze) or `INERT.` (inertial fuze). However, this is not implemented and will always result in an instantaneous fuze.

NB: you cannot choose to release 2 bombs at once (dual mode).

Cannons and Guns

The Mirage uses DEFA cannons⧉. It is assumed:

- DEFA 554 for the single-seat Mirage 2000-5: the rate of fire can be changed to either 1800/min (0.033) or 1200/min (0.05) using the PPA.

- DEFA 553 in the CC442 gun pod for the Mirage 2000D has a constant rate of fire of 1300/min (0.046).

In the PPA the gun mode can be set to either air-to-air or air-to-ground ("cannon air-sol").

AS-37 Armat (Anti-Radiation)

There is very little information available for the Armat missile - especially how the aiming in the cockpit is done. Therefore, the implementation is purely fictional and takes inspiration from the DCS AV-8B Harrier AGM 122 Sidearm setup. Most probably the missile was only available in the -C version, maybe in the -D/N versions. This is why a rather primitive display system only using the HUD is used - only the -D and -5 versions have displays, which could show a page like in the F-16 or F-18 MFDs. If you have any information/hints available to make the implementation more realistic, then let the developers know.

For aiming you need to combine the RWR display (see Section 7.5.3) with information in the HUD:

- The HUD only displays a narrow field of view and filters on surface or naval assets which have an air radar. Unknown target types will not be displayed. A mximum of 8 threats are displayed (more severe threats are prioritised).

- The HUD is based on the passive radar homing detection capabilities of the missile, which has been chosen to be 50 nm (the max range of the missile is 54 nm) - which is much lower than the RWR capabilities.

- Therefore, you can use the RWR to spot potential targets and then steer the airplane into that direction until the target is displayed on the HUD (unless it is airborne or out of range). Remember that the distance from the centre in the RWR is not an indication of distance!

In the HUD all detected radiation emitters within the HUD field for view are displayed without any range information using the same type information as in the RWR. E.g. on the following screenshot you can see three radiation targets in the HUD - the same as shown in the RWR (where they overlap). The recticle is always in the centre and gets a double circle, when there is a lock. As with IR-missiles you will hear low and high volume sounds to indicate whether a lock has been acquired.

The missile needs to be fired:

- below 38'000 ft
- below 5 g
- below mach 0.9
- below 45 degs of roll
- within 50 nm of the target

Once a lock is acquired the recticle does not have to be kept over the target. However, if the recticle is moved too far away before the missile is shot, then the lock will get broken.

On the PPA page you can change between filtering on naval only, surface only or all (showing naval and surface stuff).

11 References

This page contains a structured selection of references, which can or have been used for modelling this FlightGear Mirage 2000.

11.1 Books

11.1.1 B01: Dassault Mirage: The Combat Log

Ref: Salvador Mafé Huertas, 1996; Schiffer Military History; ISBN: 0-7643-0168-3; 208 pages

Content:

- page 200: Picture of M2000-5 with all its weapons (picture by Dassault) - including amongst others the MATRA ARAMAT and rocket pods.
- page 205: Illustration of the (Mirage IIIE) Cyrano Ilbis radar air-to-ground sweep as well as the Cyrano Ilbis radar blind penetration mode.
- page 206: Illustration of Mirage IIIE level bombing and toss bombing⬿.

11.1.2 B02: Dassault Mirage 2000: Flying in Air Forces around the World

Ref: Duke Hawkins, 2017?; HMH Publications; HMH-DH-003; ISBN: 978-2-9602488-2-1; 108 pages

Content:

- In general: High resolution and high detail photos of all parts for the Mirage - and all models.
- Very few cockpit pictures - and instruments are not turned on.
- Very few weapons pictures - and only a minor selection.

