THE FIGHTER COLLECTION

Eagle Dynamics

C-101 AVIOJET

for DCS World

AvioDev SIMULATIONS

DCS SERIES

Flight Manual

INDEX

FOREWORD

The commissioning of the CASA C-101 in 1981 coincided with the appearance of the first personal computer, the Intel 8088 powered IBM XT desktop computer. More than three decades have elapsed since then, and technological advances since that time have completely changed the world of aviation, from purely analog systems, to fully integrated digital fly-by-wire flight control systems, EFIS displays, and full mission/flight management computers, that drastically alter the pilot-machine interface, increasing overall complexity, whilst reducing pilot workload and operating costs.

The C-101 was initially designed under requirements of the Air Force to provide an advanced yet simple training platform for the instruction of future fighter pilots. In addition, versions for light attack armed with more powerful engines, 7 hard-points and heads-up display were also designed.

This project seeks to develop an advanced C-101 simulation that takes into account everything that concerns the operation of the aircraft in a military context, allowing the pilot to seamlessly enter the virtual world of military aviation, through the use of cutting-edge simulation software.

For this goal to be achieved, it is required to simulate all associated systems on the aircraft, and the complex, often inter-dependent relationships between them. The instruments have their own unique behaviors and characteristics programmed into the simulation, offering not a mere interpretation of the instrument, but a fully functional virtual counter-part. For example, gyroscopic precession instruments have the associated errors; the variometer has accurate lag behavior due to internal capsule aneroid; and the airspeed indicator responds in real-time to changes in angle-of-attack, as the result of the pilots control inputs, to name a few.

The visual models of both the cockpit and exterior were developed using photographs for both references and textures. Reproduction is faithful to the point that it is difficult to distinguish between photos of the real aircraft, and the simulation.

The final result is an advanced simulation that creates an immersive experience, where pilots are aware that in order to master the simulation, they must apply real-world skills and knowledge of the aircraft systems to accomplish virtual, yet highly realistic training missions, with unprecedented detail.

I hope you enjoy this aircraft, and a new level of flight and combat simulation.

Alejandro,

Military Pilot

INTRODUCTION

1. INTRODUCTION

The CASA C-101 Aviojet is a two seat jet-powered low-wing single engine advanced trainer and light attack aircraft manufactured by the Spanish company Construcciones Aeronáuticas S.A. (CASA). It is used by the Spanish Air Force (Ejército del Aire), where it is nicknamed Mirlo (Blackbird), the Chilean Air Force, the Honduran Air Force (both call it Halcón, Falcon) and the Royal Jordanian Air Force. It is the airplane used by the Patrulla Águila in its aerobatic displays.

Its designation as C-101 follows the designation system used for aircraft designed by CASA, with the initial of the manufacturer C followed by a three-digit number. The first digit means the number of motors, one in this case, and the two following mean the first single-engine designed by the company.

Development

The C-101 "Aviojet" responds to the request of the Spanish Air Force for a training and light attack aircraft to replace the Hispano Aviación HA-200 Saeta, the HA-220 Súper Saeta and the Lockheed T-33. On the 16th of September of 1975, the Spanish Air Force signed a contract with CASA for the design, construction and development of the new jet trainer.

The plane was defined as a subsonic flight basic and advanced trainer, but should be equipped with the most modern equipment on board to facilitate the transition to fighter jets, it should possess good acceleration to get future military pilots accustomed to the performances of more advanced aircraft, it should also be very maneuverable at high and low level, and finally it should withstand load factors between +7.5 and -3.75 G. As if all that were not enough, the Aviojet should be able to land at 100 knots and be able to remain in inverted flight for 20 seconds.

Other characteristics it should fulfill were high visibility in both cockpits, student training hood system for flight without visibility instruction, and a zero height and speed ejection seat.

Another prerequisite was the absence of external fuel tanks. Inner tanks should be explosion-proof. Definitions concerning the landing gear covered different aspects, it should be designed to operate at vertical speeds of 3.4 m/s among other requisites like disc brakes, anti-skid, steering nose wheel and low pressure tires.

The controls should include electrical trim and servo-actuators. Navigational aids should include TACAN and VOR/ILS, and communication systems should include UHF, VHF and IFF-SIF. Moreover, the preliminary definition document insisted on two concepts considered essential: the maintainability and accessibility.

A requirement that was decisive in the design of the aircraft was that it should have the ability to move without additional fuel tanks from the Peninsula to the Canary Islands. Keep in mind that, when work on this airplane started (the first contract was signed as indicated on the 16th of September, 1975), the Western Sahara was still in Spanish hands, and the Aviojet was expected to conduct support missions in that territory, as they were performed at the time by the Hispano Aviación HA-220 Super Saeta which were to be replaced by the Aviojet. In the end, when the plane took off for the first time, Spain had already left the Sahara, so this feature has never come to be used, but still conditioned the whole project hindering it, since for such a large autonomy for an airplane of its size, performance had to be sacrificed by designing a very small swept angle wing, which reduced the consumption, but on the other hand also decreased maximum speed, which was a determining factor for its limited commercial success.

Once specified all preliminary requirements, design works were assigned to Madrid and Seville Office Bureaus. The assistance of the German company Messerschmitt-Bölkow-Blohm (MBB) was likewise required for the design of the rear fuselage structure, as well as the assistance of the American Northrop, which took care of the air intakes and the airfoil, seeking maximum efficiency for both.

The elected jet engine, the turbofan Garrett TFE-731-2 high bypass ratio (2.82:1) benefits from a studied modular construction for easy maintenance, weighs 327 kg and develops a maximum thrust of 1587 kg at sea level. It has also a low specific consumption, estimated at 0.22 kg/h/kg of thrust, and excellent performances under high load factors.

The first wind tunnel test took place at the National Institute for Aerospace Technology (INTA) "Esteban Terrada", fulfilling low speed tests with a 1/7 scale model. Afterwards, the high speed tests were performed in the supersonic tunnel at the Royal Aircraft Establishment at Bedford, England, and the process was completed in Lille, France, where the Aviojet was subjected to spin performance tests using a 1/18 scale mock-up.

After multiple tests of structural rigidity, developed in Getafe, and equipment performance tests, and after the refinements and corrections due to these works, prototype P1 came out of the factory hangar at Getafe. It was registered XE-25-01 and painted with an orange and white scheme. It was on the 28th of May, 1977.

On the 27th of June, four days before the scheduled date, the P1 took off piloted by Colonel De La Cruz Jimenez. The flight was simply trying to test the controls behavior and even, for safety reasons, the landing gear was retracted. It showed that the new aircraft was a very maneuverable machine, to the extent that both 406th Squadron Saeta airplanes who escorted him had difficulties to follow the C-101 during the turns carried out. On the 29th, the Aviojet was officially presented at a ceremony attended by King Juan Carlos I. Right after that, preliminary tests began, totaling 80 flights and 107 hours over which various performances, flight characteristics, systems, etc. were tested.

INTA preliminary reports were delivered to the Air Ministry, and further tests with prototypes P2, P3 and P4, as well as development works and improvements were conducted. To the end of 1978, INTA granted the type-approval, with number 530/78/1.

March the 17th of 1980 marked the official delivery of the first four series aircraft to the Spanish Air Force. The first C-101 entered service on the 4th of April of 1980 in the 793rd Squadron of the Spanish Air Force Academy at San Javier (Murcia).

Variants

C-101EB

This is the version ordered by the Spanish Air Force, where it receives the designation E.25. It is the version that has been manufactured in larger numbers, 88 airplanes built. The Aviojet (officially nicknamed "Mirlo" and unofficially "Culopollo" in Spain) has several roles within the Spanish Air Force, the most famous being flight training in the Basic Flight School. The C-101EB is the release version of the aircraft and therefore the less sophisticated.

Figure 1-1 C-101EB

C-101BB

This is the export version of the C-101EB trainer. It differs from the previous one in the Garrett TFE731-3-1J engine which has some more power (200 pounds) than the EB's Garrett TFE731-2-3J and in the installation of six underwing pylons for loads up to 500 kg, plus a hard point under the fuselage for modular recognition equipment, electronic countermeasures, laser designator, double barrel 12.70 mm machine gun or 30 mm DEFA cannon container. The Chilean Air Force purchased 12 units, 4 from CASA and the other 8 mounted by ENAER. They are locally known as T-36 Falcon. Four other units were sold to the Air Force of Honduras.

Figure 1-2 C-101BB

C-101CC

It first flew on the 16th of November of 1983 and is a light attack optimized version, built under request from the Chilean Air Force. It has the same ability to carry weapons as the C-101BB, but with an increased autonomy, which in this model comfortably exceeds seven hours. In addition, the turbofan Garrett reaches 4700 pounds of thrust. It is known as A-36 Falcon in Chile, where 23 units (one made in Spain, the rest mounted at ENAER in Chile under license) were delivered. The Chilean Air Force studied the possibility of using it as a launching platform for the Sea-Eagle anti-ship missile, for which purpose the C-101 would be fitted with a Ferranti HUD and an inertial guidance system FIN 2000. However, this possibility was canceled when the Chilean Navy bought 8 Eurocopter Cougar helicopters, equipped with AM.39 Exocet anti-ship missiles. Yet the Chilean C-101s have received various modifications of equipment including fire control system and navigation, HUD and possibility of using the Rafael Shafrir 2 air-to-air missile. The C-101CC was also acquired by Jordan, used as trainer and light attack airplane. 16 C-101 serve in the Air College King Hussein at Al-Mafraq Air Base.

Figure 1-3 C-101CC

C-101DD

CASA finally developed an improved version named C-101DD with new avionics, including for example a GEC Marconi radar, a trajectory calculating computer, HOTAS controls, ALR-66 radar warning receiver, a Ferranti HUD, chaff and flares launcher and compatibility with the AGM-65 Maverick missile. That plane flew as a prototype in 1985 and was subsequently presented as a contender for the JPATS contest of the United States Air Force and Navy, but did not receive any order.

Figure 1-4 C-101DD

Users

Chilean Air Force: 35 (12 C-101BB and 23 C-101CC).

Spanish Air Force: 88 C-101EB.

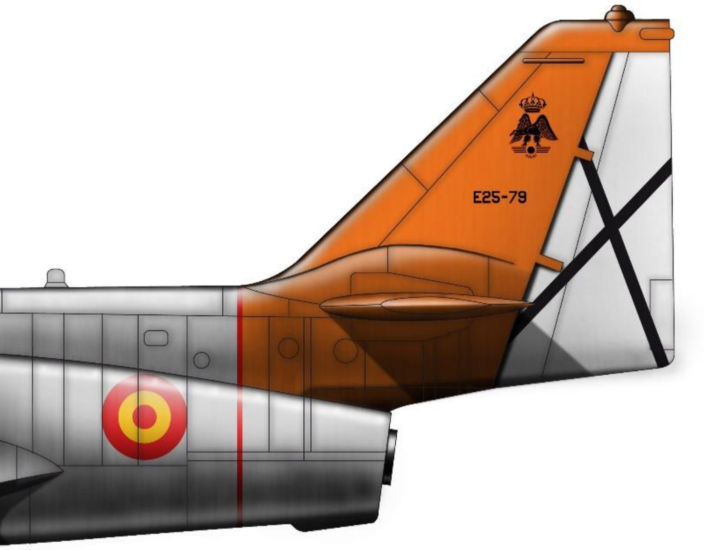
Honduran Air Force: 4 C-101BB. These aircraft scored several kills against drug smuggling aircraft.

Royal Jordanian Air Force: 16 C-101CC.

Patrulla Águila

Figure 1-5 Patrulla Águila in formation

The C-101 is the aircraft used by the Patrulla Águila (Eagle Patrol). Its name was chosen in honor to the Air Force Academy emblem. The first exhibition took part more than 30 years ago, and is inheritor to the tradition of the former Patrulla Ascua. It is formed at part-time by instructors of the Basic Flight School of the Spanish Air Force Academy since, unlike other aerobatic teams, they don't dedicate full-time to it, but must combine their activity on the Patrol with their teaching duties, which makes their achievements even more meritorious. Another factor that increases the merit of the members of the Patrol is the limited performance of the airplane itself, as to perform certain maneuvers that can be performed easily with other airplanes, in the case of the Aviojet they must exploit the possibilities of the airplane practically to the limit. They have conducted hundreds of air shows throughout Europe, Middle East and North America (including the opening ceremony of the 1992 Summer Olympics). Its accuracy and its figures are becoming legendary, and it may be emphasized that it is the only one that makes landings of the seven planes in formation.



AIRCRAFT CHARACTERISTICS

AvioDev SIMULATIONS

2. AIRCRAFT CHARACTERISTICS

The C-101EB is a two seat advanced and basic trainer in tandem configuration, manufactured by Construcciones Aeronáuticas, S.A. (C.A.S.A.). The aircraft is of metal construction, with low wing and positive dihedral, equipped with a retractable tricycle landing gear and powered by a Garrett TFE 731-2-2J single bypass engine. Most controls and instruments are duplicated in the front and rear cockpits, and Solo flight is undertaken from the front cockpit. The cockpit is pressurized and air conditioned, and the rear one has provision for blackout curtains for instrument training flights. Ejection seats provide safe escape at zero airspeed and zero altitude in level flight. The aircraft has one fuselage tank made of flexible material and three integral wing tanks: one center and two outer tanks - the outer tanks are used for ferry flights. Flight controls are mechanical with servo-actuated aileron control. The aileron and horizontal stabilizer trim controls are electrically actuated. Each elevator trailing edge incorporates a fixed trim tab, which is adjusted on the ground. The hydraulic system provides power to the trailing edge flaps, speed brake, wheel brakes and landing gear system. The speed brake is located in the lower center fuselage.

Figure 2-1 shows the aircraft general arrangement.

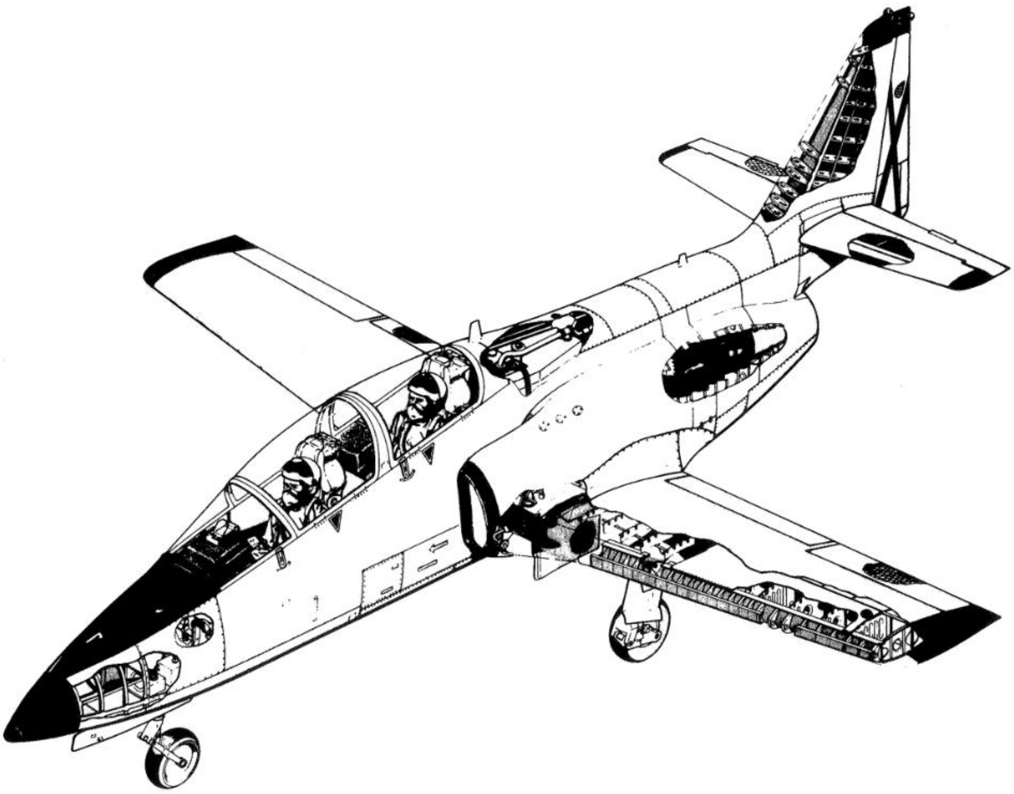


Figure 2-1 C-101 Scheme

2.1. AIRCRAFT DIMENSIONS

The overall dimensions of the basic aircraft with normal tire and strut inflation and center wing and fuselage tanks with normal fuel loading, are:

