SEVENTH EUROPEAN ROTORCRAFT
AND POWERED LIFT AIRCRAFT FORUM

Paper No. 29

A LIGHT HELICOPTER FOR NIGHT FIRING

J.F. CANDAU

S.N.I.A.S. HELICOPTERS - LA COURNEUVE FRANCE

September 8 - 11, 1981

Garmisch-Partenkirchen

Federal Republic of Germany

Deutsche Gesellschaft für Luft- und Raumfahrt e. V.

Goethestr. 10, D-5000 Köln 51, F.R.G.

A LIGHT COMBAT HELICOPTER FOR NIGHT FIRING

J.F. CANDAU

S.N.I.A.S. HELICOPTERS
LA COURNEUVE FRANCE

oOo

The Dauphin night firing armament system extends anti-tank action to cover night combat.

The complete armament system is comprised of the following sub-assemblies :

- a carrier = The SA 365 M Dauphin
- a weapon = The HOT missile
- day time and night time avionics and optronics.

The SA 365 M Dauphin has a multipurpose airframe, is manœuvrable, controllable and highly survivable.

The 4 kilometer range HOT missile is currently the most efficient of the anti-tank missiles.

The night time anti-tank warfare mission covers the aspects of :

- Piloting
- Navigation
- Target seeking
- Firing.

Piloting

The equipment consists of individual, self-contained, light-weight, bifocal microchannel binoculars.

To reduce the pilot's work load, an autopilot provides automatic hover hold.

Navigation

A self-contained navigation system enables the helicopter to be navigated at night independently of any ground means.

Target seeking and firing

Search of the objective and firing is by use of a passive system of thermal imagery (VENUS system).

The thermal camera (target seeking) and the localizor (firing) are in a gyrostabilized platform located in the nose of the helicopter.

The development of the night firing on Dauphin started in 1977, the first night firing trials took place in 1980 and the complete weapon system will be available in 1983.

A light combat helicopter for night firing

The lessons drawn from recent conflicts and modern armies' equipment show that assault tanks constitute the most important of threats when it comes to land engagements.

Numerous means are available for the fight against tanks, but the most efficient of these is the helicopter/guided missile system.

Missiles, following a first generation of guided versions (AS 11, AS 12), have evolved towards a so-called second generation family. This second generation stands out on account of an increased range, but more particularly for an automatic remote-control system much easier to use (HOT).

The third generation of missiles will essentially be characterized by improved guiding, which will become self-contained after target designation on the point of firing (fire-and-forget missiles). This future generation will appear in service in the late 1980s.

Awaiting this development, the defence against tanks must be improved by increasing the operational envelope of current systems.

The use of an anti-tank missile on a helicopter makes it possible, for example, to :

- parry a tank attack hastily in an area where the defence is lacking or access is tricky,
- check a tank thrust to enable a suitable defence to be set up.

The Gazelle/HOT or Dauphin/HOT armament systems such as they exist today enable these goals to be achieved in day-time.

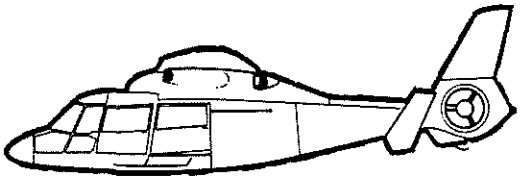
The L C H (Light Combat Helicopter) armament system extends anti-tank action to cover night combat.

Armament system definition

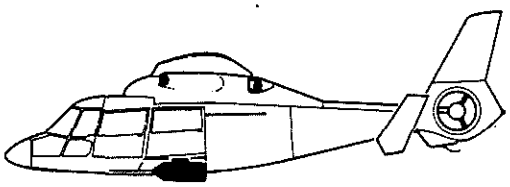
The L.C.H. armament system is comprised of the following sub-assemblies :

■ A CARRIER

The SA 365 M Dauphin 2

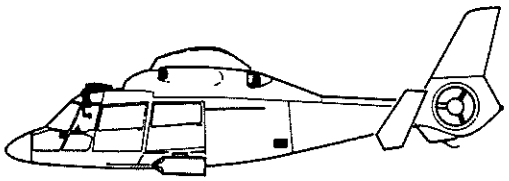


■ A WEAPON



The HOT second generation missile.