11.1.3 B03: 35 Years of Air Superiority

Ref: John Lekkas, 2023; Eagle Aviation; ISBN 978-618-85165-3-3; 124 pages

Content:

- In general: Tells the story (in Greek and English) of the Hellenic Air Force 331 squadron "Theseus" and their use of the Mirage 2000-5 Mk2.
- Quite a few high resolution cockpit and weapons pictures.
- Cockpit pictures: page 9, 52 (not turned on)
- Instrument pictures: page 25/81/88/89 (turned on - by night), page 80 (turned on - by night backseat), page88 (high resolution VTM)
- HUD pictures (guns against F-16): page 1/5/43/102

11.1.4 B04: Mirage 2000-5: Groupe de chasse 1/2 Cigognes

Ref: Alexandre Paringaux, 2017: Zéphyr Editions; "5"; ISBN 978-2-36118-249-6; 179 pages

Content:

- HUD pictures: page 7, 68 (simulator)
- VTB pictures: page 68 (simulator)
- VTM pictures: page 71 (plus all other instruments in high resolution - but probably simulator)
- Picture of leg tablet: page 66/67

11.1.5 B05: Mirage 2000D: Escadron de Chasse 3/3 Ardennes

Ref: Alexandre Paringaux, 2013: Zéphyr Editions; "1"; ISBN 978-2-36118-122-2; 80 pages

Content:

- Picture of leg tablet: page 57

11.1.6 B06: Dans le Repair du Mirage 2000D: Nancy-Ochey

Ref: Alexandre Paringaux, 2013; Zéphyr Editions; ISBN 978-2-36118-116-1; 144 pages

Content:

- A number of pictures of different weapon configurations - and some close-ups
- page 75: some instruments on the simulator consoles
- page 82: front cockpit by night with instruments running (in simulator)
- page 84: back cockpit by night with instruments running (in simulator)
- page 107: front cockpit of crashed plane

11.1.7 B07: Mirage 2000N: Escadron de Chasse 2/4 La Fayette

Ref: Alexandre Paringaux, 2016; Zéphyr Editions; "4"; ISBN 978-2-36118-211-3

Content:

- Many weapon configurations - also conventional weapons (page 94 & 96/97 4 GBU-12)
- page 111: night illuminated front cockpit with working VTB (in simulator)
- page 62: picture of leg tablet

11.1.8 B08: Les Forces Aériennes Stratégiques: 50 ans d'alerte nucléaire

Ref: Alexandre Paringaux, 2015; Zéphyr Editions; "3"; ISBN 978-2-36118-168-0

Content:

- page 4: picture of front cockpit 2000N by night illuminated (simulator)

11.1.9 B09: AMD-BA Mirage 2000D

Ref: Frédéric Lert; Les Matériels de l'Armée de l'Air et de l'Aéronaval; Histoire & Collections; ISBN 978-2-35250-253-1

11.1.10 B10: Mirage 2000: L'histoire and l'armée de l'Air de 1974 a nos jours

Ref: Hervé Beaumont, 2024; 2e édition; Sophia Editions; ISBN: 978-2-38514-081-6.

Content: * Each version incl. the prototypes are described in depth in concise language - not so much "stories".

11.2 Articles in Journals

11.2.1 Jets - L'aéronautique à réaction et son histoire

No 23, November 1997

A01: Riccardo Niccoli: En vol sur Mirage 2000-5 (4 pages)

- page 7: cockpit view of the front panel. Shows amongst others the 4 stripes indication of not working screens and the possibility to repeat the VTM radar screen on the VTB. And good view on the lower left panel with the 3*6 button table. The buttons are blue when illuminated, but not much.

11.2.2 World Air Power Journal

Volume 10 Autumn/Fall 1992

A02: Paul Jackson, Dassault Mirage 2000 (46 pages)

- Detailed description with lots of pictures of all current at that time variants and all user countries.
- Quite a few pictures of weapons - some of which are not used any more.
- page 60: instruments view of M-2000C and M-2000-5 (not very good resolution).

11.2.3 Nouvelle Revue d'Aeronautique et d'Astronautique

No. 2, 1997

A03: Georges Mas, Marc Pagliardini: Le Programme Radar RDY

Retrieved as "The RDY Radar Program" translation for requester NAIC/TAEA (National Air Intelligence Center), document control number: NAIC-98-0124, translation number: NAIC-ID(RD)T-0124-98 from internet.