- Basic Dimensions
- Length..12.245 m......(40.17 ft)
- Wingspan..10.600 m......(34.77 ft)
- Height..4.250 m......(13.94 ft)

2.2. SPECIFICATIONS

- Wing Specifications
- Dihedral...5.00°
- Sweep Angle..4.07°
- Aileron Deflection Limits (Neutral Trim)...-24.0°/+17.0°
- Flap Deflection..10.0° TKOFF/30.0° DOWN
- Wing Area...20.0 m^2
- Flap Area...2.45 m^2
- Aileron Area...1.17 m^2

- Horizontal Stabilizer Specifications
- Dihedral..0°
- Sweep Angle..10.6°
- Elevator Deflection Limit (Neutral Trim)..± 20.0°
- Elevator Trim Limits...-6.5°/+2.0°

- Vertical Stabilizer Specification
- Sweep Angle..46.6°
- Rudder Deflection Limit..±20.0°

- Airbrake
- Deflection Angle Limits...+0.0°/-45.0°

2.3. WEIGHTS

- Operating Empty Weight...3375 kg......(7440 lbs)
- Normal Operating Weight (standard fuel load version).........4844 kg....(10680 lbs)
- Maximum Weight (ferry fuel load version)............................5366 kg....(11830 lbs)

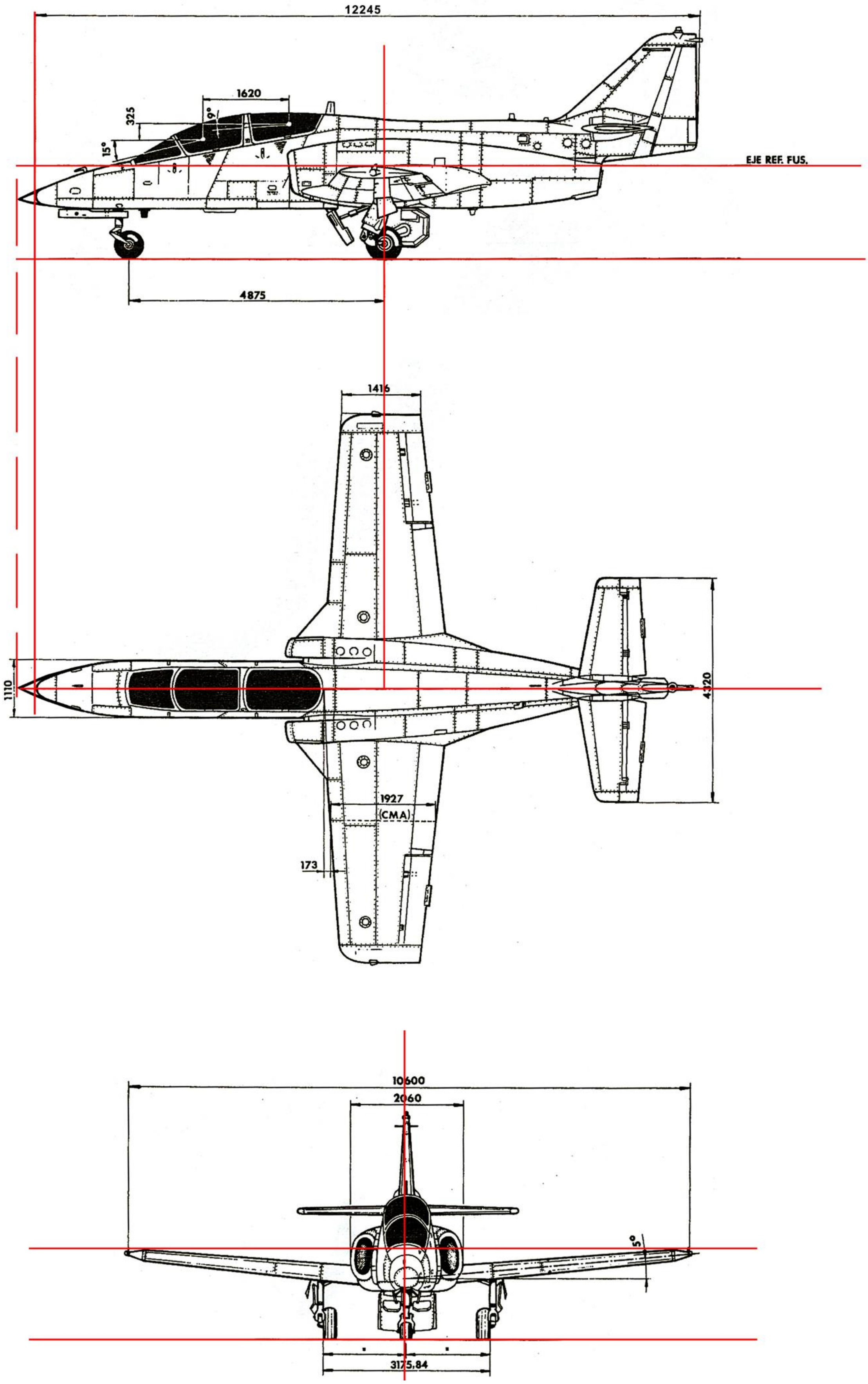


Figure 2-2 Aircraft dimensions

AIRCRAFT SYSTEMS

3. AIRCRAFT SYSTEMS

3.1. FRONT COCKPIT CONTROLS AND INDICATORS

Figure 3-1 Main Instrument Panel

1. Horizontal Situational Indicator (HSI)

2. Attitude Direction Indicator (ADI)

3. Altitude-Encoding Altimeter

4. Vertical Speed Indicator (VSI)

5. Turn and Slip Indicator

6. Clock

7. Hydraulic System Pressure Indicator

8. Radio Magnetic Indicator (RMI)

9. Combined Airspeed/Mach Meter

10. Vertical Accelerometer

11. Low Pressure Turbine (N1) RPM Indicator

12. Inter-Turbine Temperature Indicator (ITT)

13. High Pressure Turbine (N2) RPM Indicator

14. Oil Pressure Indicator

15. Oil Temperature Indicator

16. Fuel Flow/Fuel Used Indicator
17. DC Bus Voltage Indicator
18. Standby Artificial Horizon
19. Flight Director Control Panel
20. Trim Position Indicator
21. UHF Radio Control Panel
22. UHF Radio Frequency Repeater
23. Marker Beacon Indicator
24. UHF Control Transfer Button
25. VHF Control Transfer Button
26. Master Warning Reset
27. Anti-Skid Status/Power Switch
28. Fire Warning Reset/Test
29. Master Caution Reset
30. Flap Position Indicator
31. Airbrake Position Indicator
32. Navigation Control Transfer Button
33. HSI VOR/TCN Source Selector
34. Backup UHF Antenna Selector
35. HSI “Dot/Cross” Sync Control
36. TARSYN ADI Fast Erect
37. TARSYN Mode Selector
38. HSI Brightness Control
39. Air Blower Control
40. Fuel Flow Test
41. Red Panel Light Adjust
42. Red Panel Light Adjust
43. Red Panel Light Adjust

Forward Lower Panel

55. HSI Course Selector
56. HSI Heading Selector
57. IFF Panel
58. Pedal Adjust Control

Figure 3-2 Forward lower panel

Forward Left Panel

59. Gear Position Indicator
60. Gear Lock Override
61. Gear Handle
62. Pitot Heat
63. Stall Warning System Test
64. Stall Warning System Power
65. Anti-Rain System [NOT INSTALLED]
66. Left Taxi/Landing Light
67. Right Taxi/Landing Light
68. Parking Brake Handle
69. Canopy Locking Handle

Figure 3-3 Forward left panel

Forward Right Panel

Figure 3-4 Forward right panel

44. Left Battery Contactor
45. Master Battery Contactor
46. Right Battery Contactor
47. DC Bus Tie
48. Engine Generator Contactor
49. Engine Generator Test Function
50. Essential DC Bus Transfer
51. AC Primary/Secondary Selector
52. Caution/Warning Panel Brightness Selector
53. Caution/Warning Panel Test
54. Caution/Warning Panel

Left Side Panel

Figure 3-5 Left side panel

1. Fuel Panel
2. Engine Control Switches/Anti-Ice and GPU
3. Flap Lever
4. Throttle Lever and Gear Warn Mute
5. Emergency Gear Extension
6. Emergency Flight Control Panel
7. Circuit Breaker Panel

Right Side Panel

Figure 3-6 Right side panel

8. Oxygen System Pressure
9. Cabin Altitude
10. Intentionally Left Blank
11. Illumination Panel
12. VOR Radio Panel
13. TACAN Radio Panel
14. Oxygen Valve
15. Audio Panel
16. VHF Comm Radio Panel
17. Pressurization/Environmental Control Panel

3.2. REAR COCKPIT CONTROLS AND INDICATORS

Figure 3-7 Rear main panel

Figure 3-7.1 Rear right panel

Figure 3-7.2 Rear left panel

Note: See each system description in this manual for differences with front cockpit.

3.3. POWER PLANT

The power plant consists of a Garrett TFE 731-2-2J turbofan engine mounted in the aft fuselage, with air inlet ducts located on each side of the fuselage and converging at the engine air inlet. Equipped with two mechanically independent spools, the low pressure (LP) spool consists of a fan and a four stage axial compressor driven by a three stage axial turbine, while the high pressure (HP) spool consists of a centrifugal compressor driven by an axial turbine, both of which are single stage. The exhaust and fan gases are discharged through independent concentric ducts. It has a bypass ratio of 2.75. The accessory gearbox drives the starter generator and hydraulic pump by means of the HP spool. It provides a static thrust of 3700 lbs at sea level, without taking into account bleed air or accessory drive losses.

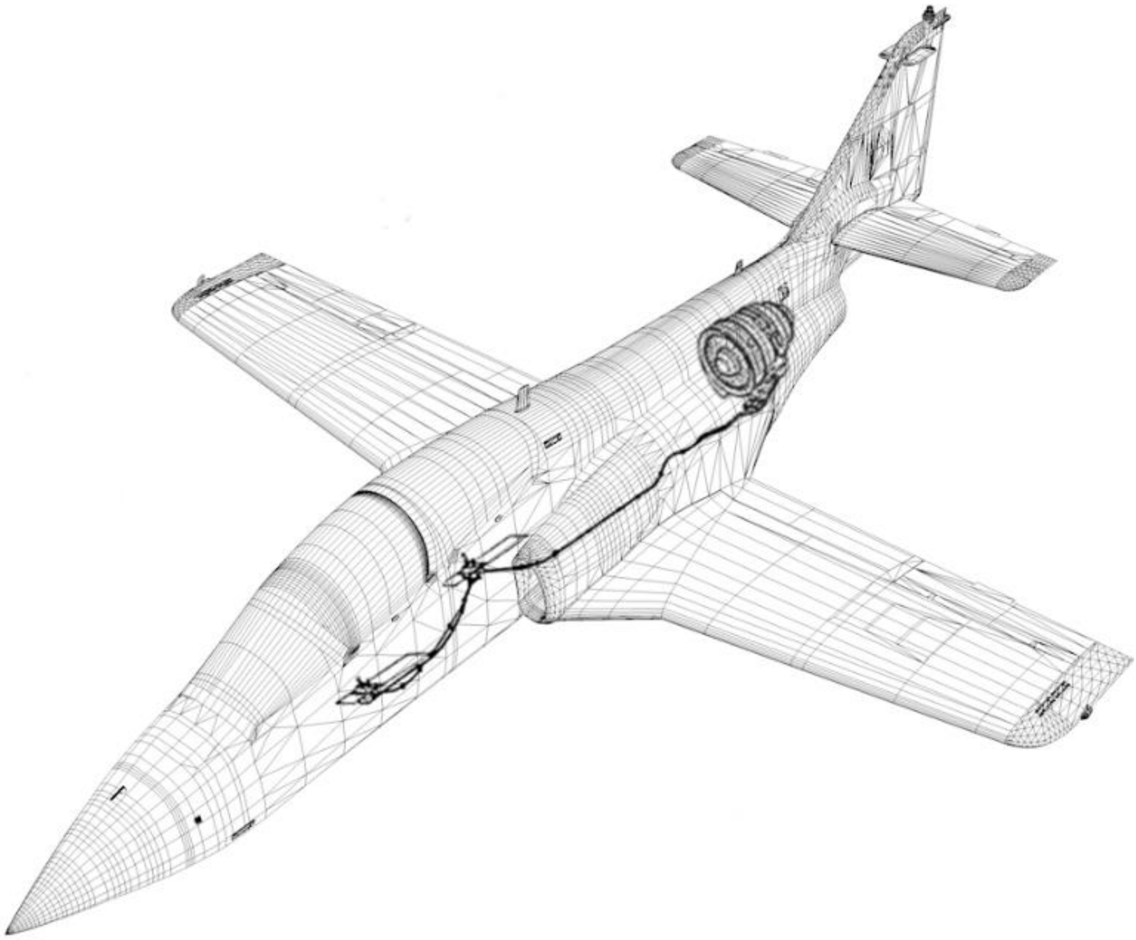


Figure 3-8 Power plant

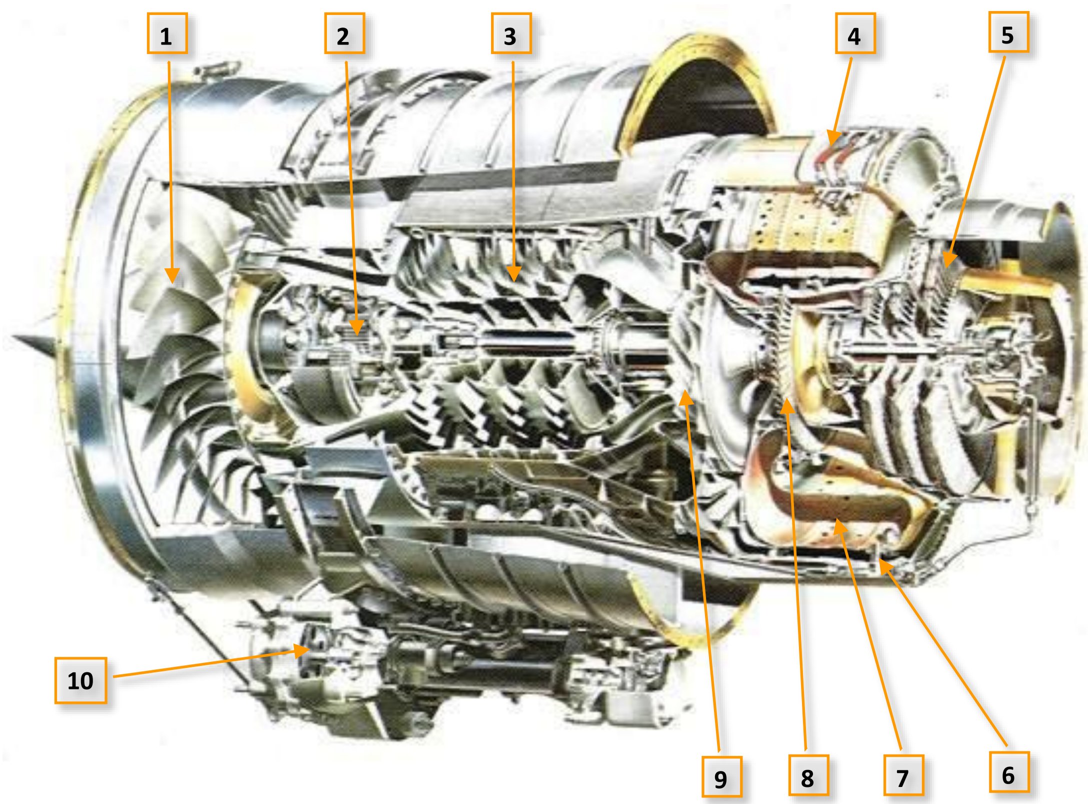


Figure 3-9 Garrett TFE 731-2-2J

1 FAN

2 PLANETARY REDUCTION GEARS

3 FOUR STAGE LOW PRESSURE AXIAL COMPRESSOR

4 FUEL MANIFOLD

5 LOW PRESSURE TURBINE

6 IGNITER

7 COMBUSTION CHAMBER

8 SINGLE STAGE HIGH PRESSURE AXIAL TURBINE

9 SINGLE STAGE HIGH PRESSURE RADIAL COMPRESSOR

10 ACCESSORY GEARBOX

Engine Fuel System

The engine fuel system consists of a fuel pump assembly, a hydro-electromechanical fuel control unit (FCU), a fuel flow divider assembly, fuel nozzles and an electronic computer.

