13 th EUROPEAN ROTORCRAFT FORUM

3.10

PAPER No. 105

PANTHER , A DAUPHIN WARRIOR

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MARIGNANE - FRANCE

September 8 - 11 , 1987

ARLES , FRANCE

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INTRODUCTION

The AEROSPATIALE SA 365M PANTHER is a multi-mission modern combat helicopter. With a 4100 kg maximum mission weight, the PANTHER belongs to the medium-weight helicopter range featuring a fair stealthiness for combat and NOE missions while having and excellent carrying capacity of 10 commandos for transport missions.

As derived from the DAUPHIN, it inherits all those advanced technologies specific to a modern aircraft.

Its two TURBOMECA TM 333-1M engines equipped with an electronic fuel control unit and ensuring a 631 kW takeoff power provide it with the extra power required for military operation.

For the PANTHER to be an actual weapon system, its structure has been adapted to accommodate the most efficient heliborne weapons, especially 20 mm axially-mounted cannons, 68 mm or 2"75 rocket launchers, HOT or TOW anti-tank missiles or MISTRAL or STINGER air-to-air missiles.

The SA 365 M PANTHER is therefore a modern and multi-mission aircraft providing the military operators not only with the DAUPHIN'S performance, handling qualities and reliability but also with a thorough but simple, efficient, easy to implement and highly available weapon system.

PANTHER, A DAUPHIN WARRIOR

The AEROSPATIALE Helicopter Division has always wanted to be present in the military markets (which amount to 60 % of the sales) and to offer the Headquarters products with an advanced technology and perfectly adapted to the armies' and navies' requirements.

In the early 1980's, AEROSPATIALE decided to take advantage of this experience and proposed a medium-weight military helicopter with a high engine power, as extrapolated from the 'DAUPHIN' family and liable to fulfil the following missions .

- Tactical transport
- Fire control
- Anti-tank warfare

This helicopter was named 'PANTHER'

It is now being industrialized.

While benefiting from the experience and developments achieved for other aircraft, it provides the operator with a large versatility and thus allows contemplating the future adaptation of the various weapon and avionics systems which are currently being designed or developed.

1 – THE MILITARY HELICOPTER :

SELECTING A MARKET SEGMENT

The AEROSPATIALE 'HELICOPTER' Division takes advantage of a good experience in ground-based military helicopters through its past productions, such as both light scout and combat helicopters (ALOUETTE II, ALOUETTE III, GAZELLE) and heavier tactical transport aircraft (PUMA, SUPER-FRELON, SUPER-PUMA). Moreover, the Helicopter Division takes part jointly with its German partner MBB in the design of the future European specialized armed helicopter HAP/PAH2/HAC which is a two-place tandem seat aircraft upgraded for the anti-helicopter and night-time anti-tank missions.

The interest offered by a versatile, low-cost and readily available military aircraft was clearly demonstrated by the market survey : Only those countries with a strong military and economical power, provided with highly equipped and structured armed forces and, generally, with an aeronautical industry, can have a heliborne armed component structured around numerous specialized helicopters with various weights (light scouting and liaison helicopters + specialized combat helicopters + heavy-weight tactical transport helicopters). Then, facing high acquisition and operating costs (specialized aircraft development costs, limited series-production aircraft acquisition costs, logistics cost to maintain a very diversified helicopter fleet, crews and mechanics training costs) must obviously be admitted.

Very numerous countries wish to follow the same principles regarding the operation of 'heliborne armed forces' but they simply want to devote lower budgets.

For all these countries, the solution lies in the multi-role military aircraft in so far as the compromise selected to obtain such a feature takes account of a sufficient operational efficiency for every mission selected :

* For enemy scouting and harassing missions, light and stealthy small-size aircraft provide discretion and low vulnerability.

* For armed missions, in addition to stealthiness, speed, platform stability, a good weight and volume carrying capacity is required while providing a 2-hour flight endurance at least. Moreover, an easily adaptable structure is required for the installation of weapons, sights, ammunitions and avionics.

* Lastly, for carrying the commandos, in addition to speed and endurance, the number of troops transported, hence the cabin volume and accessibility are obviously important.

Considering these various components, it is straightly concluded that a good multi-role military aircraft should weigh between 4 and 5 tons in order not to be too small and too heavy.

With a view to offering an aircraft within this segment and being present in the armed helicopter market between the current range and the future export versions of the Franco-German combat helicopter expected for 1997-2005, AEROSPATIALE has decided to develop and propose this ground-based military version of the DAUPHIN so-called PANTHER (fig. 1 and 2).

Fig. 1 : THE SA 365 M PANTHER IN FLIGHT

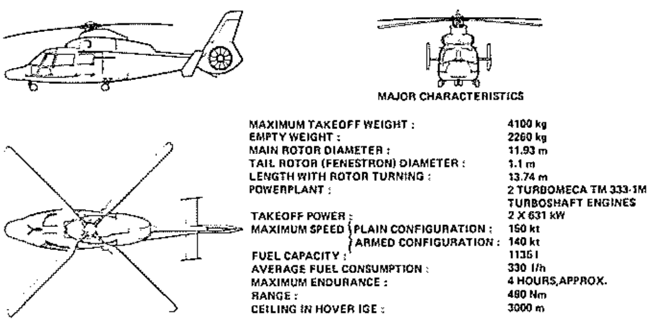


Fig. 2 : SA 365 M PANTHER CHARACTERISTICS

2 -- PANTHER's MISSIONS

Thanks to its versatility, the PANTHER can fulfil a very wide range of missions. The helicopter design has been optimized around 4 primary missions :

2.1 – PRIMARY MISSIONS

2.1.1 – COMMANDO TACTICAL TRANSPORT MISSION

The PANTHER inherited a well arranged wide cabin from the DAUPHIN family ; this cabin is fitted with 4 lateral doors : 2 forward hinged doors and 2 rear sliding doors. It can accommodate troop seats for carrying, embarking and disembarking 8 to 10 equipped troops through the sliding doors and features 4 two-place face-to-face seats designed for 8 commandos ; this layout can accommodate another 2 back-to-back seats in the centre cabin area. (fig. 3).

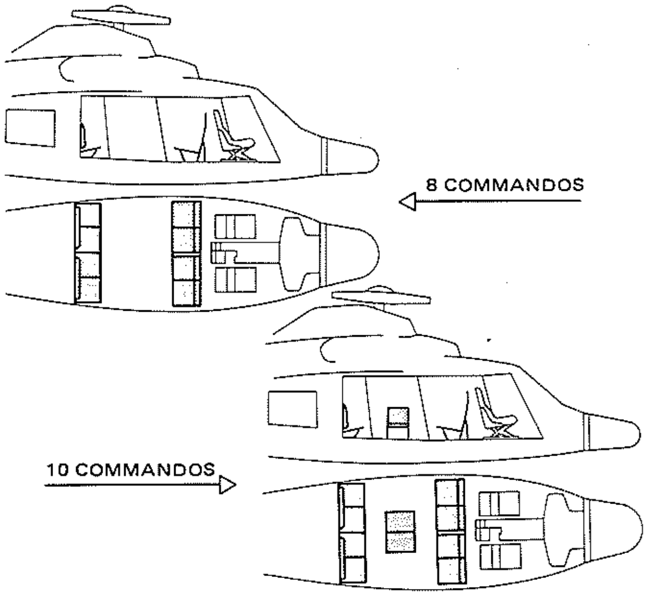


Fig. 3 : COMMANDO TRANSPORT LAYOUT

In the transport configuration, the aircraft takes advantages of a large fuel capacity allowing it to conduct all types of missions : some examples (see fig. 4) in ISA + 20°C/500 m altitude conditions are given below :

* Transport of 8 commandos over 540 km
* Transport of 10 commandos over 360 km
* Successive rotations to carry 130 commandos per hour to a point 10 km (6.2 miles) away.