11.2.4 Dassault Aviation - Engage!

Special Issue

A04: Mirage 2000-9

URL: https://www.dassault-aviation.com/wp-content/blogs.dir/1/files/2012/08/Mirage_2000-9_special_issue1.pdf

2 - 2003

A05: RDY2 multi role, multi function radar

A06: M53-P3 a new engine under the skin

11.3 Documents

11.3.1 D01: Fiche technique Mirage 2000D

URL: https://www.defense.gouv.fr/sites/default/files/air/Fiche%20technique%20Mirage%202000D.pdf

Dassault Mirage 2000D - Fiche Technique - Un Mirage Rénové

11.3.2 D02: Brétigny-sur-Orge - le A-2019-01-A

URL: https://www.defense.gouv.fr/sites/default/files/bea-e/A-2019-01-A.pdf

Bureau enquêtes accidents pour la sécurité de l'aéronautique d'État - Rapport d'enquête de sécurité - A-2019-01-A

Content - investigation of a Mirage 2000D crash during training at very low altitude on January 9th 2019.:

- Page 4: abbreviations
- Page 23: explanation and picture of the VTB visualisation for terrain following.
- Page 34, chapter 2.2.6.4: how the VTB and VTH react if flying below the set margin above terrain.
- Page 43, chapter 2.3.2.1: more text describing the terrain visualisation (which reads from right to left!).

11.3.3 D03: Mirage 2000-C - Manuel Pilote

Ca. 131 pages in French. Available as pdf-file on the internet.

11.3.4 D04: M2000-C User Manual DCS - RAZBAM

The user manual for the Mirage 2000-C simulated in the DCS combat simulator by RAZBAM. Available at RAZBAM DCS Manuals.

11.4 Links

- Armée de l'Air et de l'Éspace:
    - Home page: https://www.defense.gouv.fr/air
    - Mirage 2000D: https://www.defense.gouv.fr/air/nos-aeronefs/nos-avions/mirage-2000
    - Mirage 2000-5F: https://www.defense.gouv.fr/air/nos-aeronefs/nos-avions/mirage-2000-5f
    - Air Actualités: https://www.calameo.com/accounts/14334
    - YouTube channel: https://www.youtube.com/channel/UC9tdrNLs9QpsFZI050UARkQ
    - Escadron de Chasse 1/2 "Cigognes": https://www.gc1-2cigognes.fr/
    - Wikipedia FR: Liste des escadres AdlA
- Dassault:
    - Mirage 2000⧉
- Others:
    - Forum thread: Mirage 2000 RDM/RDI/RDY Radars and other avionics⧉
    - Blog post⧉: quite a few details on systems and weapons with pictures
    - Scalemates Dassault Mirage 2000 Walkarounds⧉

11.5 DVDs

11.5.1 V01: Mirage 2000 - 20 Years in Hellenic Air Force Service

Ref: www.11aviation.com; 87 minutes; Greek language / no subtitles

Content:

- File 05-3
    - 21:05 minutes: HUD on ground

- File 05-4
    - 2:33 min: HUD on ground/take-off
    - 5:13 - 07:50: (ditto)
    - 10:00: HUD landing
    - 11:00: HUD with seeker

11.5.2 V02: Mirage 2000-5

Ref: Hellenic Air Force Yearbook; Airutopia, David Maxwell; 2012 Special Projects; ca. 1 hour; mostly English with Greek subtitles.

Content:

- File 01_1:
    - 5:58: Roll-rate = 270 degs / second
    - 7:09: HUD
    - 27:45/28:21/20:03-29:24: target in HUD

- File 01_2:
    - 16:20: startup with engine gauge instrument
    - 18:00: weapons page display
    - 19:14: attitude page display
    - 19:21: VTB tactical display
    - 19:30: Navigation page display

- File 01_3:
    - 10:01 / 11:04: Backseater HUD

11.6 YouTube Videos

11.6.1 Y01: Mirage 2000 Planète Science

URL: https://www.youtube.com/watch?v=MoVsmaIs_pU

Content:

- At around 9 minutes for ca. 2 minutes: live images of the 5 screens

11.6.2 Y02: DGA : Le Mirage 2000B qui se prenait pour un Rafale

URL: https://www.youtube.com/watch?v=a5ZwYXixT28

Content:

- At around 6 minutes for ca. 1 minutes (and also before and after) close-up pictures of the CC422 gun-pod

11.6.3 Y03: Le Mirage 2000 - Documentaire sur l'aviation

URL: https://www.youtube.com/watch?v=jDCxWEynbu4

Content:

- At around 21:30 for ca. 15 seconds live pictures left MFD (in simulator)

11.6.4 Y04: AB Moteurs Mirage 2000

URL: https://www.youtube.com/watch?v=bFHF9j_LvPk

Content:

- From around 29-41 minutes (with interruptions): walk-through of the cockpit, which gives a good insight into the French terms used.
- Some live footage of HUD here and there.