Anti-Surge Device

There is an anti-surge valve that permits part of the LP compressor air to bleed to the fan duct. This is to avoid compressor stall or surge during certain conditions, like abrupt application of power that can affect the equilibrium of air through the LP spool and the pressure aft of the spool which can create instability of the air flow.

Engine Anti-Ice System

The engine is equipped with an anti-ice system, which provides an air flow from the HP compressor into the fan nose cone. It also heats Pt2 and Tt2 sensors with electrical resistors.

Engine Oil System

The engine oil system is fully automatic and requires no manual control. A system that detects metal particles in the oil illuminates a red PART METAL (CHIP DETECT) warning panel light.

Engine Starting System

The engine starter-generator can be energized by the aircraft batteries or an appropriate GPU regulated to 28V DC.

Engine Control Panel

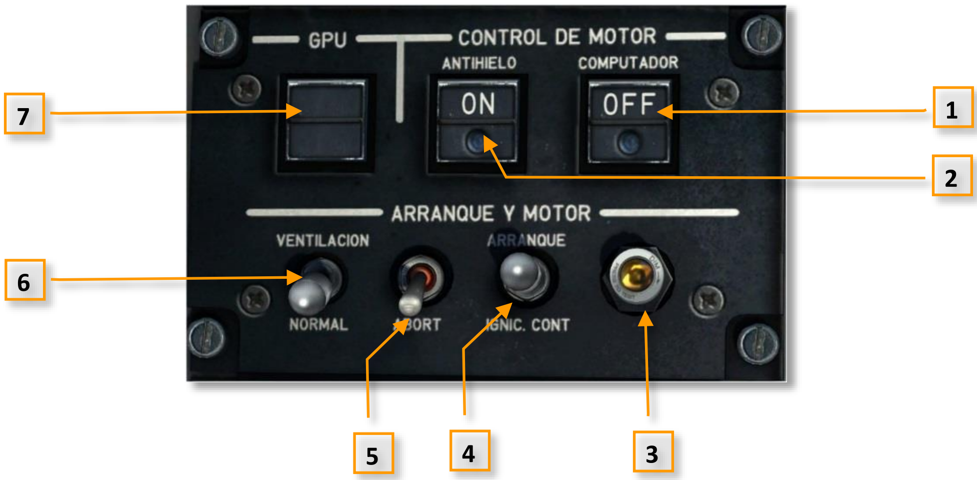


Figure 3-10 Engine Control Panel

1 COMPUTER SWITCH

2 ANTI-ICE SWITCH

3 IGNITION LIGHT

4 IGNITION SWITCH

5 ABORT START SWITCH

6 START SWITCH

7 GPU SWITCH

Each cockpit is equipped with an Engine Control Panel which comprises the following switches:

Computer switch

In auto mode, the computer indicator switch light remains out. When depressing the switch to manual mode, MAN illuminates in amber. In case of computer failure, an amber COMPUT. (COMPUTER) caution panel light illuminates.

Anti-ice switch

Depress the switch to energize the anti-icing system. It will indicate ON in white letters over black. Ice can form when the OAT is at or below 10°C and there is visible moisture or the difference between the OAT and the dew point is equal to or less than 2°C.

Ignition switch

The three-position toggle switch is marked ARRANQUE (START) and IGNIC. CONT (CONT IGN). To start the engine, hold the switch to START for approximately 2 seconds to energize the igniters and starter-generator. In CONT IGN position, only the igniters are energized. Use continuous ignition for takeoff, landing and during icing conditions, heavy turbulence or when flying in thunderstorms.

Abort start switch

This two-position switch is spring-loaded to the neutral position. It de-energizes the starter-generator when held to the ABORT position. It's used to abort a normal start before the automatic disconnect de-energizes the starter at 50% N2. It is also used to de-energize the starter-generator and ignition when starting with the computer inoperative.

Start switch

This is a three-position toggle switch marked NORMAL and VENTILACIÓN (CRANK). In NORMAL, the automatic start sequence is armed; engine rotation initiates when the ignition switch is held to START. In CRANK, the engine is motored without initiating the start sequence. This is normally used to clear the residual fuel in the combustion chamber following a start failure.

GPU switch

It is used to connect the GPU current to the airplane electrical network. The upper part of the indicator switch will illuminate with GPU in green when a GPU is connected to the aircraft and has power available. Depress the switch to energize the aircraft circuits - ON will display in green in the lower part of the switch. To de-energize the aircraft circuits, depress the switch - ON will extinguish.

GPU CONNECTED TO THE AIRPLANE

AIRPLANE CIRCUITS ENERGIZED

ENGINE ANTI-ICE ENERGIZED

ENGINE COMPUTER DISCONNECTED

Figure 3-11 GPU/Anti-ice

Engine Controls and Indicators

Power Levers

The power levers are located on the left console of each cockpit. They are interconnected with the engine by a flexible transmission. Each power lever grip incorporates a speed brake switch, a manual fuel enrichment button and a PTT microphone switch. The lever must be moved up to bring it from IDLE to STOP to pass through the quadrant gate, this protects against inadvertent fuel shutoff when retarding the power lever. With gear retracted and power lever between IDLE and approximately 33° forward, a micro-switch in series with an altitude pressure switch activates an audible warning. This aural warning of retracted gear at low power is cancelled by a silence button at the base of the power lever quadrant. The front cockpit power lever incorporates a friction lock.

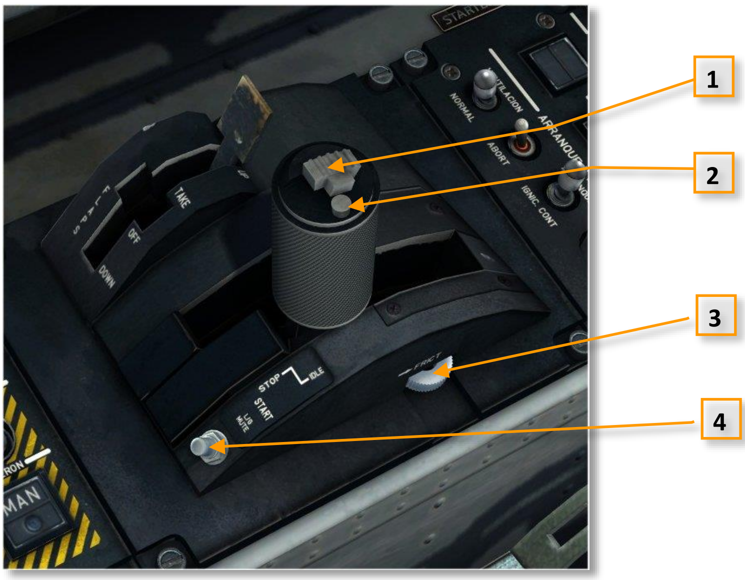


Figure 3-12 Power levers

1 SPEED BRAKE SWITCH

2 PTT MICROPHONE SWITCH

3 FRICTION LOCK (FRONT ONLY)

4 LANDING GEAR WARNING SILENCE BUTTON

Tachometers

Low pressure compressor N1, and high pressure compressor N2 rotor speeds are provided by tachometer indicators on the instrument panels, in percent of rated rpm.

Figure 3-13 Tachometers

Engine Temperature Indicators

Located on each instrument panel, they show Inter Turbine Temperature (ITT) in °C.

Figure 3-14 Temperature indicator

Fuel Flow Indicators

They show fuel flow in pounds per hour, as well as total fuel used, on each instrument panel. There is a reset button in the lower right corner, and a test button in the right side of the instrument. When depressed, the indicator will show a fuel flow of 1200 lbs/h and the totalizer will show 10 lbs increments every 30 sec.

Figure 3-15 Fuel flow indicator

Oil Temperature Indicators

There is an indicator on each instrument panel. The probe, which is located in the lubrication line of the fan reduction gearbox, sends a signal to the 28V DC indicator, displaying the oil temperature in °C.

Figure 3-16 Oil temperature indicator

Oil Pressure Indicators

The oil pressure indicator reads oil pressure transmitted by a pressure sensor located in the same lubrication line as the oil temperature indicator. This 115V AC sensor receives its voltage from an inverter incorporated in the 28V DC front instrument panel indicator, and the indication is in psi. The signal is transmitted through an amplifier to the rear position indicator.

Figure 3-17 Oil pressure indicator

Oil Pressure Warning Lights

When oil pressure drops below 25 psi, a 28V DC pressure switch causes a red PRES. ACTE. (OIL PRESS) light to illuminate in the warning/caution panel of each cockpit.

Figure 3-18 Oil pressure warning light

Chip Detector Warning Lights

A red PART METAL (CHIP DETECT) warning light will illuminate in each cockpit warning/caution panel if metal particles accumulate in the engine oil. This may be indicative of imminent engine failure. Only available in some airplanes. Not implemented in DCS: C-101.

Figure 3-19 Chip detector warning light

Engine Ignition System

The ignition system comprises an ignition unit and connecting leads to two igniters. It requires 10 to 30V DC to energize them.

Ignition Switches

There is an ignition switch on each Engine Control Panel. It is a three-position toggle switch labeled ARRANQUE (START) and IGNIC. CONT (CONT IGN, continuous ignition). During engine start, the switch is held to START for approximately 2 seconds to energize the igniters and starter-generator. In CONT IGN position, only the igniters are energized. The ignition light will illuminate while the ignition is on.

Ignition Lights

There is a yellow press-to-test ignition light located adjacent to each ignition switch. It illuminates to indicate when the igniters are energized, regardless of mode.

Figure 3-20 Ignition light on

3.4. AIRCRAFT FUEL SYSTEM

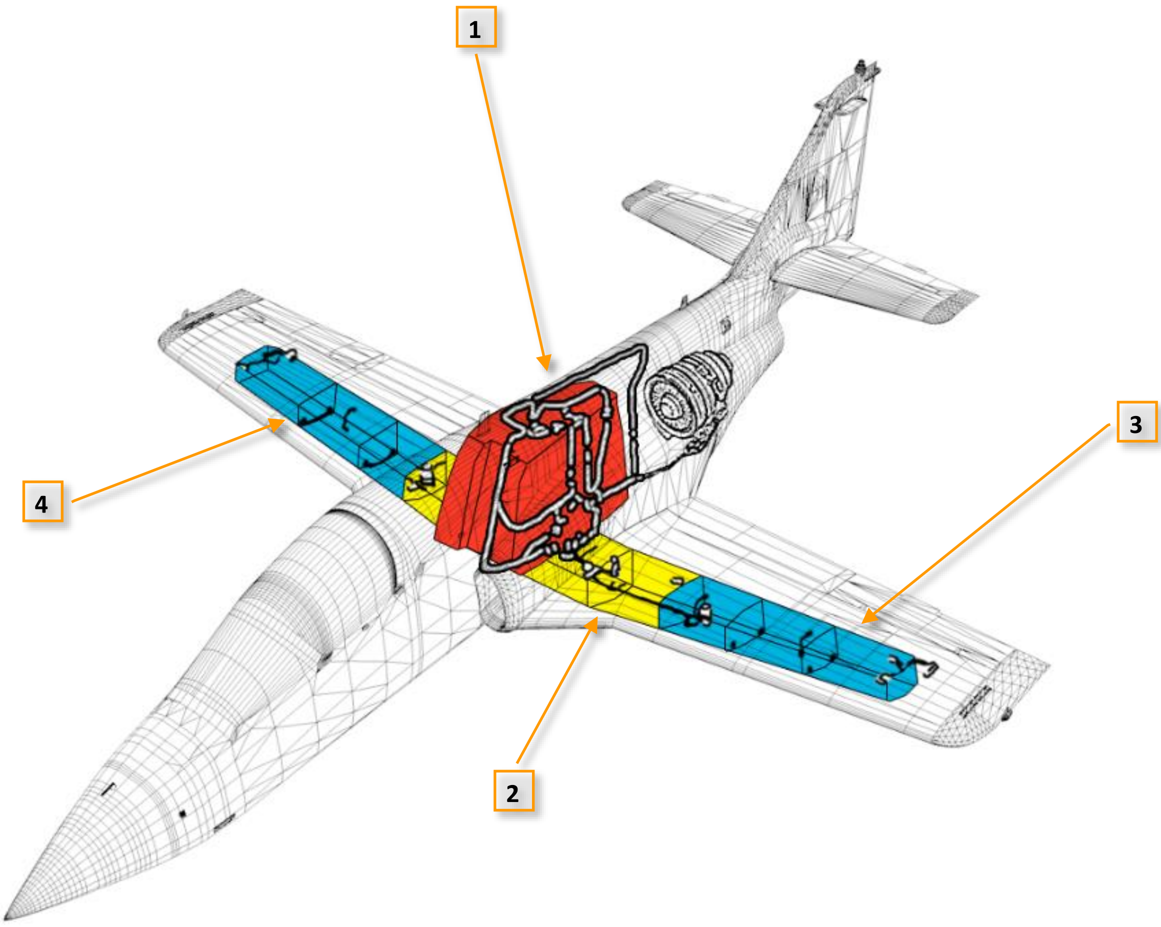


Figure 3-21 Aircraft fuel system

1 FUSELAGE TANK

2 CENTER WING TANK

3 LEFT OUTER WING TANK

4 RIGHT OUTER WING TANK

The aircraft fuel system, as shown in above picture, comprises four fuel tanks; one in the fuselage, one in the center wing and one in each outer wing. The fuselage tank is fabricated in a flexible material. A boost pump (submerged pump) is housed in the engine feed cell, which, closed off by a counterweighted valve, permits inverted flight for about 30 seconds. All the tanks are filled with anti-explosive polyurethane foam. The three integral wing tanks feed their fuel directly to the fuselage tank from where the fuel is supplied to the engine.

Refueling can be accomplished by pressure or by gravity.

Transfer System

Fuel is transferred from the wing tanks to the fuselage tank by four identical transfer pumps, two in the center tank and one in each outer tank. They are energized by the 28V DC secondary bus. Check valves prevent fuel transfer from one wing tank to another. The correct sequence of transfer is to first consume the outer wing tanks contents, if they contain fuel, and then the center tank contents.

Transfer Pump Switches

There are four transfer pumps, each of them has a three-position toggle switch located on the fuel panels mounted on the left console of each cockpit. They are labeled AUTO and MAN. In AUTO, the pump is energized until all the fuel in the tank is transferred. In MAN, the pump is energized until the switch is set to OFF. MAN is restricted to abnormal operation in order to avoid the pump to run dry, which would reduce its operational life.

Transfer Pressure Indicators

Fuel transfer pressure is detected by a pressure switch in the common fuel transfer line and shown in a transfer pressure indicator located on each fuel panel. The indicator displays a horizontal green bar under normal pressure, and a horizontal red bar when low pressure is sensed. When the pressure switch detects low fuel pressure, an amber PRES. COMB. (FUEL PRESS) light illuminates in each cockpit warning/caution panel.

Figure 3-22 Fuel press warning light/Transfer pressure indicator

Boost System

Boost Pump Switches

There is a guarded boost pump indicator switch in each fuel panel. When the boost pump is energized, the switch is extinguished. To de-energize the pump, depress the switch so that OFF is illuminated.

Fuel Shutoff Valve Switches

Each fuel panel has a guarded fuel shutoff valve indicator switch. It controls the fuel shutoff valve located between the fuselage tank and the engine. It displays OFF when the valve is closed. An amber LLAV. COMB. (FUEL VALVE) light illuminates in each cockpit warning/caution panel whenever the shutoff valve is not fully open.

Boost pump de-energized

Fuel shutoff valve de-energized

Boost pump energized

Fuel shutoff valve energized

Figure 3-23 Boost pump/fuel shutoff valve switch

Figure 3-24 Fuel valve warning light

Fuel Quantity Indicating System

Fuel quantity is measured in the fuselage tank and in the center wing tank. There is no indication of outer wing tank contents.