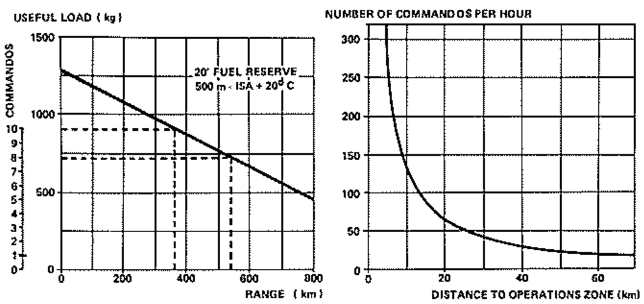
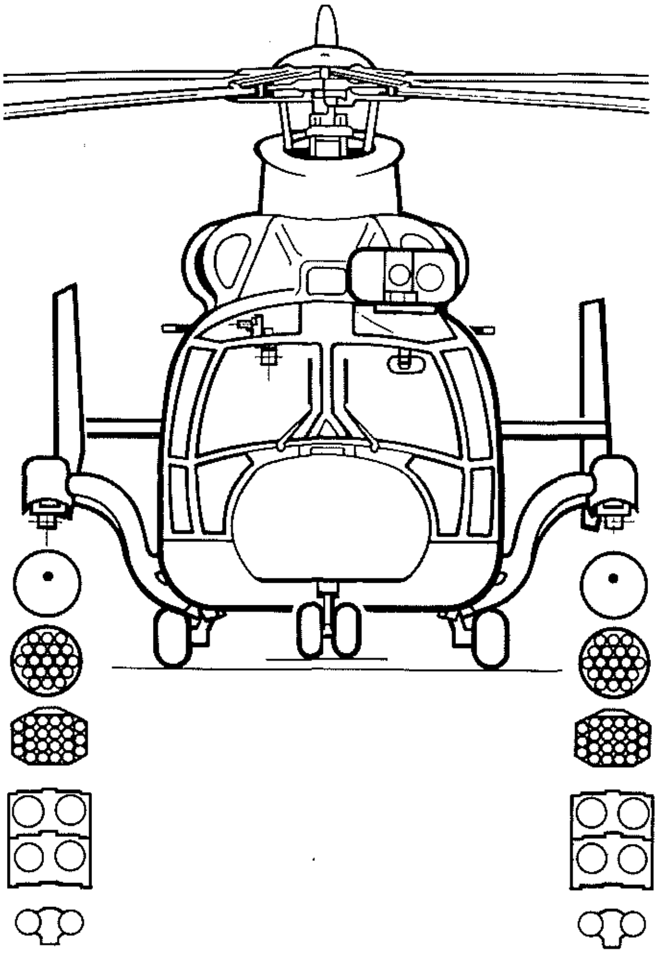


Fig. 4 : TRANSPORT MISSION : PERFORMANCE

2.1.2 – ARMED MISSIONS

For armed missions, the PANTHER can be equipped with various axially-mounted weapons suspended under lateral pods secured to 4 structure hard points, below sliding doors in order not to hinder the opening of the doors (fig. 5).



POD FOR 20 mm	CANNON
2.75" x 19	ROCKET LAUNCHER
68 mm x 22	ROCKET LAUNCHER
HOT MISSILE	LAUNCHER
AIR/AIR MISSILE	LAUNCHER

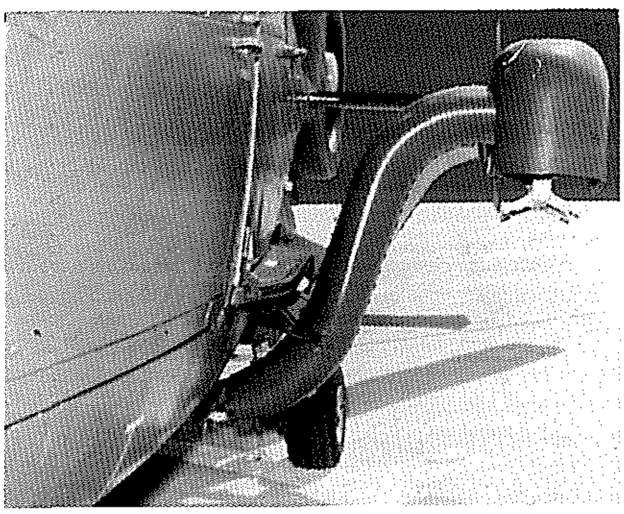


Fig. 5 : WEAPON PODS AND CARRYING CAPACITY

These pods are designed to be multi-purpose and can accommodate all current weapons (HOT or TOW anti-tank missiles, MISTRAL or STINGER air-to-air missiles, cannons, various rockets, etc.)

The end of each pod is provided with :

- A hooking and releasing device (release unit) mounted on an elevation-moving system.
- An electro-mechanical actuator equipped with a slaving system used to adjust the line-of-sight to an optimum value (automatic or crew-controlled action according to the weapons used). (Fig. 6).

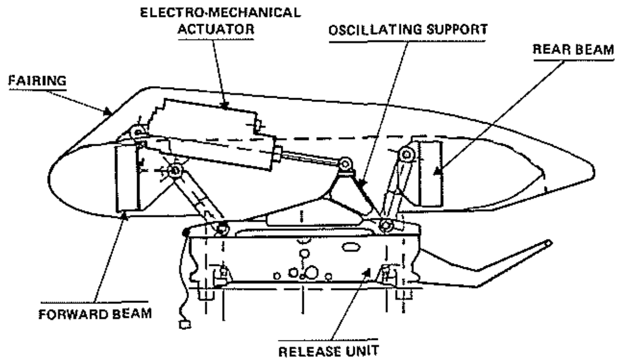


Fig. 6 : ELEVATION - SLAVING SYSTEM MOUNTED AT THE END OF WEAPON POD

2.1.2.1 – Fire control mission weapons

For zone neutralization and ground troops protection and support missions, the PANTHER can be equipped with rocket- launchers, cannons or both combined weapons as fitted to its multi-purpose pods (Fig. 7).

Fig. 7 : THE PANTHER IN A FIRE SUPPORT CONFIGURATION. IT IS EQUIPPED WITH BOTH A GIAT 20 mm CANNON POD ON LH SIDE AND A BRANDT 68 mm ROCKET – LAUNCHER CONTAINER ON RH SIDE.

* Rocket-launchers :

2 rocket-launcher systems have been experimented successfully.

. THOMSON-BRANDT rocket-launchers equipped with 68 mm rockets (22 off) .

. FORGES DE ZEEBRUGE rocket-launchers equipped with 2"75 rockets (19 off).

During the firing phase, the elevation-slaving system adjusts the rocket-launcher to a fixed value as optimized during a firing test campaign.

*20 mm cannon

The GIAT cannon pod NC 20-M-621 has been selected to equip the PANTHER ; this pod incorporates the weapon itself and a 180-shell ammunition band in a single spindle-shaped container.

The rate-of-fire is 740 shots per minute and the initial speed is 1000 m/s.

This solution offers the advantage of an extremely flexible implementation both for rearming and replacing the weapons.