11.6.5 Y05: Les Guerriers du Ciel - Mirage 2000, Le Chasseur Polyvalent (Documentaire)

URL: https://www.youtube.com/watch?v=VkRisFae93Y (same as https://www.youtube.com/watch?v=YjI7Tg75MD8)

Content:

- Presentation of the -C, -5 and N versions.
- At around 11:00: Close up view of the antennas / sensors on the tail and the back of a Mirage 2000D.
- At ca. 21:00: A few seconds of Mirage 2000-5 left side of front cockpit panel plus HUD sequence of missile launch (probably simulator)
- At around 31:00 - 32:30: Mirage 2000N simulator cockpit views

11.6.6 Y06: Mirage 2000 D : un appareil CRUCIAL avant le "tout-RAFALE"

URL: https://www.youtube.com/watch?v=uVWe9SUecsw

Content:

- Rénovation mi-vie (RMV) incl. description of the different pods (ATLIS, PDL-CTS, DAMOCLES, TALIOS) and the related guided weapons
- Around 11:03: photo of 2 loads for RM, one of them having a CC422 pod, 2 GBU and two MK82.
- At 15:15: backseat cockpit with new big screen

11.6.7 Y07: L'HISTOIRE des FANTASTIQUES MIRAGE de Dassault - doc complet (III, 5, 50, G, IV, F1, 2000)

URL: https://www.youtube.com/watch?v=GSDRy0jYgA0

Content:

- From around 48:01 until 1:07:10: M2000
- At around 1:05:01: HUD in weapons mode from Greek/Turkish M2000 vs. F-16 fight.

11.6.8 Y08: Mirage 2000 Cockpit - Documentaire avion de chasse Dassault

URL: https://www.youtube.com/watch?v=zqENHPav5P4

Content:

- Commented walk-through of the cockpit (displays black) of a M-2000C - close up

11.6.9 Y09: Mirage 2000 pour l' Ukraine? Mieux comprendre les rumeurs

URL: https://www.youtube.com/watch?v=GrNu8qAJ16s

11.6.10 Y10: A Mirage 2000 fires its cannon! A first

URL: https://www.youtube.com/watch?v=UB4Dl1hhHUc

Content:

- 04:48: Overview of the firing range with different targets
- 09:03: VTB image with and without LINK16

12 Abbreviations and Jargon

12.1 French Abbreviations (Glossary)

Abbreviation	Meaning	English
A / AR	arrête	off
AST	assaut en suivi de terrain	terrain-following assault mode
AU	automatique	automatic
CAS	cannon air-sol	cannon in air-ground mode
D	droite	right
G	gauche	left
ISG	indicateur sphérique gyroscopique	attitude indicator
JVN	jumelles de vision nocturnes	night vision goggles
LL	lance leurres	decoy dispenser
M	marche	on
NOSA	navigateur officier systèmes d'armes	weapon systems officer
OPEX	opération extérieure	foreign operations
P	prêt	ready
PA	pilote automatique	autopilot
PC	post-combustion	reheat / afterburner
PCA	poste de commande armement	
PCN	poste de commande navigation	
PCR	poste de commande radar	
PGS	plein gaz sec	full military power (without reheat)
PLA	point de largage de l'armement	weapons release point
PPA	poste préparation armement	
PSM	poste sélecteur de modes	
RTBA	réseau très basse altitude	military low-flying areas
S	selectionné	selected
SA	semi-automatique	semi-automatic
SCALP	système de croisière conventionnel autonome à longue portée	conventional cruise missile
SDT	suivi de terrain	terrain following
TBA	très basse altitude	very low altitude
VTB	visualisation tête basse	HDD - head-down display
VTM	visualisation tête moyenne	n/a - head level display
VTH	visualisation tête haute	HUD - head-up display

12.2 French Military Aviation Jargon

Jargon	Meaning
passage de dos	inverted flying

- genindex
- modindex
- search

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