Fuel Quantity Indicators

Fuel quantity indicators are located on each fuel panel. They indicate from 0 to 3200 lb in 100 lb increments. Each fuel panel incorporates a fuel quantity selector switch to display either the fuselage tank contents or the fuselage tank plus center wing tank contents.

When depressing the test button located below the front cockpit indicator, the indicator shows the sum of center and fuselage tank contents. The outer wing tank contents can be estimated by reference to the fuel totalizer incorporated in the fuel flow indicator. When the outer and center wing tanks are empty, the fuel available indicators display a red horizontal bar.

Fuel Quantity Selector Switches

There is a fuel quantity selector indicator switch on each fuel panel. If there is transfer pressure (corresponding indicator shows green) and the fuel quantity selector switch is off, the fuel quantity indicator will show fuselage tank plus center wing tank contents. In this situation, press the switch to show fuselage tank contents only, the switch illuminates FUS in amber. If there is no transfer pressure, the indication will be always fuselage contents only and the switch will be always illuminated. In this case, press the test button to show fuselage plus center wing tanks contents.

Fuselage indication only

Fuselage and center wing indication

Figure 3-25 Fuel quantity selector switch

Fuel Available Indicators

Both fuel panels incorporate a fuel available indicator for each wing tank. The low level switch of each wing tank is connected to the corresponding indicator. When fuel is available, the indicator displays a horizontal green bar. When fuel reaches low level, the indicator displays a red horizontal bar. A white bar is displayed when the indicators are de-energized.

The circuit is de-energized

There is fuel in the tank

There is transfer pressure

There is no fuel in the tank

There is no transfer pressure

Figure 3-26 Fuel available and transfer pressure indicators

Fuel Low Level Warning Lights

When the fuel level in the fuselage tank drops below approximately 370 Ib, the fuel quantity transmitter in the tank sends a signal to illuminate a red MIN. COMB. (LOW FUEL) light in each cockpit warning/caution panel.

Figure 3-27 Fuel low level warning light

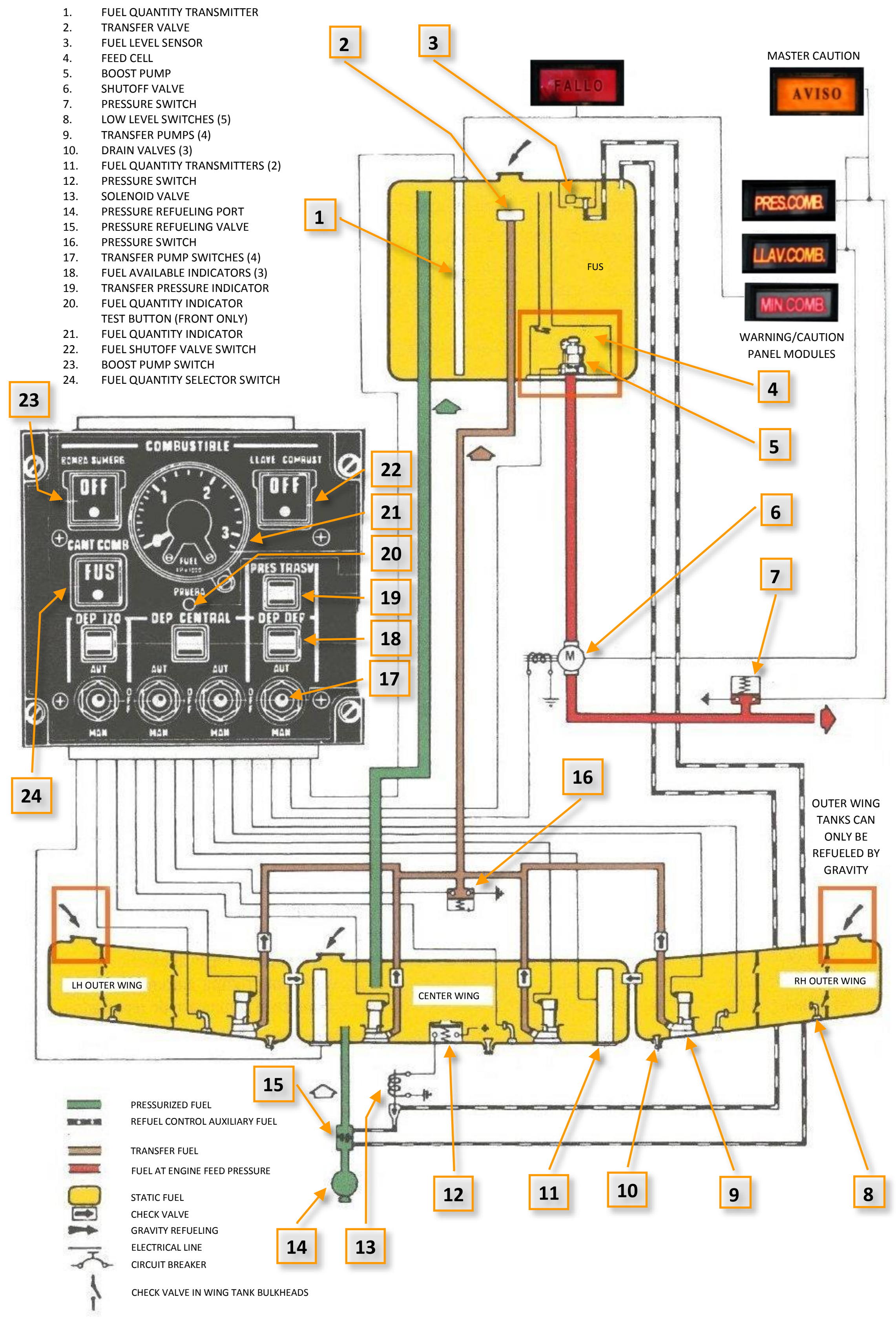


Figure 3-28 Fuel system

3.5. ELECTRICAL SYSTEM

The aircraft electrical power is supplied by DC and AC systems. DC power is supplied by an engine-driven starter-generator and two 24V 23Ah Ni-Cd batteries. There is an external receptacle to provide DC power from a ground power unit (GPU) when the engine is not in operation. AC power is supplied by two identical single phase 700VA static inverters with 115V and 26V output, the normal inverter and the standby inverter.

Starter-Generator

The starter function of the starter-generator is to initiate engine rotation for start or crank. It is powered by the aircraft batteries or a GPU. The starter is energized by the start switch on the Engine Control Panel. The generator is engine-driven through the accessory gearbox and supplies between 28V and 30V DC.

Generator Switch

This three-position switch is located on the front right subpanel. It is marked ON, OFF and RESET, and it is spring-loaded between OFF and RESET. When placed to ON, the generator connects to the secondary bus. In OFF, the generator is disconnected. Before connecting the generator or before attempting a reconnection, the switch should be momentarily placed through RESET to reset the generator field relay.

Generator Test Switch

This three-position switch is located adjacent to the generator switch on the front right subpanel. It is marked GF, OFF and OV and is spring-loaded to the OFF position. When the switch is placed to GF (ground fault) or OV (overvoltage), the respective malfunction is simulated. Satisfactory test is indicated when the generator disconnects and the red X. GEN. C.C. (GENERATOR) light illuminates in the warning/caution panel. This light illuminates in each cockpit whenever the generator is disconnected.

Batteries

The batteries are connected in parallel to the distribution system and are operated by the battery switches. Each battery has an overtemperature sensor which activates a temperature warning incorporated in the corresponding battery isolation/warning switch.

Battery Switch

The battery switch is located on the front right subpanel. When placed to ON, the batteries connect in parallel to the primary bus. The batteries are automatically disconnected from the distribution system when a GPU is connected and reconnected when the GPU is disconnected.

Battery Isolation/Warning Switches

There is an isolation/warning switch for each battery located on the front and rear cockpit right subpanels. If a battery temperature reaches 57 ± 2.8°C, TEM illuminates in the lower part of the switch. In this situation, the battery can be isolated by depressing the switch to ground it. Isolation is indicated when OFF is displayed in the top part of the switch. When a GPU is connected to the aircraft, the switches indicate OFF.

Battery de-energized

Battery disconnected

Battery reached 57°C

Figure 3-29 Battery isolation/warning switch

Battery Warning Lights

A red 70° BAT light illuminates in the warning/caution panel of each cockpit if either battery temperature reaches 70°C.

Figure 3-30 Battery warning light

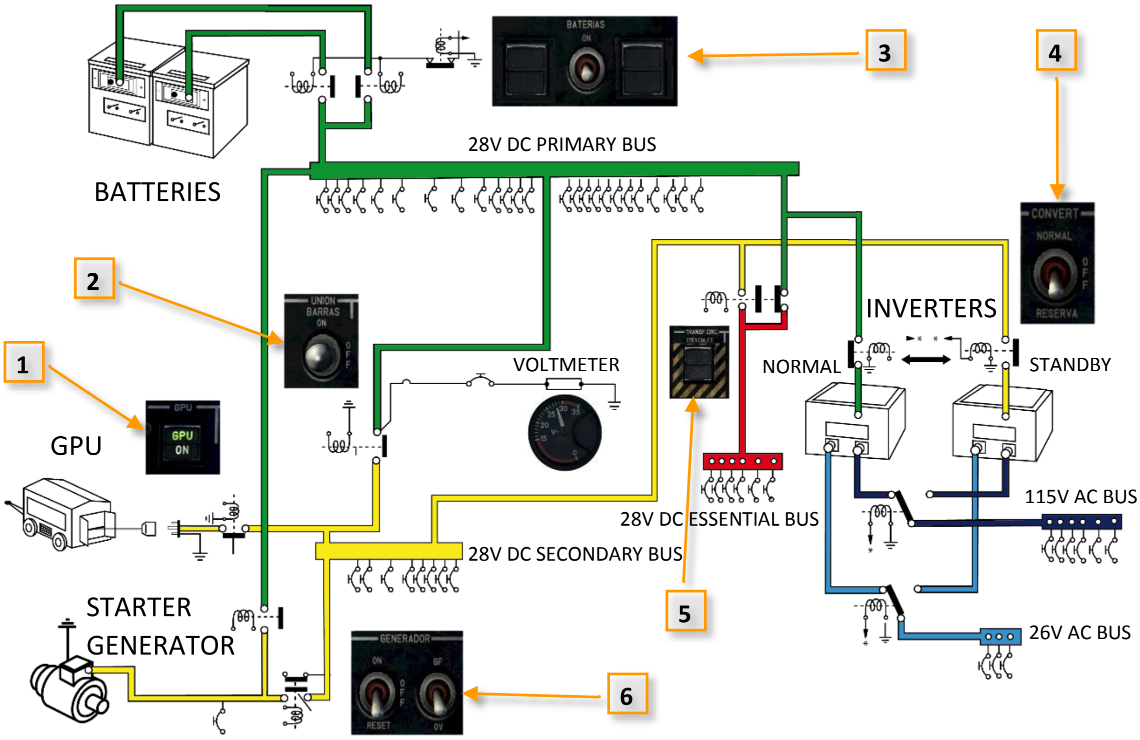


Figure 3-31 Electrical system

1 GPU SWITCH

2 BUS TIE SWITCH

3 BATTERY SWITCH AND BATTERY ISOLATION/WARNING SWITCHES

4 INVERTER SWITCH

5 ESSENTIAL BUS TRANSFER SWITCH

6 GENERATOR SWITCH AND GENERATOR TEST SWITCH

DC Distribution System

There are three DC buses: primary bus, secondary bus and essential bus. The batteries are connected to the primary bus and the generator to the secondary bus. A bus tie switch (UNIÓN BARRAS) connects the primary and secondary buses so that the generator can power the whole DC distribution system. An essential bus transfer switch (TRANSF. CIRC. ESENCIALES) permits the essential bus to be energized by either the primary or secondary bus. This assures that in the event of a failure of either the generator or batteries, the essential services can be maintained. The essential bus is normally connected to the primary bus. A GPU can be connected to energize the secondary bus. This is controlled by the GPU switch on the engine control panel. If the bus tie relay is closed, the GPU will energize the starter and entire DC distribution system. When the GPU is connected, batteries and generator disconnect automatically.

Bus Tie Switch

This is a two-position switch located on the front right subpanel. It is marked ON and OFF. When placed to ON, the bus tie relay closes connecting the primary and secondary bus.

Essential Bus Transfer Switches

This indicator switch is located on each right subpanel. The switches are connected in series. When the essential bar is connected to the secondary bus, the switch illuminates and displays ON. To connect the essential bus to the primary bus, depress the switch so that the ON indicator light extinguishes.

DC Voltmeters

The DC voltmeters, located on each instrument panel, are energized by the 28V DC primary bus. They indicate generator voltage when the primary or secondary buses are connected, and battery voltage when the buses are separated. Individual battery voltage can be checked by alternately switching off each battery by depressing the battery indicator switches with the bus tie switch in OFF.

Figure 3-32 DC Voltmeter

AC Distribution System

There are two AC buses: a 115V AC bus and a 26V AC bus.

Inverters

The AC electrical system is supplied by two identical single phase 700VA static inverters. Each inverter supplies 115V AC and 26V AC. One inverter is used for continuous normal AC power supply (NORMAL) while the other is used as a standby (RESERVA). The normal inverter is energized by the primary DC bus and the standby inverter by the secondary DC bus. If a failure of the normal inverter occurs, it is automatically disconnected and the standby inverter is connected. If the standby inverter fails, the normal inverter must be connected manually.

Inverter Switch

The three-position inverter switch, labeled NORMAL, OFF and RESERVA (STANDBY), is located on the front right subpanel. When the switch is placed to NORMAL or STANDBY, the selected inverter connects. In the OFF position, both inverters are disconnected.

Inverter Caution Lights

If there is a failure of either the normal or standby inverter, a corresponding amber CONV. NOR. (NORM INV) or CONV. RVA. (STBY INV) light will illuminate in the warning/caution panel of each cockpit.

Figure 3-33 Inverter caution lights

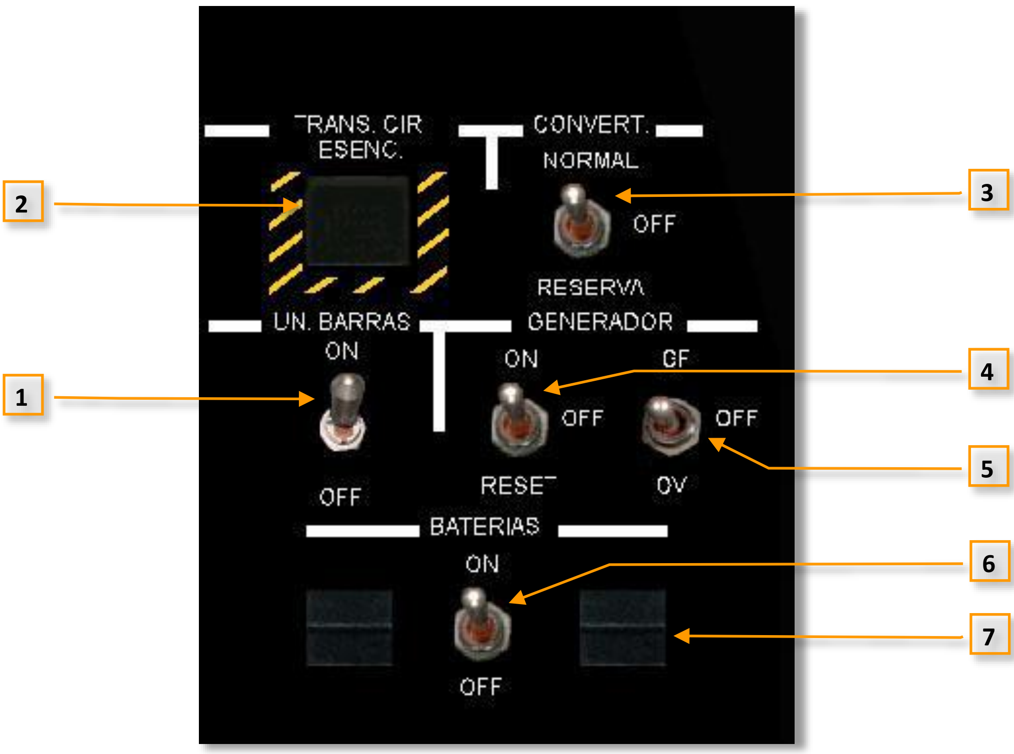


Figure 3-34 Electrical system control panel

1 BUS TIE SWITCH

2 ESSENTIAL BUS TRANSFER SWITCH

3 INVERTER SWITCH

4 GENERATOR SWITCH

5 GENERATOR TEST SWITCH

6 BATTERY SWITCH

7 BATTERY ISOLATION/WARNING SWITCHES

Circuit Breaker Panels

Most electrical circuits are protected by pop-out thermal circuit breakers. The main panel is located on the front left console, and a secondary panel is located on the rear left console for circuits that affect rear cockpit only.