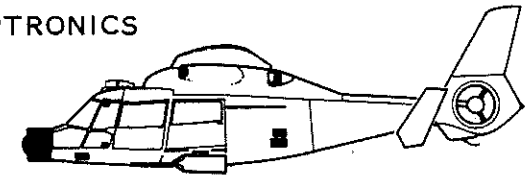
■ DAY-TIME AVIONICS AND OPTRONICS



The APX M 397 aiming sight with the corresponding optronics.

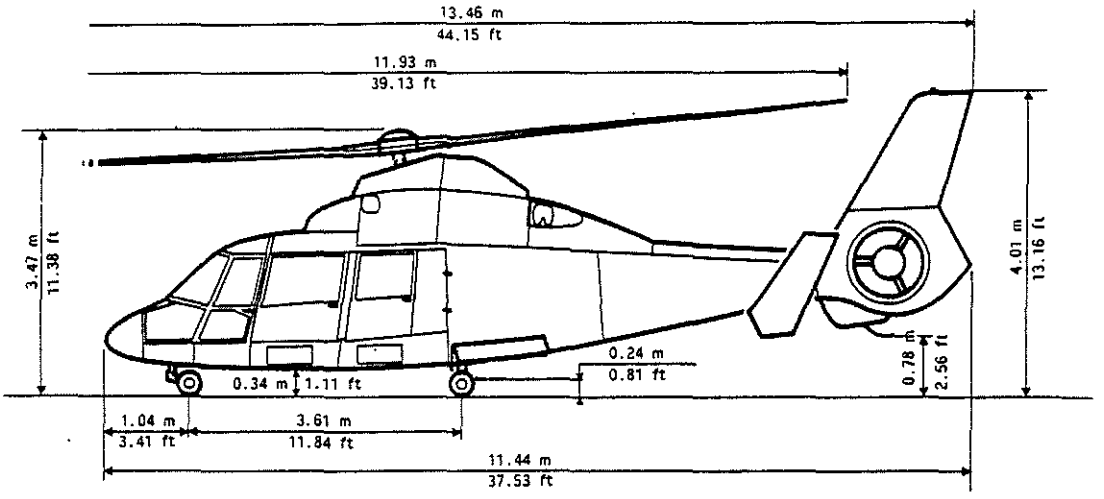
■ NIGHT-TIME AVIONICS AND OPTRONICS

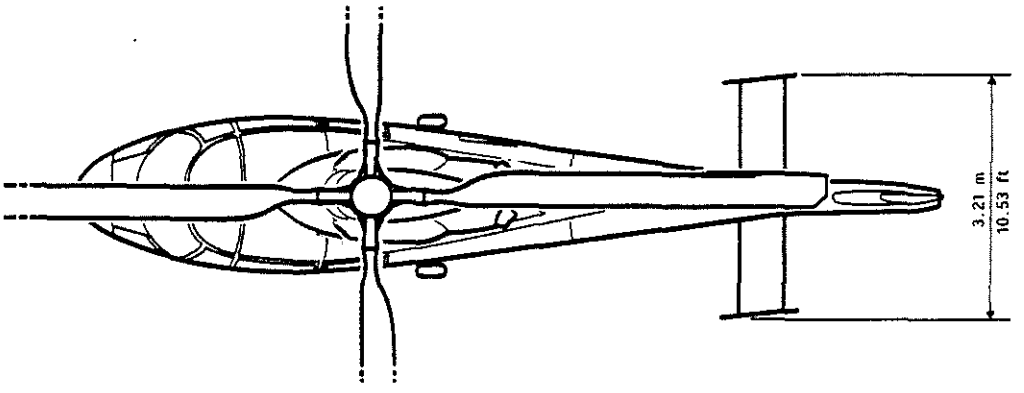
The V.E.N.U.S. system.