During the firing phase, the pilot can adjust the line-of-sight in elevation in a way the best suited to the flight configuration : the elevation-slaving system permanently holds both cannons parallel to the line-of-sight.

During the firing test campaign in CAZAUX, it has been demonstrated that a light vehicle was hit practically without fail at a range of 1000 m and with a burst of less than 10 shells !

2.1.2 2 – Air-to-air warfare mission weapons

To conduct the combat missions against enemy helicopters or even against airplanes, the PANTHER can be equipped with MATRA AATCP Mistral or STINGER infra-red guided AIR-to-AIR missiles as fitted to its multi-purpose weapon pods.

This type of weapon will be experimented and finalized during a later development phase.

All weapons carried can be mixed (Fig. 8).

Fig. 8 : TYPICAL AIR-TO-AIR WARFARE CONFIGURATION : VIVIANE IDENTIFICATION SIGHT ON COPILOT'S SIDE "GIAT" POD CANNON 20 mm ON R.H SIDE –"MISTRAL" AIR-TO-AIR MATRA MISSILES ON L.H SIDE.

2.1.2.3 – Controls and sight system for axially -mounted weapons

For the delivery of these axially-mounted weapons, the pilot is provided with a CROUZET head-up display mounted on the upper post of windshield and whose sighting head can be moved in elevation (fig. 9).

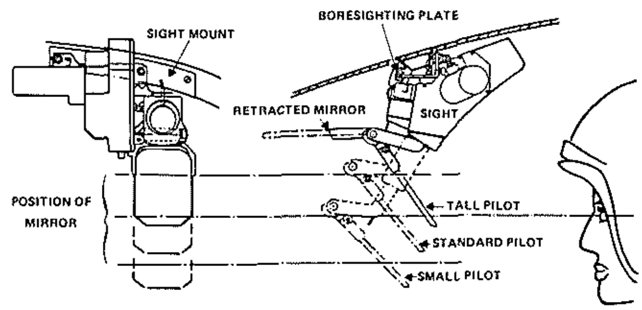


Fig. 9 : HEAD–UP DISPLAY

Flight control information and firing symbologies are displayed on a retractable optically-coated glass and superimposed on the eyepiece display.

The center cockpit console accessible by both crew members accommodates the various weapon and sight control units.

The system is designed in such a way that during the combat phases, the controls simply consist in operating pushbuttons.

Figure 9A is a simplified functional diagram of this system (the functional diagram of the "emergency release" functions, in particular, is not illustrated).

Safety firing controls (ground safety, in-flight safety excluding combat phase) are available to the crew.

The firing control itself is achieved by the pilot who depresses a pushbutton switch with a safety guard provided on the cyclic stick grip.

The elevation-slaving control is provided by a three-position switch on the collective stick grip : this control operates only when the weapons selected require the line-of-sight to be adjusted (cannon, especially).

The weapons (LH or RH weapon, or simultaneous firing) are selected by operating three pushbuttons provided on a control box mounted on the centre console :

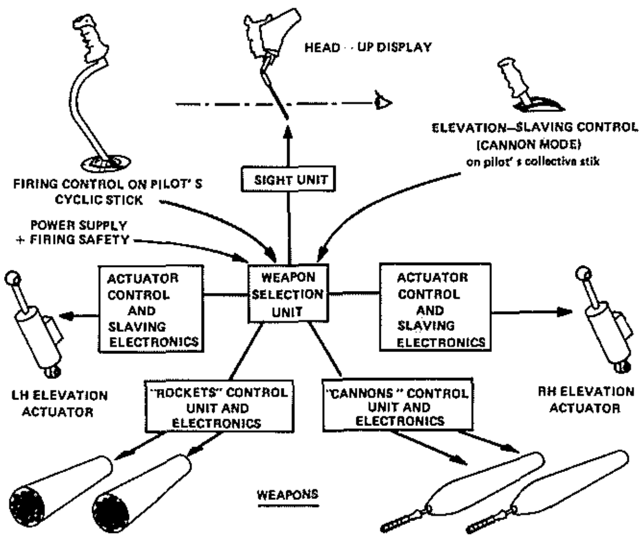


Fig. 9a : WEAPON SYSTEM FUNCTIONAL DIAGRAM

This centralized control so-called weapon selection unit provides the following functions :

* Checking for the presence of weapons on pods and identification (cannon, rocket, air-to-air missile or no weapon fitted).

* Selecting LH and/or RH weapon (pushbuttons) causing the selected system to be energized thus making it ready to be fired.

* After selection, transmitting the control mode to the head-up display control unit. The latter identifies the weapon and adjusts the elevation system thus making sighting possible.

* Feeding the selected weapon elevation setting command through an actuator control and slaving electronic unit mounted in the equipment bay.

* Where no weapon is selected, the weapon selection unit commands a fixed setting of 3° nose-up which corresponds to cruise flight (minimum aerodynamic drag).

During the various development tests and the firing test campaign, the PANTHER proved as a remarkably stable firing platform thus making the weapons used quite efficient.

2.1.2.4 – Anti-tank warfare

In the modern battlefield, it is important that the combat helicopters can ensure the anti-tank missions both by day and night.

As an experiment, AEROSPATIALE has developed a night anti-tank warfare system on a 'VENUS' DAUPHIN in the early 1980's.

The PANTHER directly benefits from this experience.

*ANTI-TANK WEAPONS

The multi-purpose weapon pods can accommodate 'EUROMISSILE HOT 2' anti-tank missile launchers.

The HOT missile is one of the most efficient anti-tank weapons : it can pierce all armours of current vehicles and has an effective range of 4,000 meters.

Its semi-automatic infra-red guiding system provides it with an optimum efficiency while being insensible to countermeasures.

The PANTHER can carry up to 8 HOT missiles (Fig. 10).

Fig. 10 : THE PANTHER IN AN ANTI-TANK CONFIGURATION USING 8 HOT MISSILES AND "VIVIANE" SIGHT

*HOT ANTI-TANK MISSILE SIGHTING AND GUIDANCE

Target acquisition, missile identification, sighting and guidance up to the target are achieved by the copilot using the VIVIANE mobile elevation and azimuth gyrostabilized sight mounted on cockpit roof.

This sight which is currently being developed for implementation aboard the GAZELLE incorporates an optical (daytime) channel and a thermal (night-time channel) that can both be used with several magnification capabilities. With a weight of 60 kg, the sight features the following ranges :

- detection .....5.2 km
- reconnaissance .....3.8 km
- identification .....2.0 km

Figure 11 shows the major components of this equipment :

- elevation (+ 40°/-25°) and azimuth slaving unit.
- thermal camera incorporating an input lens of 166 mm ensuring night-time performance
- optical units
- retractable eyepiece arm with associated lateral head-in display for thermal image display.

In addition to these display functions, the VIVIANE sight also incorporates specific firing devices .

- a laser rangefinder ensuring that firing is achieved within the missile operating range.

- the HOT localizer which permanently measures difference α between missile (I.R. radiation from its booster) and line-of-sight, along trajectory, and transmits this data to the heliborne electronic guidance system.