Figure 3-35 Front cockpit circuit breaker panel

Figure 3-36 Rear cockpit circuit breaker panel

3.6. HYDRAULIC SYSTEM

The hydraulic system powers the aileron servo-actuators, flaps, speed brake, landing gear and wheel brakes. The 3000 psi system pressure is supplied by an engine-driven pump through the accessory gearbox. The hydraulic fluid tank, with a capacity of 2.5 liters, is located in the aft fuselage. In the event of system failure, two nitrogen charged accumulators provide a secondary source of power to the wheel brakes and aileron servo-actuators.

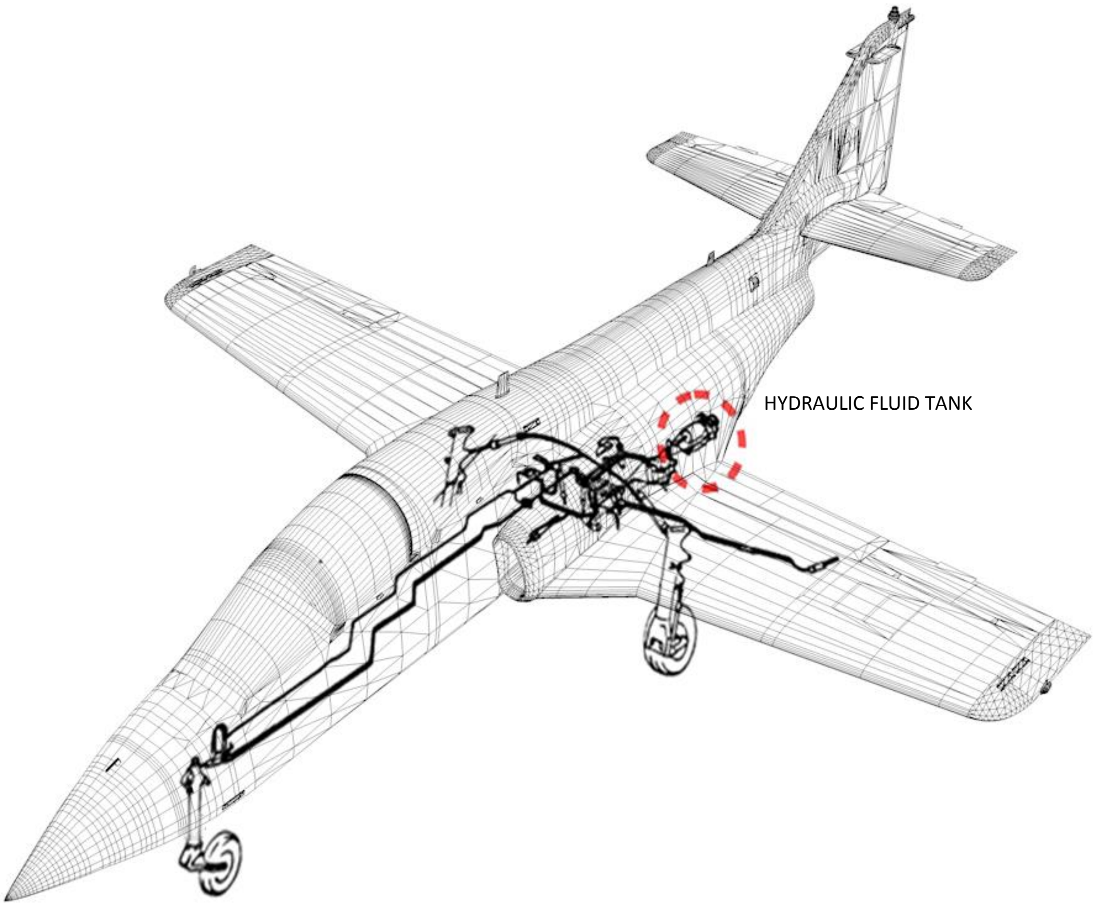


Figure 3-37 Hydraulic installation

Hydraulic Pressure Indicators

An indicator is located on each instrument panel. It is energized by the 28V DC primary bus. The rear indicator acts as a repeater of the front indicator.

Hydraulic Pressure Warning Lights

A red PRES. HDR. (HYD PRESS) light illuminates in the warning/caution panel if the pressure drops below 2000 psi. The light extinguishes at 2500 psi when increasing. The system incorporates a 10 second delay, so the indication corresponds to a permanent pressure drop.

Figure 3-38 Hydraulic pressure indicator

Figure 3-39 Hydraulic pressure warning light

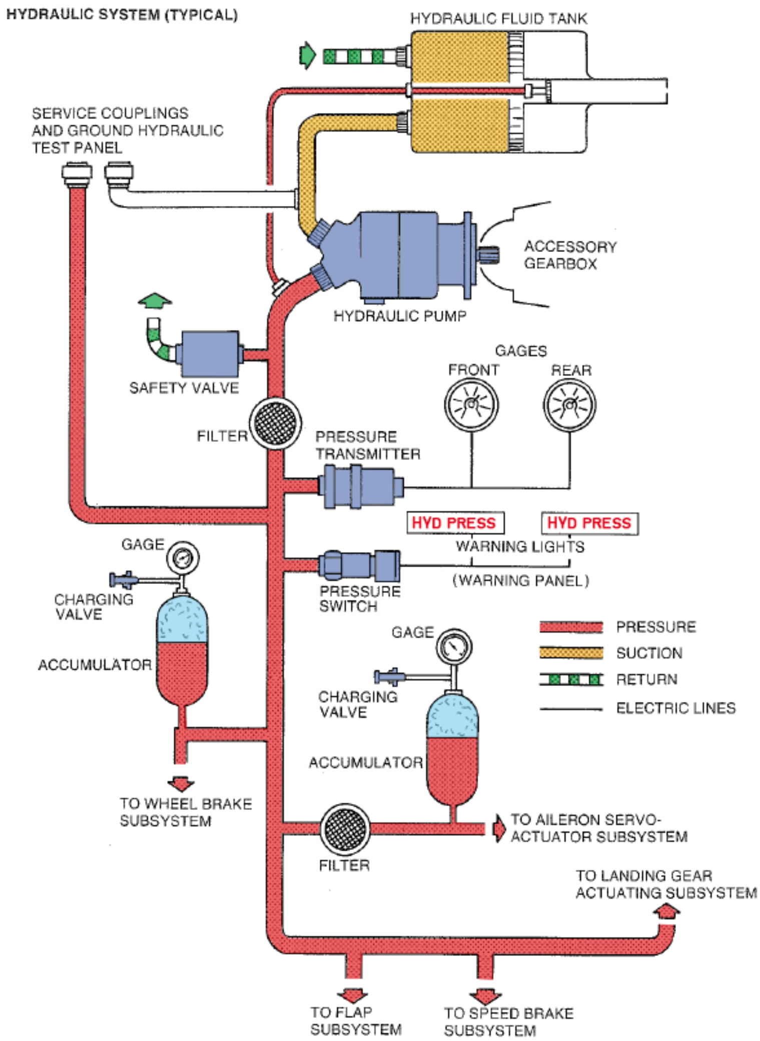


Figure 3-40 Hydraulic system

3.7. FLIGHT CONTROLS

The primary flight controls are ailerons, elevators and rudder. Secondary controls are trailing edge flaps and a speed brake in the lower fuselage. An aileron artificial feel system provides simulated aerodynamic forces to the control stick. All primary controls have electrically actuated trim controls.

Ailerons

The aileron system incorporates a hydraulically powered servo-actuator for each aileron. They are connected by a linkage of push-pull rods and bellcranks to the control stick. If a hydraulic failure occurs, a standby source of power is provided by an accumulator which can power the system for about 2 minutes. When the accumulator is discharged, the ailerons can be operated in a conventional mechanical manner subject to certain speed restrictions.

Servo-Actuator Cutout Switches

A guarded indicator cutout switch, located on the emergency panel of each left console, permits to simulate a hydraulic system failure so that pilots become familiar with manual aileron control force inputs. This is done by cutting hydraulic power to the ailerons. When depressing the switch, MAN illuminates in white letters over black, this prevents hydraulic pressure from entering the system. To re-establish normal operation, depress the switch so that the MAN indication extinguishes. This is not simulated in DCS: C-101.

Aileron Control Feel and Trim System

Due to the hydraulic design characteristics, the aerodynamic loads on the ailerons are not transmitted to the control stick, therefore an artificial feel is installed to simulate these forces. The aileron trim is actuated by a servo-motor through the artificial feel assembly. Trim tab deflection range is ±3°.

Elevators

The elevators are connected by a linkage of push-pull rods and bellcranks to the control stick.

Elevator Trim System

Pitch trim is accomplished by angular displacement of the horizontal stabilizer and is electrically actuated by the 28V DC primary bus. Stabilizer displacement ranges between +6.5° to -2°. The trailing edge of each elevator incorporates a trim tab which is manually adjusted on the ground. An interconnection between the horizontal stabilizer and the speed brake compensates for the pitch change resulting from speed brake operation.

Aileron and Elevator Trim System

Aileron and Elevator Trim Switches

A trim switch is incorporated in the grip of each control stick. When the switch is displaced laterally, forward or aft, the trim relieves forces on the control stick. It automatically returns to the center position when released, maintaining the trim setting.

Aileron and Elevator Trim Position Indicators

Aileron and elevator trim settings are displayed on the integrated trim indicator located on each instrument panel.

Figure 3-41 Trim position indicator

Emergency Elevator Trim Switches

There is an emergency switch located on each emergency panel to be used in case of failure of the control stick trim switch. The switches are labeled DOWN, OFF and UP. To operate the switch, a guard must be rotated 90°. When the switch is guarded, elevator trim is operated from the control stick switch. When either the front or rear cockpit guards are rotated, the control stick switches are inoperative, as well as the airbrake. In addition to the COMPENS (TRIMS) circuit breaker, the emergency trim is protected by a thermal circuit breaker on the emergency panel. An adjacent press-to-test light illuminates when the horizontal stabilizer actuator is energized by the emergency trim switch.

An acoustic warning can be heard in the headsets while trimming. When pulling the TONO TRIM (TRIM TONE) circuit breaker, this acoustic warning will be silenced and guards will not cut out airbrake and trim.

Control Sticks

Each stick is mounted in a yoke, the grip of each stick incorporates various controls.

Figure 3-42 Control stick grip

1 TRANSMIT BUTTON (PTT)	*5 CAMERA BUTTON*
2 STORES RELEASE BUTTON AND GUARD	*6 RAIN REPELLENT*
3 SAFETY CATCH	*7 TRIM CUT*
4 FIXED WEAPONS TRIGGER	*8 TRIM SWITCH*

Rudder Control

The rudder control is mechanically actuated through the rudder pedals by a connecting linkage of push-pull rods and bellcranks.

Rudder Pedals Adjustment

The rudder pedals are simultaneously adjustable with a handle located between the pedals. When the handle is pulled, the pedals can be adjusted. When the handle is released, the pedals lock in the selected position.

Wing Flaps

There is one trailing edge flap on each inboard wing adjacent to the fuselage. The flaps are electrically selected and hydraulically actuated.

Wing Flap Levers

A flap lever is located on the left console of each cockpit. They are interconnected by a flexible linkage and have three marked positions: UP, TAKEOFF (10°) and DOWN (30°).

Flaps Position Indicators

There are three flaps position indicators arranged vertically above each other on both instrument panels. When the flaps are in fully retracted position, the upper indicator displays UP in black letters over white. When the flaps reach their selected position, the center indicator displays T.OFF (TAKEOFF) and the lower indicator DOWN as appropriate. In any position the two remaining indicators are white. Black is displayed in all three indicators during transitions.

The circuit is de-energized or flaps in transit

Flaps up

Flaps takeoff

Flaps down

Figure 3-43 Flaps position indicators

Speed Brake

The speed brake is a panel which retracts flush to the lower fuselage. The speed brake system automatically reduces the pitch change resulting from speed brake deployment. Its position is electrically selected and hydraulically actuated. Any intermediate setting can be selected until a maximum extension of 45°.

Speed Brake Switches

A switch is located on each power lever grip. Aft and forward movement of the switch extends and retracts the speed brake respectively. The rear cockpit switch has priority over the front switch.

Speed Brake Position Indicators

There are two speed brake indicators arranged vertically above each other on both instrument panels. When the speed brake is retracted, the upper indicator displays IN in white letters over black and the lower indicator is white. When the speed brake is in transition or an intermediate position, both indicators display a black bar over white. At maximum extension, the lower indicator displays OUT in white letters over black and the upper indicator is white.

The circuit is de-energized

Speed brake in

Speed brake in transit

Speed brake out

Figure 3-44 Speed brake position indicators

Emergency Speed Brake Switches

A guarded switch is located on the emergency panel of each left console. In case of hydraulic failure, by pressing the switch, the speed brake will retract partially due to aerodynamic forces, therefore eliminating the high drag generated at full extension.

Figure 3-45 Emergency panel

1 EMERGENCY ELEVATOR TRIM SWITCH

2 SERVO-ACTUATOR CUTOUT SWITCH

3 EMERGENCY SPEED BRAKE SWITCH

4 SEAT ELEVATION SWITCH

5 PRESS-TO-TEST LIGHT

6 TRIM TONE BREAKER (FRONT COCKPIT ONLY)

7 THERMAL BREAKER (FRONT COCKPIT ONLY)

3.8. LANDING GEAR SYSTEM

The aircraft is equipped with a fully retractable, tricycle landing gear. The gear is electrically selected and hydraulically actuated. A safety switch on the main gear prevents accidental retraction of the landing gear when the aircraft is on the ground. In an emergency, this can be overridden by a red "crash" button located above the landing gear lever. Ground safety pins may also be installed to further secure the gear against inadvertent retraction. The main gear retracts inboard and the nose gear forwards.

Landing Gear Levers

A landing gear lever is located on each left subpanel. It has two marked positions, UP and DOWN. The electrical part is energized by the 28V DC primary bus. Both gear levers are mechanically connected by a cable.

Figure 3-46 Landing gear lever

Landing Gear Position Indicators

There are three position indicators on each subpanel, one for each strut. Each indicator displays UP in white letters over black when the corresponding strut is up and its gear door is locked. It displays a green bar when the strut is down and locked, and a red bar in intermediate positions. The light in the landing gear lever flashes in red when the gear is in transit.

Figure 3-47 Landing gear caution light

Landing Gear Caution Lights/Audible Signal Buttons

If a gear strut is not down and locked below 6500 feet pressure altitude and 75% N1, an amber TREN (GEAR) light illuminates in the warning/caution panel of each cockpit, and an audible signal will be heard. It can be silenced by pressing the landing gear silence button at the base of each power lever. The GEAR caution light will remain illuminated as long as the condition is met.

Emergency Gear Extension Handles

There is an emergency gear system that can be operated regardless of landing gear lever position by means of a nitrogen bottle located in the nose wheel well. A handle labeled EMERG. TREN (EMERG GEAR) is located on each left console. It can only be used once. When the gear has been pneumatically extended, it cannot be hydraulically retracted.

Emergency Gear Retraction Button (Crash Button)

The front landing gear lever has a microswitch and a locking device on the left main gear strut shock absorber that prevent the lever being moved to UP, unless the strut is fully extended. This avoids accidental gear retraction on the ground. A red crash button located above each landing gear lever permits retracting the gear while the aircraft is on the ground.

3.9. WHEEL BRAKE SYSTEM

The main landing gear wheels are equipped with disc brakes using hydraulic pressure and operated by toe action on the rudder pedals. Braking can be normal or emergency. Emergency braking is available through the parking brake.

Anti-Skid System

The normal brake system incorporates an anti-skid system to prevent wheel skid. The system releases brake pressure when a skid condition is detected.