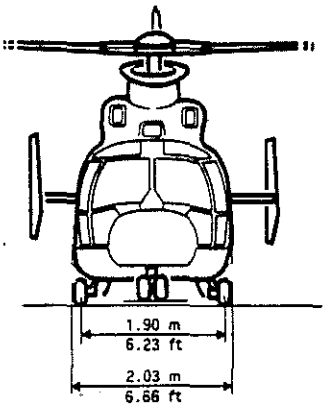


The SA 365 M Dauphin 2 LCH system carrier

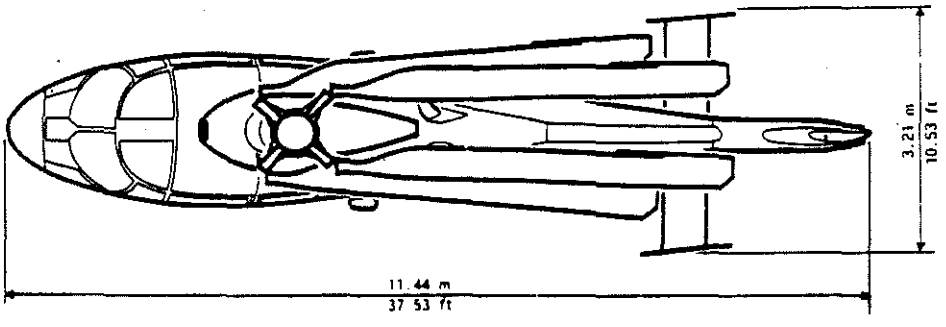
MAIN DIMENSIONS







DIMENSIONS WITH BLADES FOLDED



The SA 365 M Dauphin 2 military helicopter with a multi-role calling

A MULTI-PURPOSE AIRFRAME

The SA 365 M Dauphin 2's airframe was designed for all types of both armed and transport missions :

- anti-tank
- fire-support
- anti-guerilla
- assault transport
- rescue and casualty evacuation
- logistic transport.

PERFORMANCE SUITED TO NOE FLIGHT

■ Manoeuvrability :

the new ARRIEL 1C engine provides the SA 365 M with the necessary power reserve thereby bestowing the manoeuvrability essential in NOE flight on the L C H.

■ Controllability :

the STARFLEX rotor, the best compromise between a rigid rotor and an articulated one, contributes to the Dauphin's remarkable controllability.

■ Flight safety :

the FENESTRON and the tail wheel allow steep tail-down manoeuvres close to the ground.

ENHANCED SURVIVABILITY

■ Low detectability :

- optical : small fuselage dimensions, anti-reflective treatment of glazed areas
- acoustic : quiet air-intake, 4-bladed rotor, fenestron
- electromagnetic : wide use of composite materials
- infra-red : low reflectance paint treatment, jet exhaust deviation, engine IR emission reducing cowlings.

■ Reduced vulnerability :

3rd generation (OA2 profile) composite material blades with an extremely high mechanical resistance (impacts) and infinite service life .

armour-plating (2 front seats, fuel pump base plate, auxiliary servo-units)

self-sealing fuel tanks (immune to 12.7 mm impacts).

■ Improved safety :

the Fenestron, with a very good tolerance to impacts, fulfils the anti-torque function in the event of the tail-rotor's failing

a passive counter-measure system, of the LF omnidirectional type, giving a sectorial indication of any radar threat (on the ground, airborne or ship-based).

*

MAIN CHARACTERISTICS		PERFORMANCE at maximum gross-weight	
10/14 seater		VNE	315 km/hr
Max. gross weight	3,900 kg	Fast cruise speed	275 km/hr
Empty weight	1,940 kg	Economical cruise speed	230 km/hr
Engine oil	12 kg	Rate of climb in oblique flight	6.5 m/sec.
Useful load	1,948 kg		
Turboméca ARRIEL 1C turbine engine, take-off power	710 ch	Range (with std tanks)	855 km
		Endurance " "	4 hrs 15 min.
Continuous max. power	594 ch	Hover ceiling OGE, ISA	1,700 m
Fuel capacity 1,140 litres (900 kg)		Hover ceiling OGE, ISA + 20°C	800 m

*

Night-time anti-tank warfare mission

For this type of mission to reach a successful conclusion, equipment resolving the problems connected with flying the helicopter and operating the armament system just has to be combined with the day-time firing system.

FLYING THE HELICOPTER AT NIGHT

This covers the aspects of piloting and navigation.