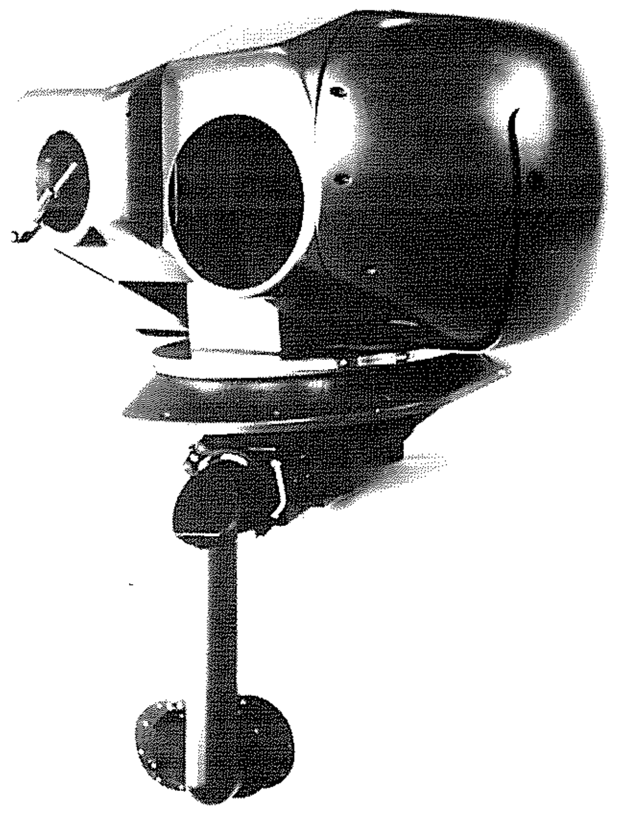


Fig. 11 : VIVIANE ANTI-TANK SIGHT

The guidance system then generates commands (trajectory corrections) to HOT missiles via the remote-control wire which unwinds behind the missile. (Fig. 12).

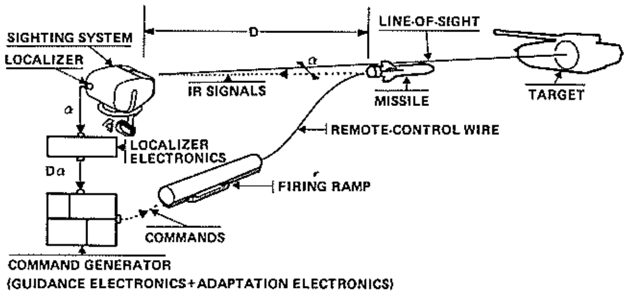


Fig. 12 : HOT MISSILE GUIDANCE PRINCIPLE

2.1.3 – NIGHT MISSION OPERATIONAL PRINCIPLES

The principle retained for flying at night lies in the association of a light-intensification night vision equipment (micro-channel passive night vision goggles) providing the pilot with a vision of external environment, with cockpit instruments adapted to the use of these NVG's (low U.V. lighting, adapted layout of instrument panel, cockpit and lighting equipment : landing light, I.R. light, formation lights).
To reduce the pilot's workload, the aircraft is equipped with :

*an AFCS which can be complemented by a coupler (especially to provide hover hold, altitude hold and aircraft slaving to the VIVIANE line-of-sight in the anti-tank configuration).

*a precise self-contained navigation system (especially using a DOPPLER-effect velocimeter) in order to be free of radio-navigation aids on ground.

2.1.4 – ARMED MISSION ENDURANCE

Despite the non-negligible weight of the various weapon systems and associated ammunitions, the PANTHER has a sufficient endurance to achieve missions even in zones away from its base.

Figure 13 shows a well equipped military aircraft (armoured seats, complete navigation system, self-sealing crashworthy fuel tanks) operating at a high altitude (1000 m) and in a hot area (ISA + 20° C).

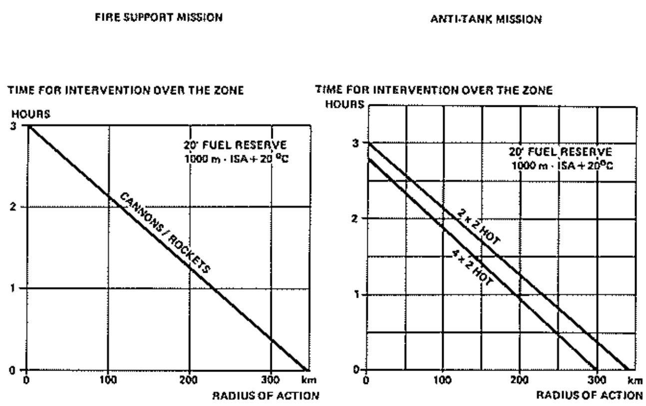


Fig. 13 : PANTHER COMBAT ENDURANCE

Owing to its qualities (low engine fuel consumption, low aerodynamic drag), the PANTHER can operate in an area located at 100 km from its base and be flown for two hours in a combat nap-of-the-earth configuration, with a fuel safety margin of 20 minutes.

2.2 – SECONDARY MISSIONS

In addition to the above mentioned primary missions, the PANTHER can be flown in most of the missions accessible to the helicopters of its category, especially :

*SAR (search and rescue) and casualty evacuation missions
Using the specific optional equipment developed for the whole DAUPHIN family (hoist, searchlight, 4-litter system...).

*External load transport
Using a sling with a 1600 kg capacity and external rear view mirrors.

*Training/Ferry/Liaison flights
Using transport layouts (passengers comfort seat, VIP de-luxe layout).

*Scouting/Reconnaissance
For this type of mission, it should be noted that the VIVIANE sight can efficiently be used as a powerful observation, detection and identification means both by day and night.

Moreover, thanks to the numerous possible cabin arrangements and access doors configuration, the PANTHER can be equipped, on request, with a side-mounted weapon system including either machine-guns or a cannon.

Figure 13a illustrates the installation of an MG151 20 mm cannon mounted on LH side, supplied by 2 containers with 250 projectiles each, allowing weapon travels of 5° upwards and 30° downwards in elevation, and 55° forward and 22.5° backwards in azimuth.

Lastly, the lateral multi-purpose supporting arms can be equipped, on request, with other axial weapons either existing or being developed (machine-guns pod, machine-guns/rockets mixed pod, cannon/rockets).

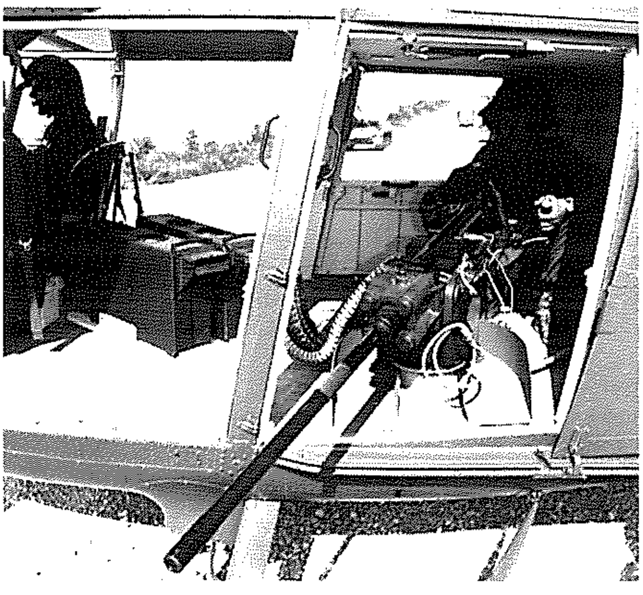


Fig. 13a : MG151 20 mm SIDE-MOUNTED CANNON

3 – A HELICOPTER ADAPTED TO THESE MILITARY MISSIONS

3.1 HELICOPTER TECHNICAL DESIGN

Issued from the DAUPHIN family, the PANTHER is characterized by the special effort made for a good adaptation to the military use. (Fig. 14).