Anti-Skid Indicator Switches

There is a Korry type indicator switch on each instrument panel. The anti-skid indicating system is energized by the 28V DC primary bus. The indications with gear down are as follows:

Anti-skid connected/de-energized

Anti-skid failure

Anti-skid disconnected

Figure 3-48 Anti-skid Korry button

Parking/Emergency Brake System

In case of hydraulic system failure, an accumulator, located in the nose wheel compartment, provides a secondary braking power source. The system is actuated by a parking/emergency brake handle located on each left subpanel.

Parking/Emergency Brake Handles

Emergency braking is applied by pulling the parking/emergency brake handle. It's not possible to use differential braking as pressure is applied equally to both wheel brake units. The parking brake is set by pulling and rotating it clockwise 90° to lock it in the parking position.

3.10. STALL WARNING SYSTEM

The system consists of an angle of attack (AoA) transmitter, a computer and a vibrator, connected to the pedals. When the AoA exceeds a certain limit, the computer sends a signal to activate the vibrator. This happens at around 10 to 15 KIAS before the stall.

Stall Caution Light

An amber AVIS. PERD. (STALL) light illuminates in the warning/caution panel of each cockpit under the following conditions:

a. Short circuit in the potentiometers of the AoA transmitter.

b. Power supply failure to the pedal vibrator.

c. Failure of the test mode.

Stall Warning Switches

A two-position switch labeled ON and OFF is located on each left subpanel to energize the stall warning system.

Stall Warning Test Switches

There is a three-position switch located on each left subpanel adjacent to the stall warning switch. This switch is labeled PRUEBA SIST. (TEST), OFF and TRANSM. When held to TEST, the following is initiated to indicate system serviceability:

a. The amber AVIS. PERD. (STALL) light illuminates in the warning/caution panel of the front cockpit.

b. The pedal vibrator actuates in approximately 8 seconds.

c. The AVIS. PERD. (STALL) light extinguishes in approximately 10 seconds.

If the switch is held to TRANSM, the AoA transmitter potentiometer circuits are tested. The AVIS. PERD. (STALL) caution light illuminates to indicate serviceability.

3.11. PITOT STATIC SYSTEM

The pitot-static system supplies impact (pitot) and atmospheric (static) pressures to the anemometer, altimeter and variometer. The static pressure is connected to the pressure switch that activates the reduced power and gear retracted at low altitude warning system. The pitot tube, which can be electrically heated, is located in the upper forward fuselage nose section. There is a static port on each side of the fuselage.

Pitot Heat Switches

A pitot heat indicator switch is located on each left subpanel. The pitot heat is energized through the 28V DC primary bus. To connect the heater, depress this Korry button - ON will be displayed in white letters over black. The AoA probe will be heated as well when the push-button is on.

Figure 3-49 Pitot heat Korry button

Pitot Heat Caution Light

An amber CAL. PITOT (PITOT HEAT) light illuminates in the warning/caution panel of each cockpit when a circuit failure occurs in the pitot heat system.

3.12. INSTRUMENTS

Refer to FRONT/REAR COCKPIT CONTROLS AND INDICATORS section for illustrations of instrument panels.

Mach/Airspeed Indicators

There is an identical indicator on each instrument panel which displays Mach number and indicated airspeed in knots (KIAS). A control button is located in the lower right corner, whose function is to manually set a triangular index that can be used by the pilot as speed reference.

Figure 3-50 Airspeed indicator and Machmeter

1 SPEED INDEX

2 INDICATING NEEDLE

3 MACH SCALE

4 SPEED REFERENCE SELECTOR

Turn and Slip Indicators

There is an indicator on each cockpit. It consists of a conventional instrument with a gyroscopic mechanical system, energized by the 28V DC essential bus. The instrument displays angular velocity around the vertical axis. Each dot represents a turn of 90° per minute. The inclinometer indicates if the turn is being performed in a coordinated manner or if, on the contrary, there is any slip or skid during the turn.

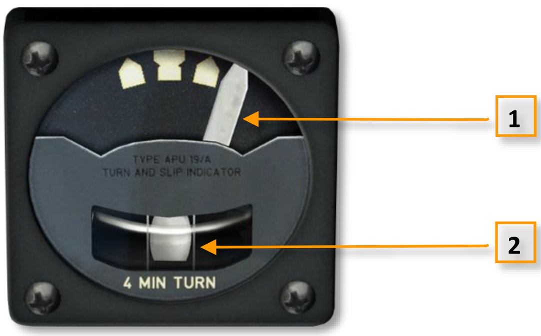


Figure 3-51 Turn and slip indicator

1 TURN NEEDLE

2 INCLINOMETER

Vertical Speed Indicator (VSI)

An indicator is located on each instrument panel. It displays vertical speed in fpm (x 1000) up to ±6000 fpm.

Figure 3-52 Variometer

Standby Artificial Horizons

An indicator is located on each instrument panel. It provides roll and pitch reference as a back-up to the ADI. The instrument is energized by the 28V DC essential bus. The indicator mechanism consists of a cylinder that remains constantly horizontal and pivots around the axis, displaying pitch angles in 10° increments. The upper part of the cylinder (positive angle = nose up) is colored light gray, the lower part (negative angle = nose down) is black. Roll indication is displayed in the upper part of the display. A fixed miniature airplane symbol provides visual indication of roll and pitch attitude. There is a fast erect knob (pull to operate) in the lower right instrument corner. Gyro caging is achieved by pulling and turning the knob to the right. The pitch angle can be adjusted by turning the knob without pulling. A warning flag appears in case of de-energization or internal electrical fault.

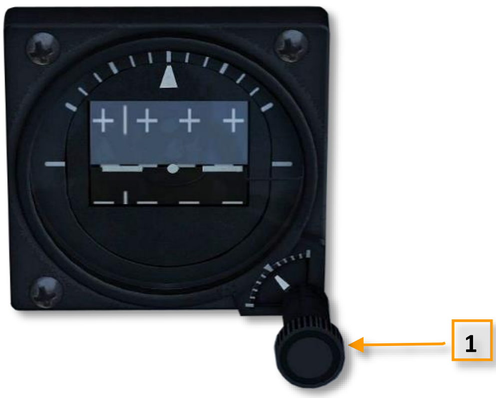


Figure 3-53 Standby artificial horizon

1 FAST ERECT KNOB

Altitude-Encoding Altimeter

An altitude-encoding altimeter is located in the front instrument panel. Altitude is shown by a three digits drum counter (tens of thousands, thousands and hundreds of feet) and a pointer in 50 ft increments. The Kollsman window can be adjusted in a margin between 950 mb and 1050 mb. The encoder device is energized by the 115V AC bus and provides coded altitude information to ATC through the IFF transponder.

Figure 3-54 Altitude-encoding altimeter

1 BAROMETRIC SCALE ADJUSTING KNOB	*3 POINTER*
2 BAROMETRIC SCALE (KOLLSMAN WINDOW)	*4 THREE DIGIT DRUM COUNTER*

Altimeter

There is an altimeter located in the rear instrument panel, similar to the one installed in the front panel, but without the encoder device.

Standby Compass

A standby compass is located on the front right instrument panel. It is a magnetic compass used as a back-up instrument.

Figure 3-55 Standby magnetic compass

1 COMPASS LIGHT SWITCH

Accelerometers

An accelerometer is located on each instrument panel. The instrument measures and records positive and negative G loads by means of three pointers. One pointer shows present G load, while the other two record maximum positive and negative G loads reached. A PUSH TO SET button in the lower left corner is used to return the recording pointers to the 1 G position.

Figure 3-56 Accelerometer

1 PUSH TO SET BUTTON

3.13. WARNING, CAUTION AND INDICATOR LIGHTS

Warning, Caution and indicator lights provide a visual indication of malfunction or the status of certain equipment and systems. The light system consists of a red FIRE warning light, a red master WARNING light, an amber master CAUTION light, a warning/caution panel and the indicator lights on the panels and consoles.

Master Warning/Caution Lights

A red master warning and amber master caution light are located on each instrument panel. They are labeled FALLO (WARNING) in black letters over red and AVISO (CAUTION) in black letters over amber. The red and amber colors signify critical conditions requiring immediate action and conditions of a less critical nature respectively. The system to which a master light refers can be identified by reference to the warning/caution panel. When a condition is identified, the master light should be cancelled by depressing the push-button. This resets the light to re-illuminate if a further condition occurs. When a master light is cancelled, the aural warning that sounds simultaneously is also cancelled.

Figure 3-57 Master Warning

Figure 3-58 Master Caution

Warning/Caution Panels

There is an identical warning/caution panel on each cockpit right subpanel. They simultaneously identify the malfunctions indicated by the master WARNING or CAUTION lights. The left column of the panel illuminates the warnings in red, corresponding to the red master WARNING light, and the right column illuminates the cautions in amber, corresponding to the amber master CAUTION light. This panel is energized by the 28V DC primary bus.

An intermittent 600 cps audio signal sounds when the red master WARNING light illuminates, and a continuous 200 cps audio signal sounds when the amber GEAR caution panel light illuminates.

LOW FUEL	FUEL PRESSURE
FIRE	FUEL VALVE
OXYGEN PRESSURE	AIR CONDITIONING
CANOPY UNLOCKED	GEAR
COCKPIT PRESSURE	PITOT HEAT
HYDRAULIC PRESSURE	COMPUTER FAILURE
OIL PRESSURE	ANTI-ICE
CHIP DETECTOR	STALL
70° BATTERY	NORMAL INVERTER
GENERATOR	STANDBY INVERTER

Figure 3-59 Warning/Caution Panel

Warning/Caution Panel Test Switches

There is a spring-loaded switch on each right subpanel. When TEST is selected, all the warning/caution panel lights illuminate, together with audio signals.

Warning/Caution Panel Bright/Dim Switches

A selector switch is located on each right subpanel. It has two switch positions, BRIGHT and DIM, for panel illumination adjustment.

Engine Fire Warning Lights/Test

There is a red master FUEGO (FIRE) warning light located on the upper right part of each instrument panel, as well as a red FIRE light in each warning panel. It illuminates in black letters over red in case of an engine fire/overheat. The master push-button serves also as a test switch for the detection system. The circuit is energized by the 28V DC essential bus.

Figure 3-60 Engine fire wng

3.14. CANOPIES

There are two canopies, forward and aft, that open to the right. To close and lock the canopy, grab the canopy safety catch, close the canopy and then move the canopy lock/unlock handle forward. To unlock and open the canopy, move the canopy lock/unlock handle back-ward, squeeze the canopy safety catch and open the canopy.

Figure 3-61 Canopy opening

Interior Canopy Lock/Unlock Handles

A handle is located on the left side of each cockpit. When moved forward, the canopy locks.

Interior Canopy Detachment Handles

A handle is located on the right side of each cockpit that permits the canopies to be fully opened for emergency evacuation or maintenance.

Canopy Unlocked Warning Lights

A red BLOC. CAB (CANOPY) warning panel light illuminates in each cockpit when either cockpit is not fully closed.

Figure 3-62 Detachment handle

Figure 3-63 Canopy unlocked warning light

3.15. EJECTION SEAT

Each cockpit is equipped with a fully automatic, cartridge operated, rocket assisted Martin Baker Mk-10 ejection seat to provide safe escape within the envelope of zero speed, zero altitude in the speed range between zero and 600 KCAS and between zero altitude and 50000 feet.

Red safety pins are provided to render the explosive devices safe while the aircraft is on the ground. These pins must be removed before flight. Ejection is initiated by pulling a seat firing handle situated between the legs on the seat front.

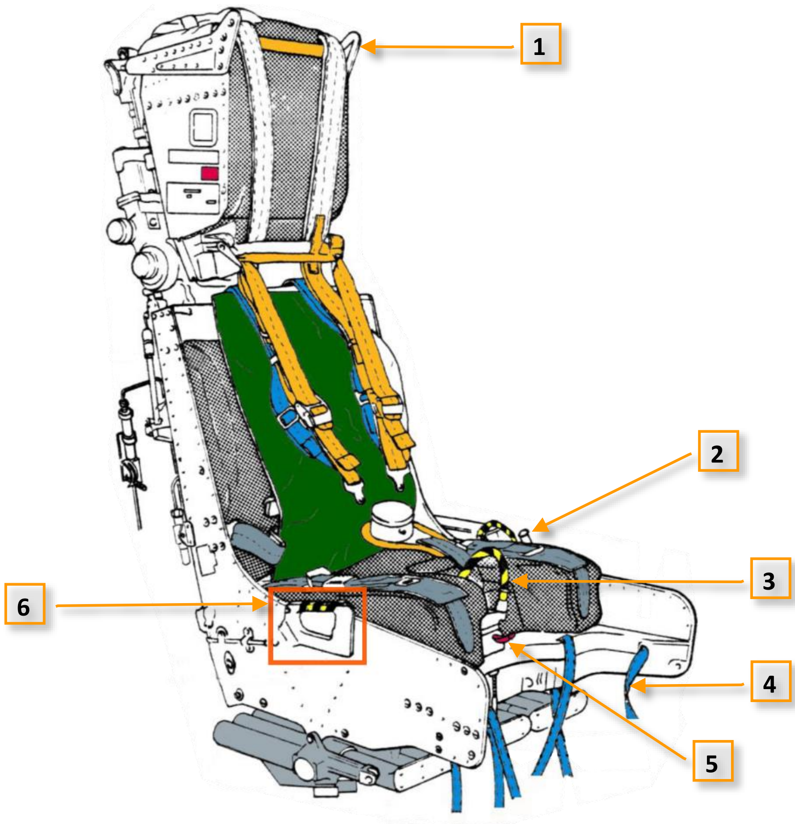


Figure 3-64 Ejection seat

1 CANOPY BREAKERS	*4 LEG RESTRAINT LINES*
2 GO-FORWARD CONTROL	*5 SAFETY PIN*
3 SEAT FIRING HANDLE	*6 MANUAL SEPARATION HANDLE*

Seat Elevation Switches

A seat elevation control switch is located on each emergency panel on the left consoles. It has two positions, UP and DOWN, which indicate the direction of seat travel. See figure 3-30.

3.16. ENVIRONMENTAL CONTROL SYSTEM

The environmental control system comprises pressurization, air conditioning, windshield and canopy de-misting, anti-G suit and emergency cockpit ventilation. The system operates on bleed air from the engine HP and LP compressors, and it uses external ram air to cool the bleed air through a bypass valve, which is automatically activated by a temperature controller in AUTO mode and manually activated in MAN mode.

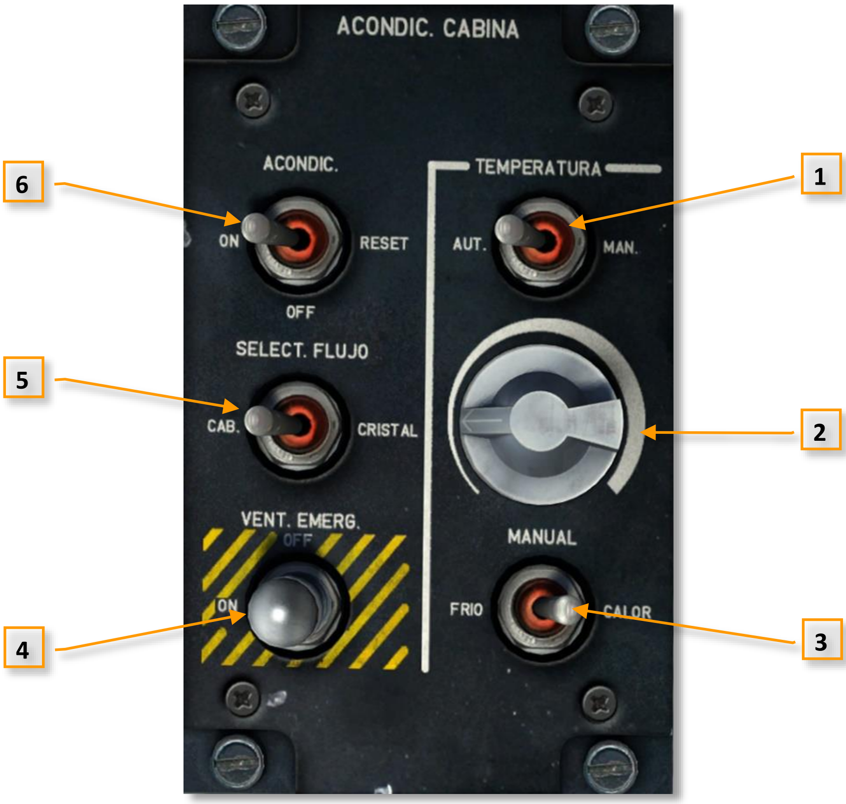


Figure 3-65 Air conditioning panel

1 MODE SELECTOR SWITCH

2 TEMPERATURE SELECTOR

(AUTO MODE)

3 MANUAL CONTROL SWITCH

4 EMERGENCY VENTILATION SWITCH

5 FLOW SELECTOR SWITCH

6 CONDITIONING/PRESSURIZATION SWITCH

Cockpit Pressurization

The system maintains cockpit pressure in relation to airplane altitude according to a specific pressurization program. The red PRES. CAB. (CKPT PRESS) warning light illuminates when a cabin altitude of 25000 ft is reached.