- Piloting ,

  three operations are linked to this function :

  - aircraft stabilization
  - in flight parameter check
  - route following

- Navigation ,

  this includes :

  - **knowledge of the current position**
  - **definition of the route to be followed.**

ARMAMENT OPERATION AT NIGHT

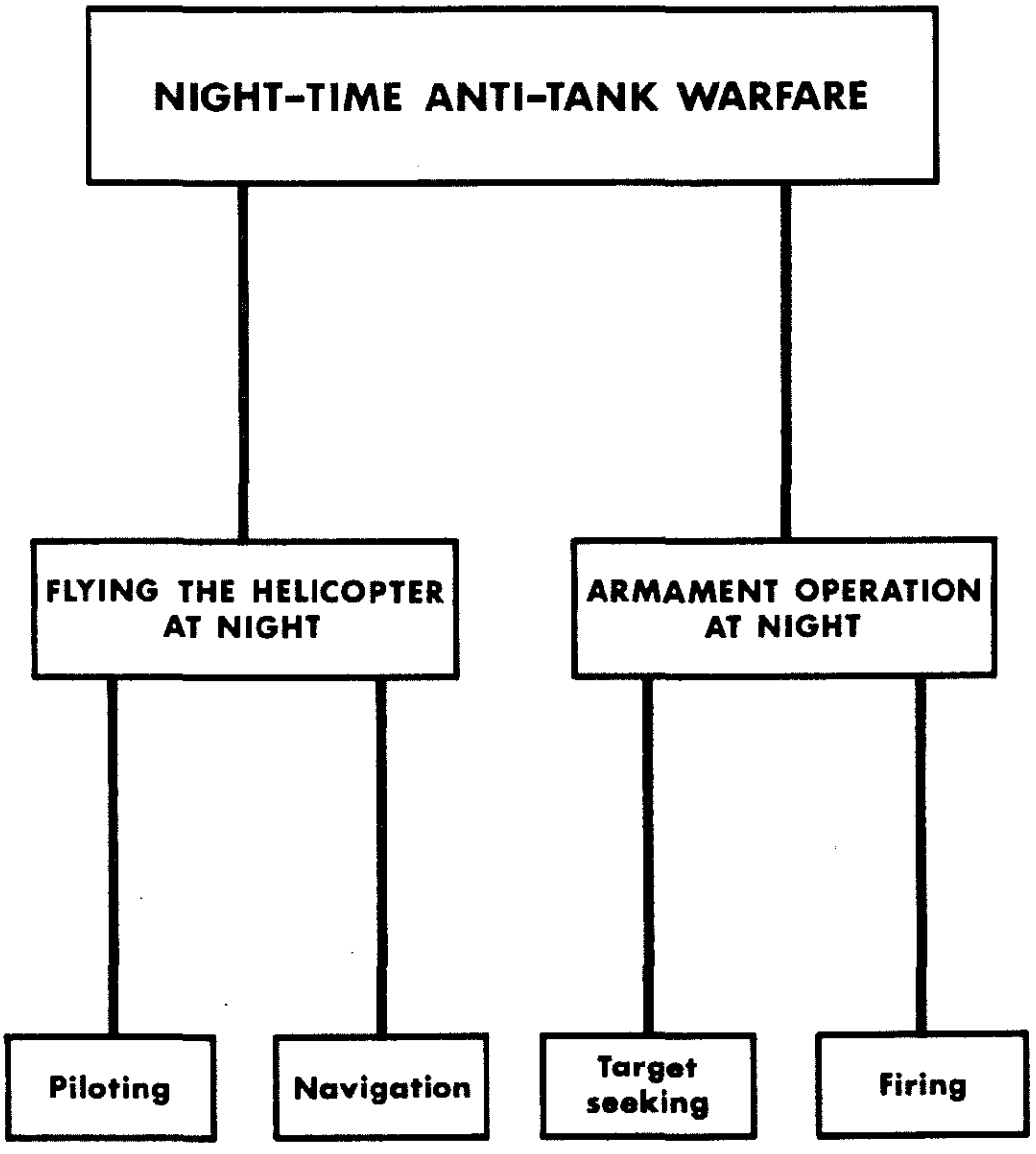
There are 2 essential phases when it comes to operating the weapon system

- target seeking which entails :

  - terrain observation
  - target detection
  - target acquisition

- actual firing which calls for :