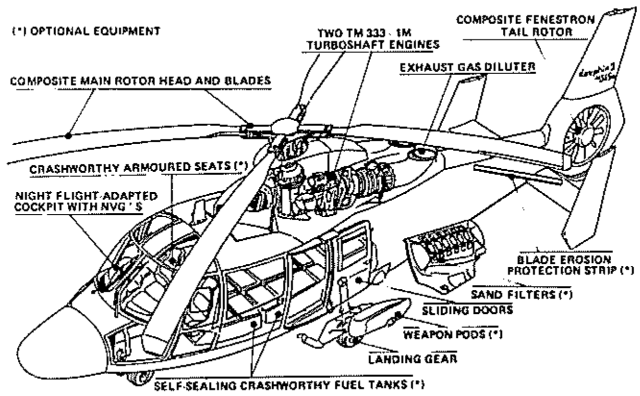


Fig. 14 : TECHNICAL DESIGN

3.1.1 – The airframe is directly derived from that of the SA 365F navy version with several additional capabilities :

- self-sealing crashworthy fuel tank
- strong points for weapon pods
- mounts for the various sights
- lateral plain footsteps for commandos
- armoured/crashworthy crew seats.

3.1.2 – The main rotor is the 11.33 m diameter four-bladed rotor from the DAUPHIN family ; it is of an advanced technology (composite blades, STARFLEX rotor hub, swept-back blade tip caps).

This rotor proves well adapted to combat :

- firing tests have shown its low vulnerability
- its 5 % relative flapping excentricity is a good compromise between rigid rotors which often cause vibrations and instability and conventional hinged rotors which are sometimes reproached for poor maneuverability and controllability.

3.1.3 – The tail rotor offers all the advantages specific to the Fenestron concept in terms of flight safety at low altitude.

The PANTHER is equipped with the upgraded Fenestron (1.1 m diameter) developed for the SA 366 G1 U.S. COAST GUARD and featuring good performance in 35 kt lateral wind.

3.1.4 – The powerplant is made up of 2 TURBOMECA TM 333 1M turboshaft engines featuring full authority digital electronic fuel governing.

This engine (631 kW takeoff power, 565 kW continuous power) provides the aircraft with the extra power required for combat N.O.E. flight and operation in harsh weather conditions (high altitude, high temperature).

The modular design of this engine facilitates the maintenance operations (fig. 15) :

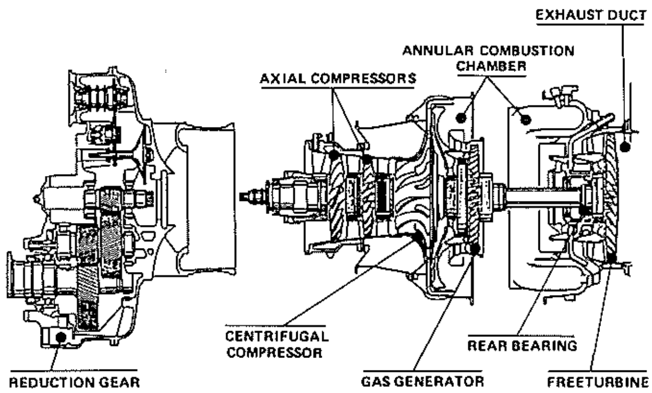


Fig. 15 : TURBOMECA TM 333 - 1M TURBOSHAFT ENGINE

- The forward reduction gear module provides 6000 rpm drive
- The generator module incorporates .

  . 2 axial compressor wheels
  . 1 centrifugal compressor
  . 1 generator turbine wheel

The distribution blades upstream of the first compressor wheel are mobile in incidence, which allows optimum adaptation of the compressor whichever is the generator rpm.

- The freeturbine rear module incorporates .

  . centre shaft coaxial with generator
  annular combustion chamber
  . freeturbine

- The govêrnor electronic calculator receives information from the various sensors and generates commands on :

  . fuel metering unit
  . inlet guide vane incidence position
  . total cut-off in case of an overspeed.

Figure 15a is a simplified functional diagram of this fuel governing system. In particular, the fuel metering unit control with full authority is a duplex fully digital control. The control of the compressor inlet guide vanes is also a digital control, but incorporates an analog redundancy.

In addition to the obvious engine governing functions, the system ensures other function, summed up hereafter :

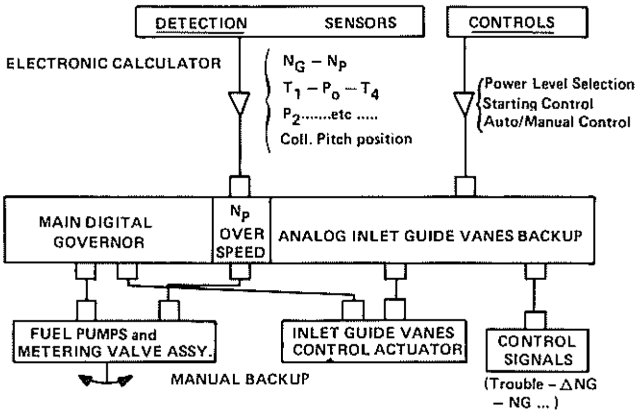


Fig. 15a : TM 333 - ENGINE FUEL CONTROL SYSTEM

– OUTPUT SHAFT CONSTANT SPEED

– TURBINE INLET TEMPERATURE PROTECTION

  . Limitation of $N_G = f\ (t_1)$

  . Max. Contingency Pwer - Intermediate Contingency Power - Max. Training Power

– ENGINE SURGE PROTECTION

  . Acceleration control
  . Inlet Guide Vanes control

– ENGINE FLAME-OUT PROTECTION : deceleration control

– TRANSIENT ANTICIPATOR

– ENGINE POWER SHARING : proportional N_P governor

– AUTOMATIC STARTING

– GROUND IDLE GOVERNING SYSTEM

– SELF-TEST AND TROUBLE MONITORING AND DISPLAY

– ENGINE MAINTENANCE FOLLOW-UP CALCULATION

– POWER TURBINE OVERSPEED PROTECTION

3.1.5 ENGINE CONTROLS AND MONITORING SPECIAL FEATURES

To implement and monitor a helicopter turbine engine, the crew have to know a certain number of parameters intended to ensure the following functions :

- engine control
- engine operation monitoring
- engine power assurance check

The helicopter control parameters are those used by the crew to maintain the power delivered by the engines within the limits approved for the engine and helicopter.

The monitoring parameters are those allowing any engine malfunctioning to be detected.

The engine power assurance check is intended to ensure that the engines can deliver the power required to achieve the performance laid down in the Flight Manual while staying within the approved limitations.

On the SA 365 M aircraft equipped with TM 333 engines, the powerplant control parameters are torque and N_G. For precise reading and easy control, the N_G as a control parameter is presented as below ;

$$\Delta N_G = N_{G\ \text{Max. Takeoff Power}} - N_G$$

This parameter is set up by the governing system from limit N_G at current maximum takeoff power (as a function of t_0). The current N_G is now a monitoring parameter only.

The other monitoring parameters are T_4, N_p, oil pressure and temperature, fuel pressure, to which alarms are added.

Figures 15b et 15c show the main equipment available to the crew for engine control and monitoring.