Air Conditioning/Pressurization Switch

This switch is located on the air conditioning panel. It must be ON for cockpit pressurization and air conditioning.

Cabin Altimeter

It is located on the forward right console and functions as a normal altimeter displaying cabin pressure altitude. See figure 3-67.

Air Conditioning

Cockpit temperature is regulated in automatic or manual modes as mentioned above.

Cockpit Temperature Control

In AUTO, the temperature is controlled by setting the temperature selector. In manual (MAN) mode, the temperature is controlled by setting the control switch to (CALOR) HOT or (FRÍO) COLD.

De-Mist Control

With the flow selector switch in CAB position, air flow through the diffusers to the windshield and canopy is minimal while the flow to the cockpit is maximum. In CRISTAL (WINDSHIELD) position, the flow through the de-misting diffusers is maximum.

Emergency Cockpit Ventilation

The system permits the flow of ambient air to the cockpit in case of pressurization failure, uncontrollable temperature, etc. It consists of a set of emergency ventilation valves which remain closed in normal operation.

Emergency Ventilation Control

When the switch is placed to ON, ambient air enters the cockpit through an intake located on the nose fuselage.

Windshield Rain Removal System

The system applies repellent fluid to the windshield when the switch incorporated in the front cockpit control stick or in the front left panel is depressed.

Figure 3-66 Rain repellent switch

3.17. OXYGEN SYSTEM

The pilot's oxygen is contained in two high pressure bottles located in the nose equipment compartment. The pressure is shown in the oxygen panel pressure indicator of the front cockpit, and repeated in the rear cockpit indicator. A pressure reducing valve reduces the bottle outlet pressure to 80 psi. Then the oxygen flows to the masks through a regulator which reduces the medium pressure to low pressure. Oxygen flow for both pilots is indicated simultaneously in the front and rear oxygen panels.

Oxygen Valve Lever

The lever on the right console of each cockpit is used to open and close the corresponding oxygen valve. It is marked A (O) for open and C for close.

Figure 3-67 Oxygen panel and cabin altimeter

Figure 3-68 Oxygen valve lever

Oxygen Pressure Warning Panel Light

A PRES. OXIG. (OXY PRESS) warning light illuminates when system pressure to the regulator drops below 45 psi.

Figure 3-69 Oxygen pressure warning light

3.18. COMMUNICATION AND NAVIGATION EQUIPMENT

The communication equipment consists of:

- Interphone system
- VHF transceiver
- UHF transceiver

The navigation equipment consists of:

- VOR/ILS/MB system
- TACAN
- Flight Director System

Audio Control System AN/AIC-18

The equipment permits communication between cockpits and cockpit to ground. Each pilot can independently receive any navigation station and receive/transmit any communication.

There is an audio control panel in each right console, and the microphone and earphones are incorporated in the helmet. A press to talk (PTT) switch is located in each power lever grip and each control stick grip.

Audio Control Panel

Figure 3-70 Audio control panel

1 INTERPHONE ON/VOLUME BUTTON

2 TACAN ON/VOLUME BUTTON

3 UHF ON/VOLUME BUTTON

4 VOR ON/VOLUME BUTTON

5 VHF ON/VOLUME BUTTON

6 MARKER BEACON ON/VOLUME BUTTON

7 HOT MIC MODE ON/VOLUME BUTTON

8 HOT MIC TALK BUTTON

9 CALL BUTTON

10 SELECTOR SWITCH

11 GENERAL VOLUME KNOB

Intercommunication between pilots (or with ground) can be accomplished in the following way:

INTER: To operate in this mode, the selector switch must be in the INT position, the INT button pulled and rotated to the required volume and the PTT switch depressed.

HOT MIC: In this mode it is not necessary to depress the PTT switch. The HOT MIC TALK and the HOT MIC buttons must be pulled out and the latter rotated to the required volume.

CALL: This is an emergency mode that overrides the INTER and HOT MIC modes by pressing the CALL button.

Reception of VHF and UHF radio audio signals as well as identification signals of the TACAN, VOR, DME, ILS and marker beacons is accomplished by pulling out the respective button and rotating it to adjust the volume.

The PTT is used to transmit through the VHF and UHF radios.

VHF Radio AN/ARC-134

This equipment, energized by the 28V DC essential bus, permits air to air and air to ground communications in the frequency range of 116.000 to 149.975 MHz in 25 kHz increments. The control panel is located in the right console of both cockpits.

Figure 3-71 VHF radio panel

1 POWER SWITCH

2 DIGITS TEST

3 FREQUENCY SELECTOR (10 MHz INCREMENTS)

4 FREQUENCY SELECTOR (1 MHz INCREMENTS)

5 FREQUENCY SELECTOR (0.1 MHz INCREMENTS)

6 FREQUENCY SELECTOR (25 kHz INCREMENTS)

7 DIMMER/VOLUME KNOB

VHF Transfer Switch

This switch, located on each instrument panel, transfers VHF control to/from either cockpit. A circular spot illuminates in the switch to indicate when the equipment control is gained from that cockpit.

NAV Transfer Switch

This switch, located on each instrument panel, allows control of the VOR navigation equipment to be gained by either cockpit; including vertical gyro fast erection control, TARSYN operation selector control and HSI remote control.

UHF Radio AN/ARC-164(V)

This equipment, energized by the 28V DC secondary bus, permits air to air and air to ground communications in the frequency range of 225.000 to 339.975 MHz in 25 kHz increments. The control panels are located in the front instruments panel of both cockpits.

The main elements are: the transceiver and control unit, the frequency indicator, two antennae, common with IFF equipment and located in the upper and lower fuselage, and the antenna selection switch. Antenna selection is made through this switch. In AUT, the equipment automatically selects the antenna with the best reception level.

Function Selector

In the OFF position, the equipment is disconnected. In MAIN, the main receiver is on. In BOTH, main and reserve receivers are on. The ADF position is inoperative.

Mode Selector

In GUARD position, the guard frequency (243 MHz) is automatically tuned. MANUAL position is used to tune the desired frequency. The PRESET position is used for automatic tuning of preset channels.

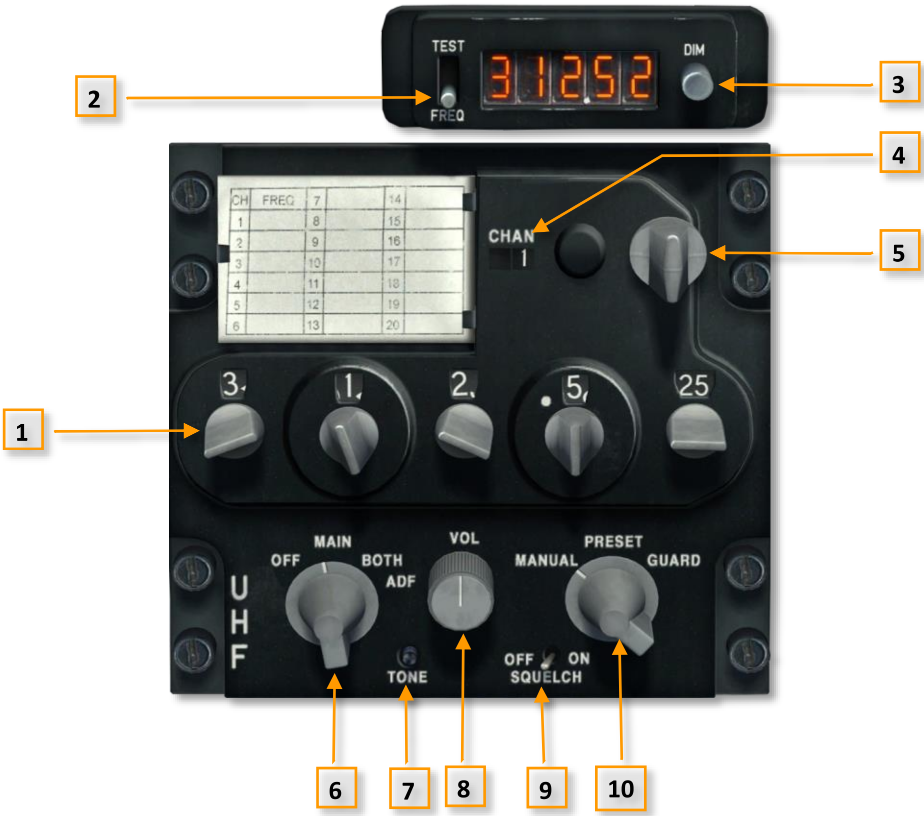


Figure 3-72 UHF control unit and frequency indicator

1 FREQUENCY SELECTORS

2 INDICATION MODE AND TEST SELECTOR

3 DIMMER

4 PRESET CHANNEL INDICATOR

5 PRESET CHANNEL SELECTOR

6 FUNCTION SELECTOR

7 TONE TEST BUTTON

8 VOLUME KNOB

9 SQUELCH

10 MODE SELECTOR

UHF Transfer Switch

This switch, located on each instrument panel, transfers UHF control to/from either cockpit. A circular spot illuminates in the switch to indicate when the equipment control is gained from that cockpit.

VOR/ILS/MB Equipment AN/ARN-127

This equipment is a full navigation and landing aid system. It receives VOR, localizer, glide slope and marker beacon signals. Output signals from the receiver go to the ADI, HSI, RMI and marker beacon lights. It also provides station identification and marker beacon audio signals to the headsets through the audio panel. The VOR/LOC function receives and processes VHF signals from ground stations in the frequency range between 108.00 and 117.95 MHz in 50 kHz increments. The required VOR station or localizer frequency is set on the VOR/ILS control panel of either cockpit. The signal is tuned by the panel which has gained control, according to the NAV transfer switch selection. The GS function receives and processes signals for glide slope deviation. The MB function receives and processes marker beacon signals of 75 MHz which produce a visual indication in the three marker beacon lights (blue, amber and white) located in the front instrument panel of each cockpit, representing OM, MM and IM. When pressing the VOR-MK TEST button, all three marker beacon lights will illuminate and the VOR test will be performed.

Figure 3-73 VOR/ILS control panel

1 VOR/MARKERS TEST BUTTON

2 DIGITS TEST

3 DIMMER

4 FREQUENCY SELECTOR (1 MHz INCREMENTS)

5 FREQUENCY SELECTOR (0.1 MHz INCREMENTS)

6 FREQUENCY SELECTOR (0.05 MHz / 50 kHz INCREMENTS)

7 OFF/VOLUME KNOB

TACAN Equipment AN/ARN-118

This equipment provides bearing, course deviation, and distance (slant-range) to a ground or ship-borne station. The control panel is located on the right console of both cockpits. The bearing is depicted in each RMI and HSI and the distance and course deviation is displayed in each HSI.

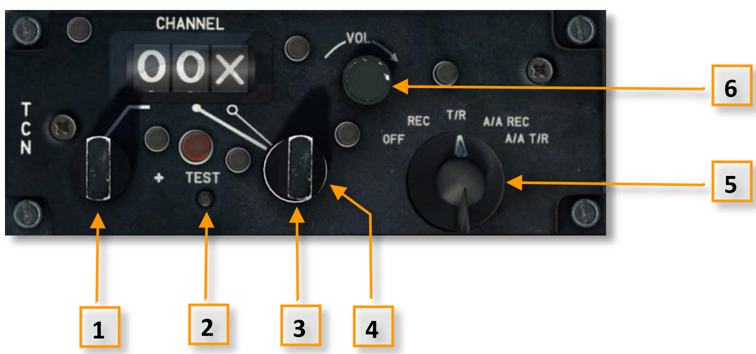


Figure 3-74 TACAN control panel

1 CHANNEL SELECTOR (TENS)

2 TEST BUTTON

3 CHANNEL SELECTOR (UNITS)

4 X/Y MODE SELECTOR

5 MODE SELECTOR

6 VOLUME KNOB

In REC mode, the transceiver operates as a navigation signal receiver only to get course indication. In T/R mode, it also gets distance indication. A/A REC is similar to REC mode except that the course information is received from another airplane. A/A T/R mode is used to get course and distance information from another airplane.

Interrogation and response frequencies always have a 63 MHz difference. Therefore, to be able to contact and receive information from another airplane, a channel with 63 MHz separation must be tuned. Example: if the transmitting airborne station is on channel 11X, the receiving aircraft must be on channel 74X. (Always same X or Y mode).

VOR/TACAN Selector

This push-button is used to show either VOR or TACAN in the HSI.

Figure 3-75 VOR/TACAN selector

Flight Director System

This system provides attitude and radio navigation information integrated in the ADI and HSI. The system comprises the following components located in the cockpit: Attitude Director Indicator (ADI), Horizontal Situation Indicator (HSI), Flight Director Computer, Flight Director Annunciator, HSI Remote Control and Altitude Control.

The system comprises the following components located outside the cockpit: Gyroscopic System, Navigation Coupler, Flux Valve and Flags Amplifier.

Attitude Director Indicator HZ-444

The ADI combines the attitude display with computed steering signals to direct the pilot to intercept and maintain a desired flight path. The ADI displays pitch and roll attitude, glide slope deviation, localizer deviation, failure flags, inclinometer and attitude self-test. It also incorporates Flight Director cross-pointer command bars. The aircraft is flown to the intersection of the command bars. The commands are satisfied when the bars are aligned with the center dot of the aircraft symbol. The horizontal bar displays computed pitch commands and the vertical bar displays computed roll commands.

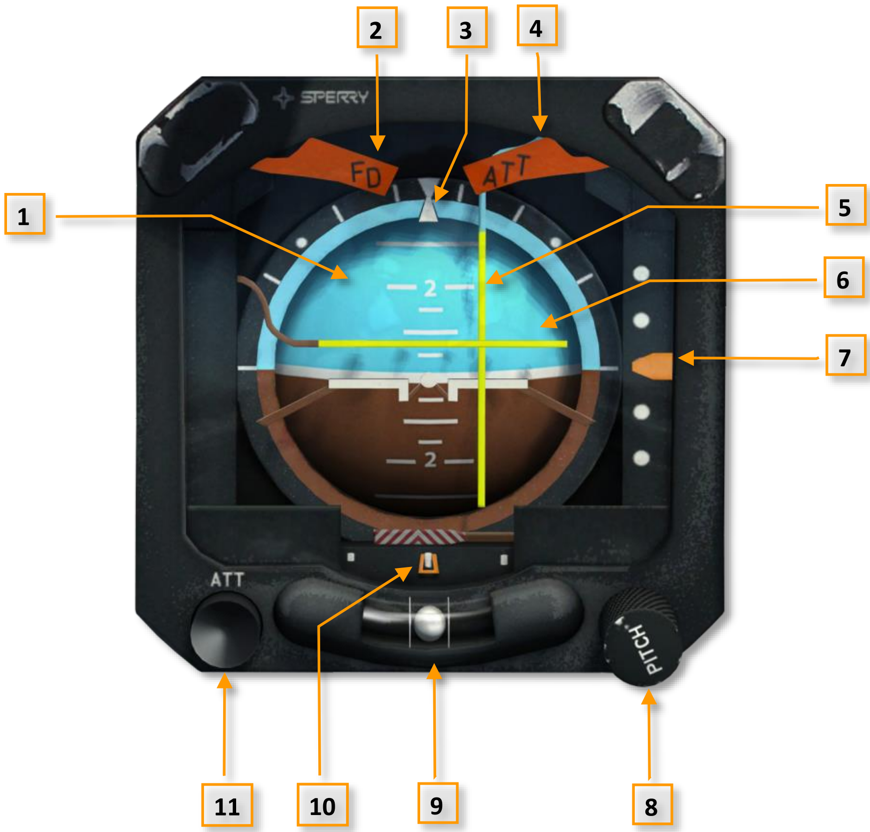


Figure 3-76 ADI

1 ATTITUDE SPHERE

2 FLIGHT DIRECTOR FAILURE FLAG

3 ROLL INDEX

4 ATTITUDE FAILURE FLAG

5 ROLL COMMAND BAR

6 PITCH COMMAND BAR

7 GLIDE SLOPE DEVIATION POINTER

8 PITCH ADJUSTMENT KNOB

9 INCLINOMETER

10 LOCALIZER DEVIATION POINTER

11 ATTITUDE TEST BUTTON

The attitude sphere moves with respect to the aircraft symbol to display actual pitch and roll attitude. Pitch attitude marks are in 5-degree increments. The roll index shows actual roll attitude through a movable index and fixed scale reference marks at 0, 10, 30, 45, 60 and 90 degrees.