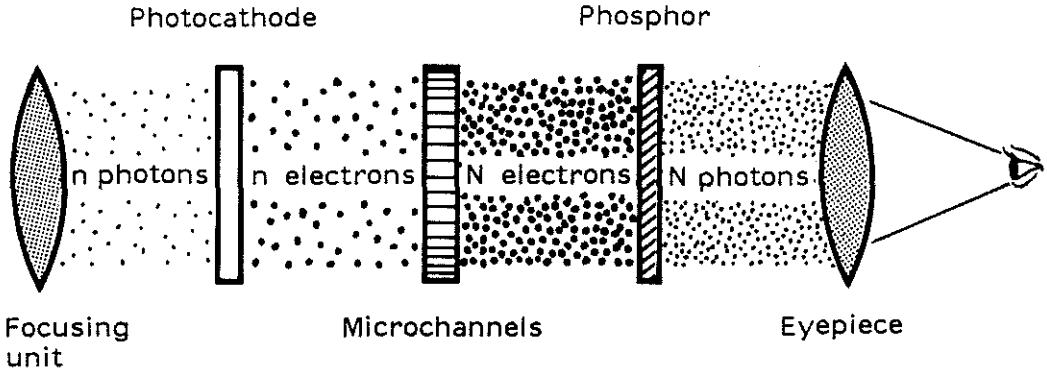
  - holding the line of sight
  - guiding the missile along the line of sight.


NIGHT-TIME ANTI-TANK WARFARE
FLYING THE HELICOPTER AT NIGHT
ARMAMENT OPERATION AT NIGHT
Piloting
Navigation
Target seeking
Firing

PRINCIPLE SELECTED

Visual-flight by view of the outside world coupled to conventional instrumentation

The outside surroundings are viewed via a nocturnal vision device operating on the light intensification principle.



Light intensification principle :

- a photocathode transforms photons into electrons
- a microchannel disc multiplies the electrons (secondary emission)
- an image is displayed by the electron flux on a phosphor screen
- an eyepiece enables the image formed to be seen.

✱

FLYING AID

- So as to reduce the pilot's workload, the conventional instrumentation is backed up by an autopilot providing 3-axis dynamic stabilization and hold of the flight attitude and heading references.
- The automatic hold of hover can be achieved by coupling between the autopilot and a Doppler-effect speedometer.
- Coupling with a radio-altimeter permits the automatic hold of the altitude.
- The coupler finally holds the heading on the line of fire, the information necessary to this function being supplied by the aiming sight.

Night-navigation

The self-contained navigation system intended for the L.C.H. must enable the helicopter to be navigated at night independently of any ground means.

This system provides :

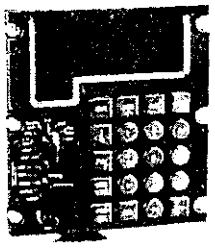
the current position

the route to be followed to head towards the objective.

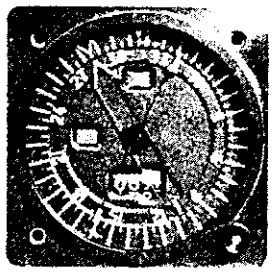
SYSTEM BREAKDOWN

The Nadir-Crouzet self-contained navigation system includes :

- one fixed aerial Doppler radar delivering the ground-speed components with respect to the helicopter.
- one compensated airspeed indicator giving the true speed.
- one magnetic heading reference made up of a magnetic detector and a gyroscope.
- one vertical reference necessary for correctly employing the Doppler speed information in turbulent flight and for calculating the magnetometric heading.
- one digital computer which :
  - performs the navigation calculations
  - maintains the current position in terms of the data introduced by the crew
  - displays the parameters on the front panel regarding localization and guiding towards the objective
  - delivers information to the peripheral indicators.
- two polar indicators which make it possible to display on-destination guiding and piloting parameters.



Digital computer



Polar indicators

PRINCIPLE OPTED FOR

Search for the objective and firing by use of a passive system of thermal imagery.

DESIGN : the VENUS system

A thermal camera operating on the principle described above makes it possible to reproduce the image of the landscape.

CHARACTERISTICS

camera weight	: 25 kg
large field	: 5.50° x 11.40°
small field	: 1.35° x 2.70°

PERFORMANCE

detection of a tank upto 4,000 m

identification upto at least 2,000 m

In order to be able to obtain a good quality image (vibration-free) and to orientate the view-finding system independently of the helicopter's movements, the system must be very accurately stabilized (30 µrd). This stabilization is achieved by placing the thermal camera on a gyrostabilized and swivellable platform.