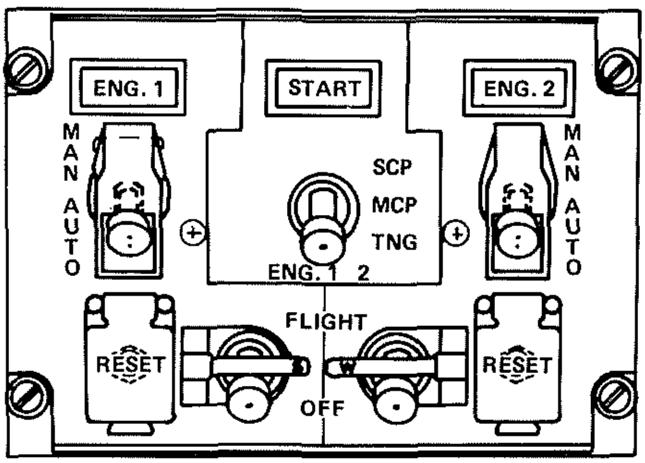
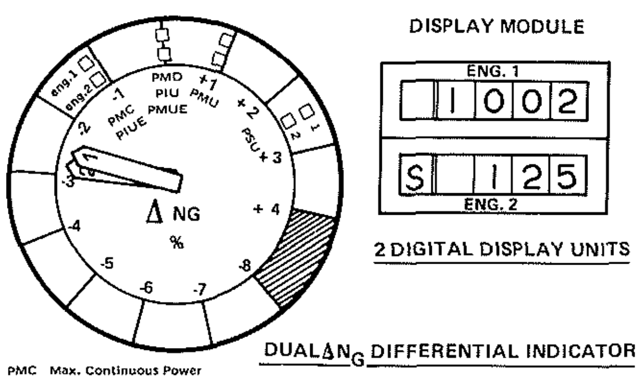


Fig. 15b : ENGINE CONTROLS PANEL ON CONSOLE



PMC Max. Continuous Power
PIUE Training Intermediate Contingency Power
PMD Max. Takeoff Power
PIU Intermediate Contingency Power
PMUE Training Maximum Contingency Power
PMU Max. Contingency Power
PSU Super Contingency Power

Fig. 15c : ENGINE MONITORING EQUIPMENT ON INSTRUMENT PANEL

.The engine controls panel is the major implementation equipment, incorporating a switch (common to both engines) for previous selection of maximum power level in case of failure (Super Contingency/Maximum Contingency/Maximum Training Power) and 2 starting switches (Off/Idle/Flight).

The engine fuel flow control levers mounted on the flight compartment overhead panel are used in emergency only, in case of failure of the fuel governing system ; in normal operation, the crew have not to operate the fuel flow control levers which remain locked in a given fixed position

The dual ΔN_G **differential** indicator which allows, for each engine, displaying the difference in % between the actual N_G gas generator speed and the maximum takeoff power rating (variable due to the electronic fuel control unit, according to the outside air temperature conditions). This ΔN_G parameter is output directly from the electronic fuel control unit.

Furthermore, this indicator incorporates, on an outboard dial ring, indicator litghts showing the maximum power levels selected.

Lastly, two digital display units provided on the instrument panel allow displaying either the actual N_G values (for the Power Assurance Checks, especially) or the fuel control unit failures.

3 1.6 – COCKPIT AND AVIONICS

The drawings of the instrument panel, console and cockpit layouts have been reviewed to provide the best compromise between a good external visibility for N.O.E. flight and arrangement possibilities for avionics and weapon system control and monitoring instruments.

Figure 16 shows an example of cockpit layout for a PANTHER in the fire support configuration using cannon and rockets and incorporating a relatively complete radiocommunication and radio-navigation equipment in addition to the CROUZET NADIR MK1 self-contained navigation system.

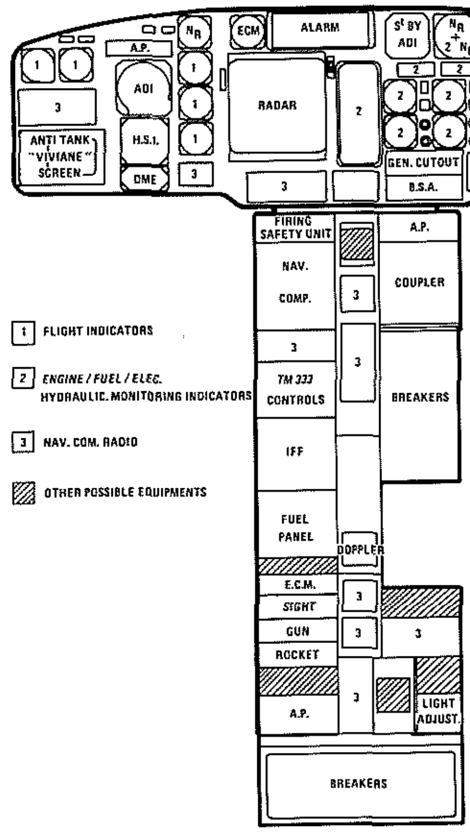


Fig. 16 : INSTRUMENT PANEL AND CONSOLE

This is an example incorporating conventional avionics.

For the future, and for more sophisticated weapons/ systems associations, especially with anti-tank missiles, digital system architectures can perfectly be envisaged on a multiplexed BUS, for instance.

As an example, figures 16a and 16b show a draft of which could be the complete digital system of a Panther equipped for anti-tank/anti-helicopter warfare :

This system includes two sub-systems :

* A basic digital system, integrated, (directly extrapolated from the IFDS system currently being developed by AEROSPATIALE for the future Super-Puma versions) provides the primary references, AFCS/Coupler, display (on 4 multi-function display units - EFIS) functions.

* A Mission Equipment Package system is organized on a BUS 1553 : the dialog between both sub-systems is achieved by the BUS monitoring calculators which also ensure the navigation and mission monitoring functions.