Movement of the platform is controlled by the day system's remote-control stick. The stabilized mirror of the APX M 397 aiming sight then works by following the position of the night platform.

The image given by the thermal camera, reproduced on a miniature cathode ray tube, is presented to the firer in the eyepiece of the day aiming sight.

* This term covers all the items of equipment that have to be added to the day firing system to form the night one.

This system thus allows :

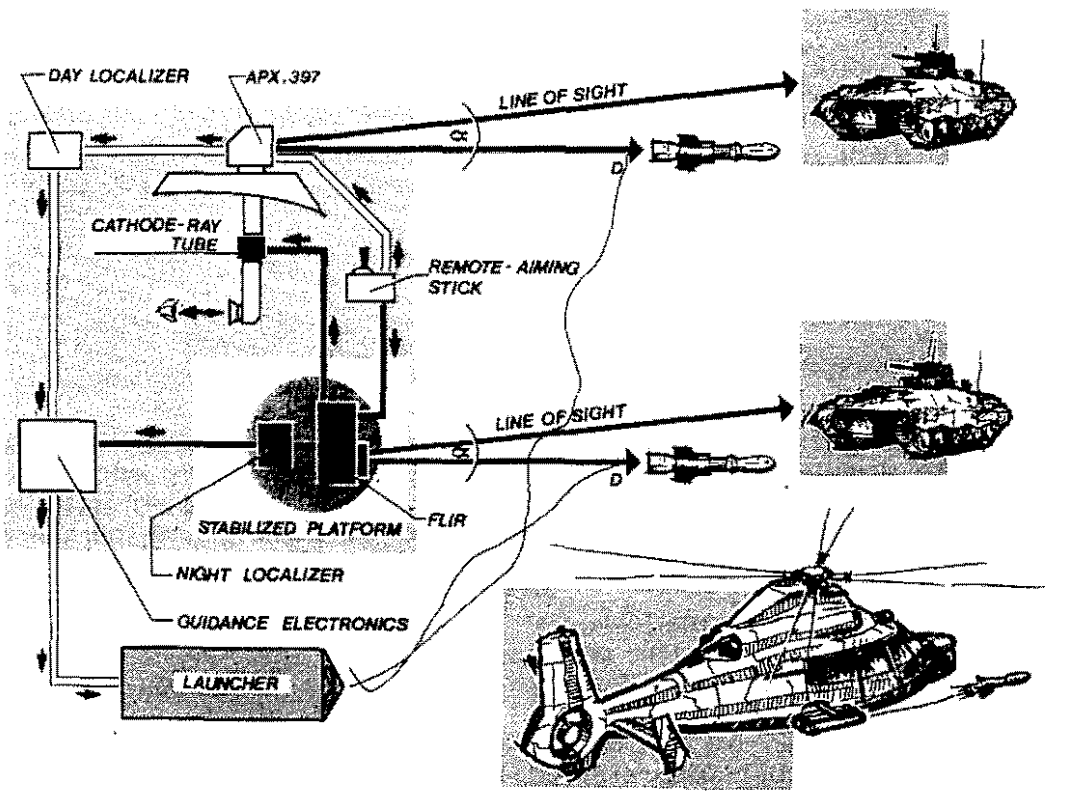
- observation of the surroundings (camera's large field)
- objective detection
- objective acquisition simply by positioning a reticle on its image (camera's small field)

whilst being independent of the level of light outside.

Night firing

MAINTAINING THE LINE OF SIGHT

Training and precise stabilization of the line of sight are ensured by the gyrostabilized platform. Just as for day firing, the copilot/ firer has only to keep the reticle on the target's thermal image.



GUIDING THE MISSILE ALONG THE LINE OF SIGHT

A localizor coupled to and harmonized with the thermal camera is mounted on the gyrostabilized platform. After firing, the missile is picked up and guided in the same way as for day firing.