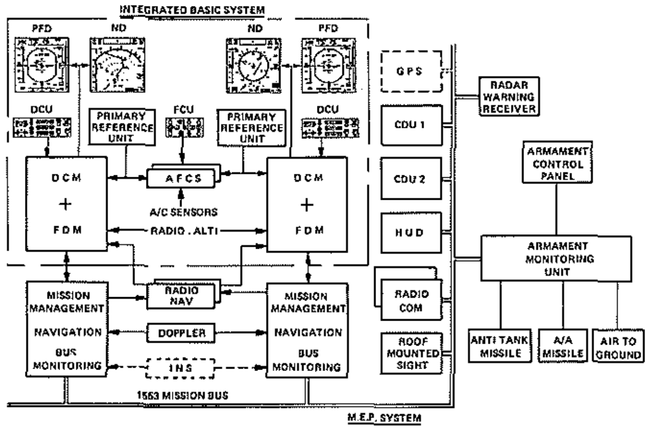


Fig. 16a : EXAMPLE OF DIGITAL SYSTEM FOR AN ANTI-TANK / ANTI-HELICOPTER VERSION

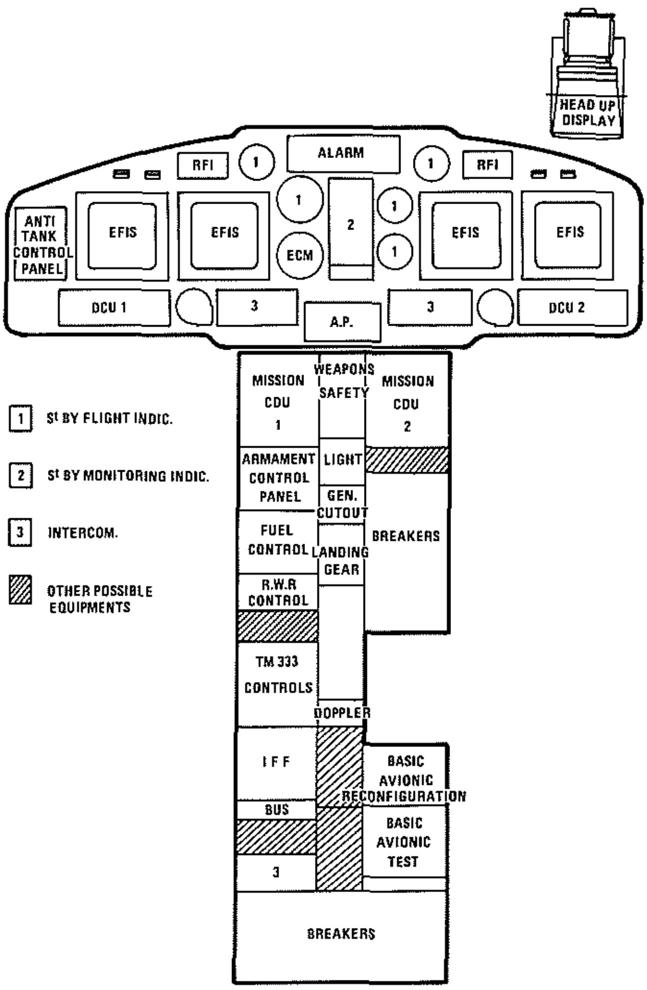


Fig. 16b : EXAMPLE OF INSTRUMENT PANEL INCORPORATING 4 MULTI-FUNCTION DISPLAY UNITS

3.2 – PANTHER OPERATIONAL ABILITY

3.2.1 – THE PANTHER IN ITS ENVIRONMENT

. Weather conditions :

The PANTHER has been designed to be flown in the most stringent weather conditions :

- Temperature : - 40° C, ISA + 35° C (50° C on ground)
- Relative humidity : 20 % to 95 %
- Rain, snow, ice
- Sand (optional equipment : sand filter fitted on engine air intake, with sand extracted by electrically operated fan)
- . Night-time flight

Several items of equipment have been taken into account to fulfil missions even at night. Flying at night being achieved with NVG's, cockpit lighting and especially instrument lighting, all controls markings and all indicator lights had to be especially reviewed : this adaptation consists in providing lighting within a wavelength range near ultra-violet, the NVG light intensification in this range remains limited.

For the same reasons, the exterior lighting was adapted :
- Formation lights
- Variable intensity landing light
- Second optional infra-red landing light.

3.2.2 – THE PANTHER AND THE ENEMY THREAT

3.2.2.1 – . Detectability :

The PANTHER takes advantage of the detectability characteristics of the DAUPHIN family from which it is the last-born helicopter :
- Reduced visual detectability due to the relatively limited size of a 4.1-ton aircraft.
- Low acoustic detectability, especially due to main rotor blade swept tip caps which reduce the aerodynamic vortex intensity and Fenestron tail rotor concept emitting within a relatively high acoustic frequency range for which the atmospheric attenuation is more significant than for a conventional tail rotor.
- Low radar detectability due to shear effect and extensive use of dielectric composite materials.
- Infra-red detectability. Considering the ever increasing number of threats, and infra-red air-to-air missiles, a special effort has been made for the PANTHER : on those aircraft equipped with turbojet engines or turboshaft engines the exhaust gas is a very powerful I.R. 'light' due to high exhaust temperature.

To reduce the hot metal plus plume signature, the PANTHER has been equipped with an exhaust gaz diluter (Fig. 17) evaporating hot gases by Venturi effect with cool air sucked from outside. This diluter has been optimized to provide 100 % efficiency in the hover where infra-red radiation measurements have demonstrated that the exhaust gases radiation level was identical to that of other helicopter elements.

Counter-measures : To reduce detectability ever further, PANTHER can be equipped, as an option, with most up-to-date counter-measure equipment items and, in particular :

- A radar warning detector informing the crew that the helicopter has been detected by a hostile radar.

- A chaff dispenser diverting I.R. self-guided or electromagnetic missiles.

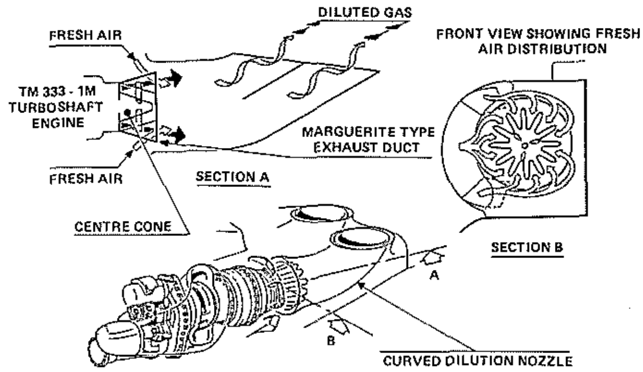


Fig. 17 : EXHAUST GAS DILUTER

3.2.2.2 – . Vulnerability

A special effort has been made to reduce the aircraft vulnerability :

- An optional pilot and copilot armoured seat is proposed
- Armouring options can be envisaged for certain vital parts such as rotor hydraulic servo-actuators, engine governing computers, etc.
- Optional self-sealing fuel tanks designed to withstand ballistics damage.

These devices are added to the basic aircraft characteristics.

- Extensive use of composite materials, especially for both rotors
- Dual main gearbox lubrication system
- Dual flight control hydraulic system
- Dual engine fire extinguishing system
- Dual pilot + copilot controls
- Two engines, etc.

3.2.2.3 – . Survivability

Like the rest of the DAUPHIN family, the PANTHER offers good survivability characteristics. The advantage provided by the Fenestron should be emphasized since its shroud quite perfectly protects the tail rotor blades. Besides the protection provided to the ground personnel who has to work around the aircraft for rearming and refuelling services in the battlefield hurry, the Fenestron ensures safety when flying nap-of-the-earth and in particular when the aircraft is hovering behind leafy cover to scout the enemy tanks.

Moreover, the aircraft can be equipped with optional equipment designed to improve survivability :
- cable cutter (power wires or ropeways strike protection system)
- crashworthy fuel tanks and systems to prevent fuel spillage in case of crash thus limiting the fire hazards
- crashworthy seats designed to restrain the vertical accelerations to be withstood by the pilot and copilot to a survivable level, in case of crash.

3.2.3 — MANEUVERABILITY AND PERFORMANCE

3.2.3.1 — . Maneuverability

The PANTHER benefits from the DAUPHIN's maneuverability and controllability qualities issued from the dynamic and aerodynamic characteristics of its main rotor and the performance of its Fenestron tail rotor.

- In hover, the Fenestron allows withstanding 35 knot cross wind while still retaining a maneuverability margin of about 10 % at the rudder pedals. 90° per second yaw maneuvers and sudden stops can be achieved without any problems of instability for tail rotor blades

- To illustrate the handling qualities in forward flight, it should be reminded that another aircraft from the DAUPHIN family, an SA 365N1 equipped with TURBOMECA ARRIEL 1C1 engines has been evaluated in simulated AIR-to-AIR combat against currently operated specialized attack helicopters ; though this SA 365N1 aircraft did not have the PANTHER's TM 333 engine extra power, it showed a very good behaviour in all simulated combat configurations (In fact, it came off victorious from most engagements !).

Moreover, the PANTHER takes advantage of the 'push-over flight' dealt with for the various fluid systems.

3.2.3.2 — . Performance :

- Flight envelope

Fig. 18

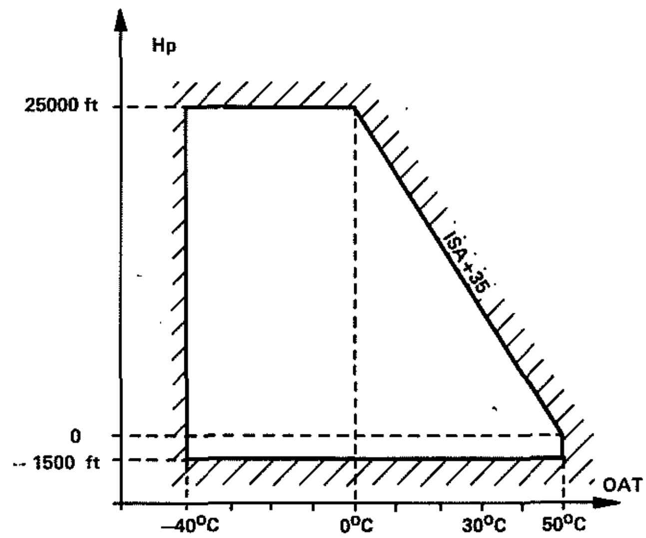


Fig. 18 : PANTHER FLIGHT ENVELOPE

- Performance in hover IGE

Figure 19 especially shows that the PANTHER can take off its maximum gross weight (4100 kg) up to an altitude of 3000 m ISA approximately.

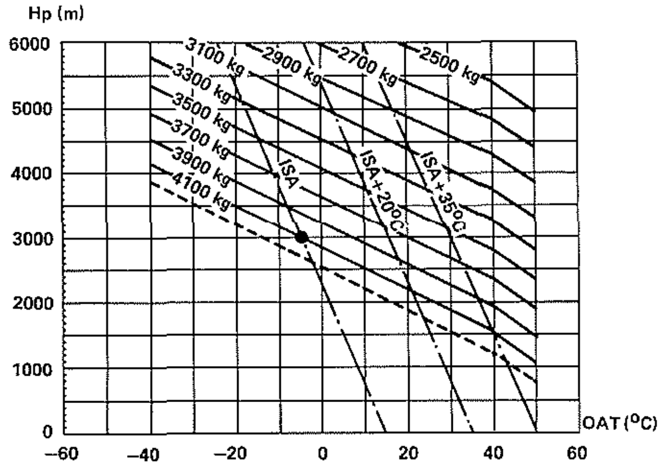


Fig. 19 : HOVER I.G.E.

- Performance in hover OGE

Figure 20 - the maximum gross weight ISA (4100 kg) can be held in hover OGE up to an altitude of 2300 m.

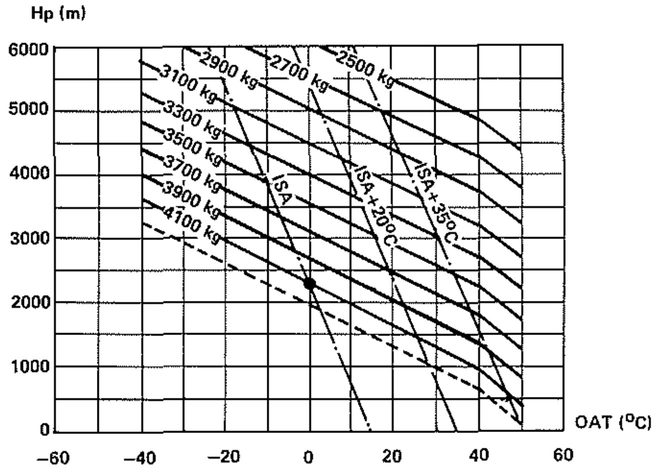


Fig. 20 : HOVER O.G.E.

- Fast cruise speed

Figure 21 shows the PANTHER airspeed performance in commando transport configuration at maximum continuous power (⩾ 280 km/h, at maximum gross weight, up to 1500 m altitude, ISA).

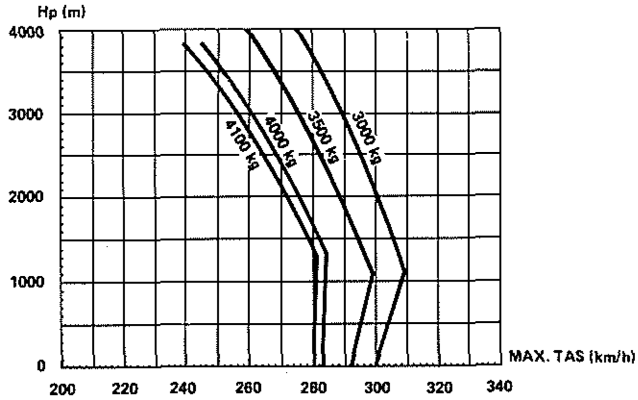


Fig. 21 : MAXIMUM CONTINUOUS SPEED (ISA)

For the armed configuration, the aerodynamic drag due to the weapons, armament supporting arms and sighting devices clearly penalizes the speed performance in a non-negligible way. This performance is still very fair, as shown in figure 22 which gives the maximum speed at Maximum Continuous Power (ISA) for a Panther in the Fire Control configuration with two cannon pods : a speed of 260 km/h approximately can be maintained, at the maximum gross weight of 4100 kg, up to an altitude of 1400 m.

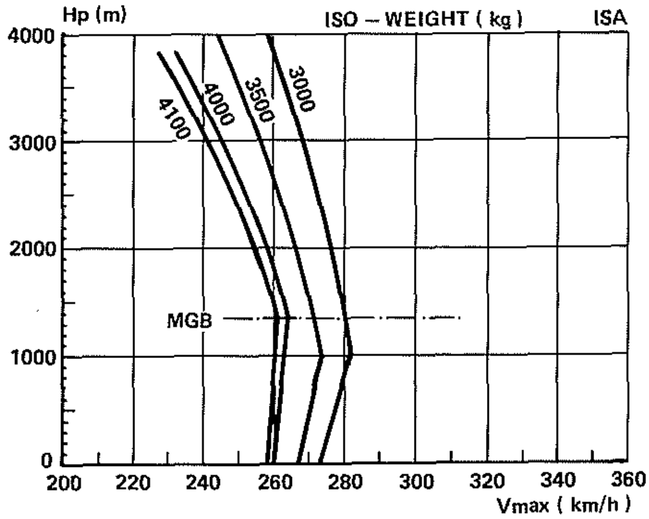


Fig. 22 : MAXIMUM CONTINUOUS SPEED (ISA) IN ARMED CONFIGURATION (TWO 20 mm CANNON PODS)

4 – CONCLUSION

There is undoubtedly a lot to say, especially on mission reliability, implementation readiness and availability but, we have preferred to lay stress on the PANTHER's specific features.

Although it is extrapolated from the DAUPHIN family, the PANTHER is not, as some may believe, a civil aircraft painted khaki. Though the overall architecture and original concepts are retained, a great number of systems and components had to be redesigned and upgraded to provide the operational ability specific to an actual combat helicopter.

Its relatively low maximum mission gross weight and reduced size make it a very maneuverable and little detectable helicopter. Its weight carrying capacity and volume allow it to fulfil transport missions (10 commandos) or armed missions (cannons, rockets, missiles) with a significant endurance (over 2.5 flying hours in the most unfavourable cases).

Its handling qualities, its stability as a firing platform and its performance have often been demonstrated during firing test campaigns and operational evaluation against other combat helicopters.

The PANTHER should then successfully enter the military multi-mission helicopter market.