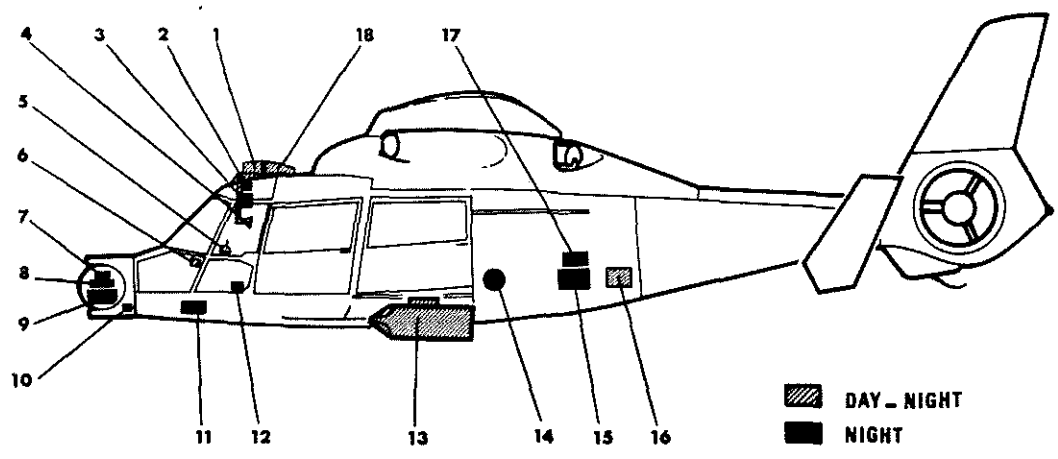
Technical definition

WEIGHT BREAKDOWN	kg
■ Empty weight, standard aircraft (troop seats removed)	1,915
■ Engine oil	12
■ Specific mission	295
• self-sealing & crash resistant fuel tanks • armour plating of crew seats & servo controls • Pilot IFR kit • Copilot IFR kit • 3-axis "duplex" autopilot SFIM PA 155 with hover-altitude hold • Nadir self-contained navigation system	
■ Radio com./nav.	48
■ Night-flying	2
• microchannel binoculars • *cabin modifications*	
■ Night-firing (VENUS)	168
• stabilized platform • thermal camera • localizor • APX M 397 sight modification • hold-mounted cooling system and electronics	
■ Equipped empty weight	2,440
■ Crew of 2	180
■ Operational empty weight	2,620

✸

WEIGHT BREAKDOWN	6 HOT	8 HOT
	kg	kg
• Operational weight, empty	2,620	2,620
• Armament	441	568
• Fuel	839	712
• Take-off weight	3,900	3,900
MISSION TIME with 20 min. fuel reserve	*3 hrs*	*2 hrs 30 min.*

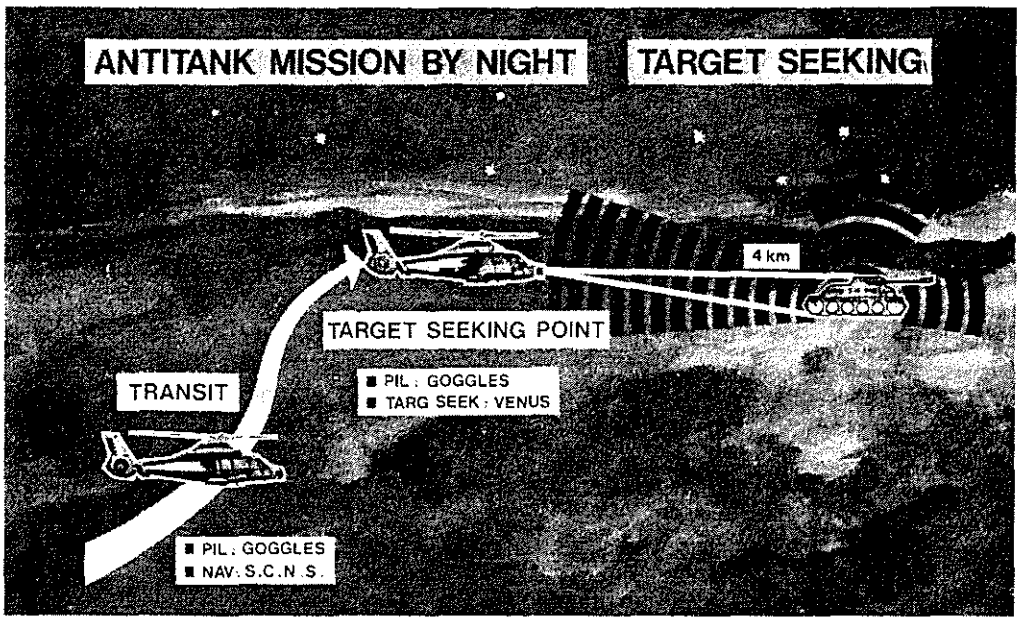
HELICOPTER ADAPTATION

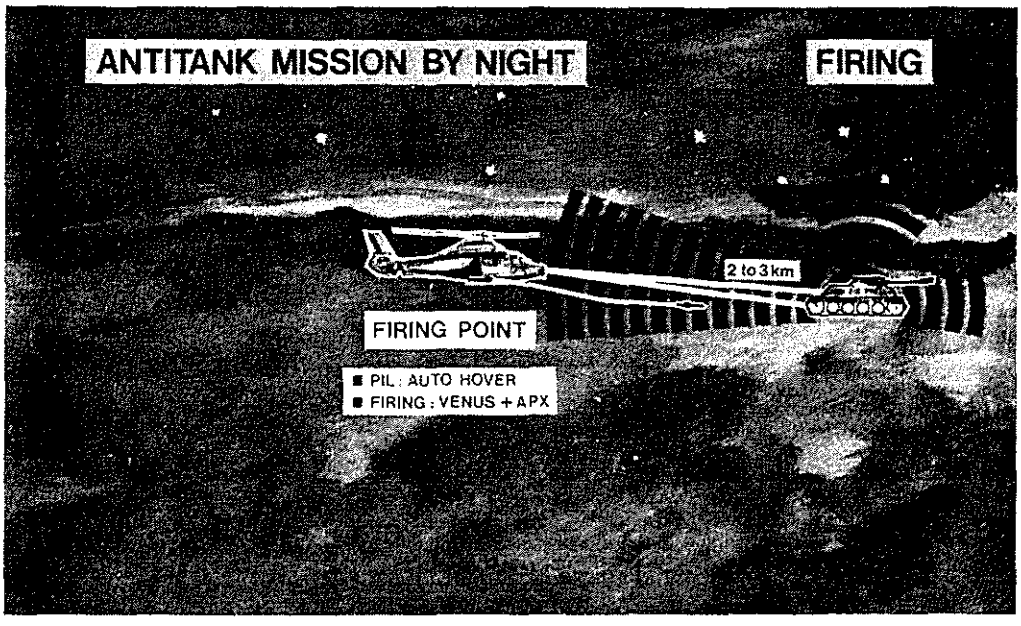


1 APX M 397 aiming sight
2 Day/night control
3 Display tube
4 Sight eyepiece support arm
5 Remote-control stick
6 HOT selection box
7 Harmonization collimator
8 Night IR localizor
9 Thermal camera
10 Localizor electronics
11 Platform supply
12 VENUS control box
13 HOT containers (4 or 3)
14 Detector unit cooling bottle
15 Camera electronics
16 HOT day electronics
17 Aiming system switching and control box
18 Day IR localizor

- The gyrostabilized platform/thermal camera/localizor assembly is located in the nose
- The platform has elevation movement of + 30° and - 20° and azimuth movement of ± 110°
- The electronic gear coupled to the system is installed in the hold
- Detector cooling is achieved by Joule-Thomson liquid nitrogen expansion. A bottled reserved supply is located in the hold and provides a supply for about 3 hours.

Operational use





Crew organization

The crew consists of 2 men both of whom are capable of piloting the machine, one of them being trained in operating the HOT armament system.

The workload is divided between the two crewmen as follows :

- THE PILOT, wearing microchannel binoculars,
  - flys and ensures in-flight safety of the helicopter
  - follows the route
  - takes part in objective observation and detection.

- THE COPILOT, observer and firer,
  - navigates (using the computor)
  - takes part in the in-flight safety of the helicopter

  during the transit phase (wearing microchannel binoculars) and,
  - fulfils the rôle of objective observation, detection and acquisition
  - carries through the missile firing sequence when the weapon is to be fired (by using the aiming sight).

Programme

1978/79 ■ Development of the aiming system

Adaptation of the VENUS system model to the Dauphin

Night-flying aid system trials

Adaptation of the night-flying system to the Dauphin

1980 ■ Night-flying trials

Real night-firing trials

1983 ● Complete weapon system available

*

SA 365 M DAUPHIN 2 LIGHT COMBAT HELICOPTER