The glide slope deviation pointer displays aircraft deviation from glide slope, provided that ILS frequency is tuned. Aircraft is below glide path if pointer is displaced upward. The localizer pointer is displayed whenever the ILS frequency is tuned and a valid localizer signal is available, showing displacement from the localizer centerline. The indication is amplified 7½ times with respect to the HSI indication, so it is intended for assessment only, since the pointer is too sensitive to be used during the entire approach.

The inclinometer, located at the bottom of the ADI, informs the pilot of any slip angle, and permits him, in conjunction with the turn indicator, to perform a coordinated turn.

When the attitude test button is depressed, the sphere shows a 20° roll to the right and a 10° pitch up attitude. The pitch adjustment knob is used to set the pitch command bar to the required pitch - see FD (Flight Director) section. A red ATT (attitude) flag appears to indicate a failure in the vertical gyro system. A red FD (Flight Director) appears to indicate that command bars are inoperative.

Horizontal Situation Indicator RD-500A

There is an HSI (Horizontal Situation Indicator) in the front instrument panel of each cockpit. It provides aircraft position with respect to magnetic heading and aircraft displacement relative to VOR and TACAN radials, localizer, and glide slope beam. It also displays distance to the station.

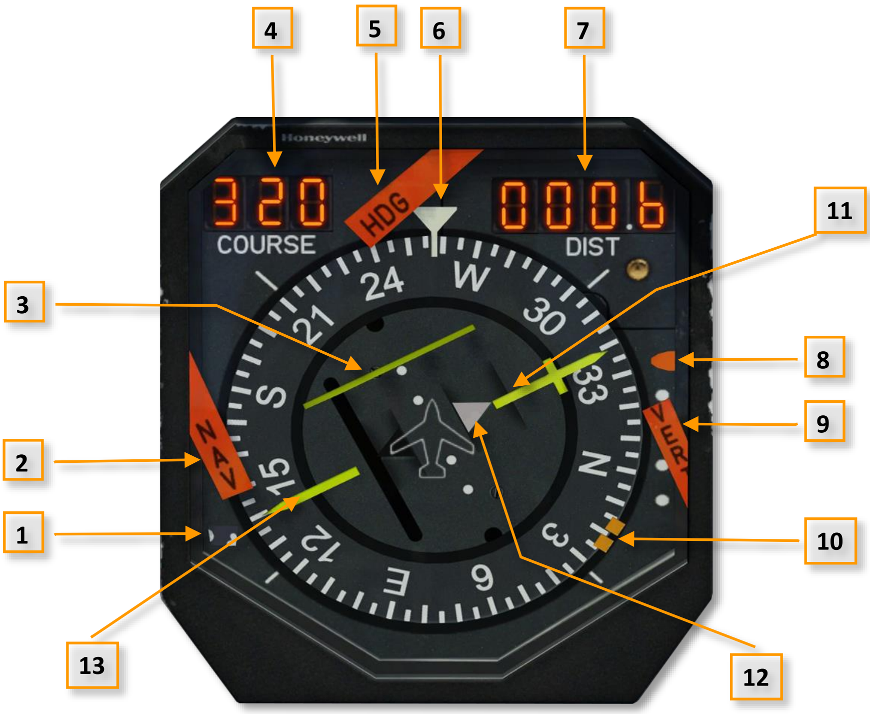


Figure 3-77 HSI

1 GYRO SYNCHRONIZATION ANNUNCIATOR

2 NAVIGATION FAILURE FLAG

3 COURSE DEVIATION INDICATOR (CDI) BAR

4 COURSE DISPLAY

5 HEADING FAILURE FLAG

6 HEADING REFERENCE INDEX

7 DISTANCE DISPLAY

8 GLIDE SLOPE DEVIATION POINTER

9 GLIDE SLOPE FAILURE FLAG

10 HEADING BUG

11 COURSE SELECT POINTER

12 TO-FROM ANNUNCIATOR

13 RECIPROCAL POINTER COURSE

The heading reference index displays gyro stabilized magnetic compass information on a dial graduated in 5-degree increments. There are fixed heading marks at 45 degrees to either side of the aircraft axis. The notched orange heading bug is positioned on the rotating heading dial by the remote heading knob to select and display preselected compass heading.

The yellow course pointer is positioned on the rotating heading dial by the remote course knob to select a magnetic bearing that coincides with the desired VOR or TACAN radial or localizer course. The set course can be read in the course display.

The TO-FROM annunciator provides VOR and TACAN TO-FROM information.

The CDI bar represents the centerline of the selected VOR, TACAN or localizer course. In ILS operation, each dot represents 1-degree deviation from centerline.

The glide slope deviation pointer is in view when a localizer frequency is tuned. Aircraft is below glide path if pointer is displaced upward.

A digital electronic display indicates distance in nautical miles to the selected TACAN or DME station.

Dimming of both course and distance displays is accomplished with the HSI dimmer located below the standby horizon.

The gyro synchro annunciator symbols • and + display directional gyro synchronization. When the system is in SLAVED mode and synchronized, both symbols are visible. See TARSYN section.

Failure flags will appear when there is a heading, VOR, LOC or GS failure.

HSI Remote Control Panel

This panel is used to select course and heading in the HSI.

Figure 3-78 HSI remote control panel

1 REMOTE COURSE KNOB *2 REMOTE HEADING KNOB*

Gyroscopic System TARSYN 333

This is a sensor system comprising a vertical gyro, a horizontal gyro and the corresponding electronic elements mounted on a common base. It supplies pitch, roll and heading information to the navigation systems. The system provides automatic initial erection and synchronization, manual directional gyro synchronization and manual vertical gyro fast erection. Manual operation is done from the TARSYN control panel.

To synchronize the gyro with the compass, the corresponding switch must be depressed towards **+** if the **+** symbol is showing in the gyro synchro annunciator, or towards • if the • is showing. The goal is to make both • and **+** equally visible, which means that the gyro is synchronized. The gyro will start precessing with time, so this process must be made from time to time during the flight.

Either compass or directional gyro can be selected for presentation with the TARSYN operation selector.

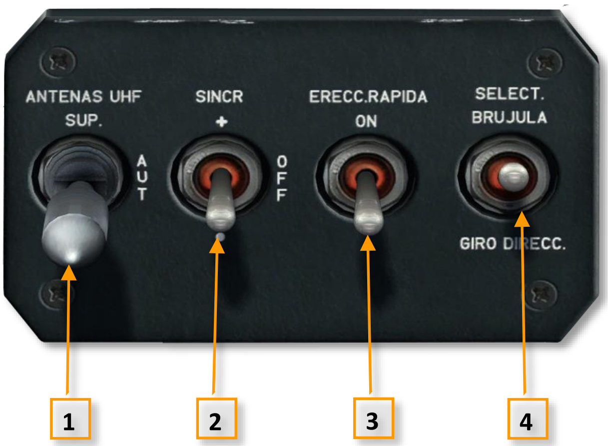


Figure 3-79 TARSYN control panel

1 UHF ANTENNA SELECTOR

2 DIRECTIONAL GYRO SYNCHRONIZATION SWITCH

3 VERTICAL GYRO FAST ERECTION

4 TARSYN OPERATION SELECTOR

Altitude Control

A static pressure sensor unit detects altitude variation and provides a signal to the ALT function of the Flight Director to keep the altitude present in the moment of mode selection.

Navigation Coupler

This equipment operates in conjunction with the Flight Director computer to carry out the PAT (Pitch Attitude Trim - see Flight Director Computer section) function as well as radial capture and crosswind correction in VOR mode.

Flux Valve

It is a magnetic azimuth detector that captures direction of the horizontal component of the Earth's magnetic field in relation to the aircraft longitudinal axis. The Flux Valve is mounted in the right wing tip and provides information to the TARSYN to keep the directional gyro aligned with the magnetic field when in SLAVED mode.

Flight Director Computer

The flight director computes and displays in both ADI's the proper pitch and bank angles required to follow a selected path. This is done by flying the aircraft to the intersection of the command bars.

The Mode Selector of the Flight Director Computer is located in the central instrument panel of the front cockpit. It consists of 9 push-buttons that permit pilot's selection of the desired operation mode. The push-buttons illuminate when pressed, connecting the corresponding operation mode.

The Flight Director Annunciator is located in the central instrument panel of the rear cockpit. It has a similar disposition as the Mode Selector, showing the mode selected in the front cockpit.

The computer combines attitude, heading, altitude and course signals to generate the corresponding signals to move the command bars of the ADI, according to the selected operation mode.

The Flight Director is energized by the 26V AC bus.

Figure 3-80 Flight Director Mode Selector

SBY Mode

The standby mode is selected by pressing the SBY push-button on the Mode Selector located in the front cockpit. This resets all the other flight director modes and biases the command bars from view. While depressed, the SBY button acts as a lamp test causing all mode annunciator lights to illuminate. When released, all the other mode annunciator lights extinguish.

GO AROUND Mode

The go around mode is selected by pressing the GO AROUND push-button. When pressed, the horizontal bar will show optimum climb angle and the vertical bar wings level. When a lateral mode is selected afterwards, the vertical bar will show that mode and the horizontal bar will remain in the go around mode.

ALT Mode

The altitude hold mode is selected by pressing the ALT push-button. It commands the required pitch to maintain barometric altitude. It should be connected with wings level, and can be used in conjunction with HDG and V/L modes before glide slope capture.

PAT Mode

The pitch attitude trim mode is selected by pressing the PAT push-button. The FD horizontal bar will hold the pitch set with the ADI pitch adjustment knob in the front cockpit.

HDG Mode

The heading mode is selected by pressing the HDG push-button. It holds the heading selected in the HSI with the heading selector knob. It can be used in conjunction with the PAT or ALT modes.

V/L Mode

The VOR or LOC mode is selected by pressing the V/L push-button. When selected, the FD will keep heading until intercept and capture of the selected VOR radial or LOC.

APP ARM Mode

The approach arm mode is selected by pressing the APP ARM push-button. When selected, the system stays ready for GS and LOC capture. V/L and GS will illuminate when the LOC and GS are captured. It can be used in combination with HDG mode.

GS Mode

The glide slope mode is selected by pressing the GS push-button. When selected, the system will provide commands for LOC and GS capture. V/L and GS will illuminate provided that there is a valid LOC and/or GS signal.

REV Mode

The reverse localizer mode is selected by pressing the REV push-button. It allows to fly a back course approach and it can be used with both pitch modes, PAT and ALT.

Radio Magnetic Indicator (RMI)

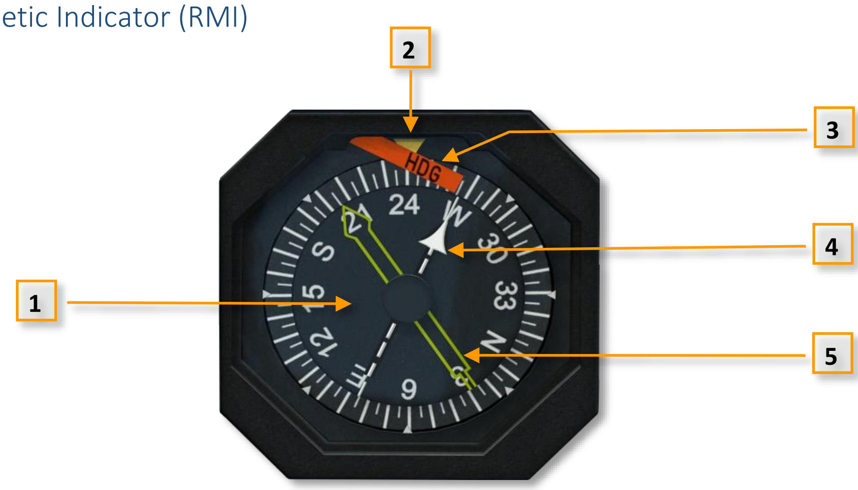


Figure 3-81 RMI

1 ROTATING COMPASS DIAL

2 HEADING REFERENCE INDEX

3 TARSYN FAILURE WARNING FLAG

4 SINGLE POINTER (VOR)

5 DOUBLE POINTER (TACAN)

There is a Radio Magnetic Indicator (RMI) located on the instrument panel of each cockpit. It gets heading data from the TARSYN gyroscopic system. The aircraft magnetic heading is displayed beneath the heading reference index. The warning flag hides the index when the heading indication is inoperative. The single pointer displays VOR magnetic bearing to the selected navigation station. The VOR radial is displayed under the tail of the pointer. The double pointer displays TACAN magnetic bearing to the selected station. The TACAN radial is displayed under the tail of the pointer. Both work independently of VOR/TACAN push-button selection.

IFF AN/APX-101

The aircraft is equipped with an IFF transponder.

The other ground or airborne interrogating unit transmits a coded pulse sequence that actuates the aircraft transponder. The transponder answers to the coded sequence by transmitting a pre-selected coded sequence back to the interrogating equipment, providing positive aircraft identification and, if required, altitude reporting data.

The equipment has four modes of operation: modes 1, 2, 3/A and C. Modes 1 and 3/A provide security identification and traffic identification respectively. Mode 2 codes are set by the ground station to provide Selective Identification Feature (SIF). The SIF enables the aircraft to transmit codes as directed within each IFF mode. Mode C provides altitude reporting to the interrogating station. The equipment is energized by the 28V DC primary bus and the 115V AC bus.

The IFF is currently not implemented in DCS.

IFF AN/APX-101 Control Panel

The IFF control panel is mounted on the front cockpit pedestal. The controls are described in the following figure. The controls numbered 2, 11, 12 and 13 are inoperative on this installation.

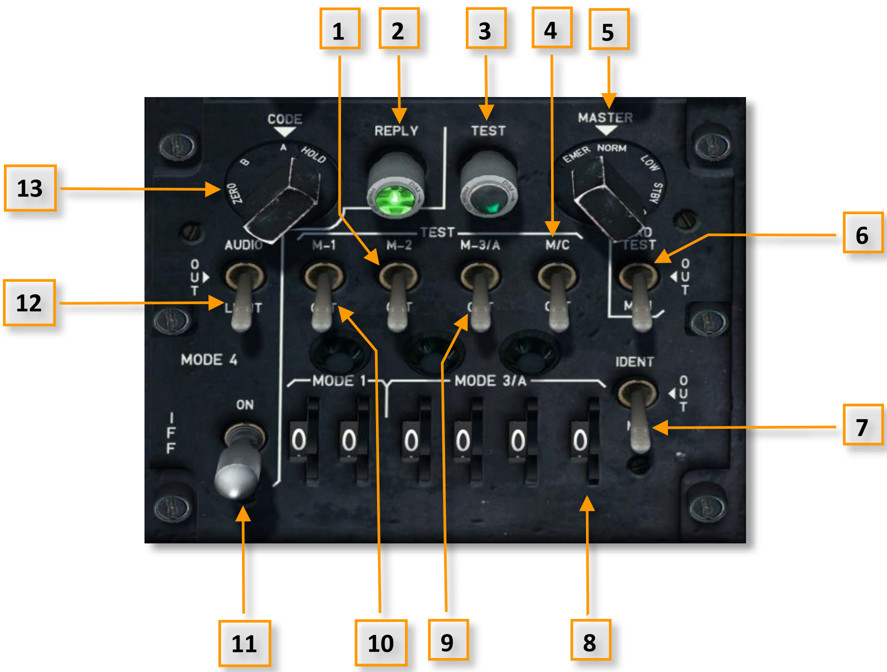


Figure 3-82 IFF panel

1 MODE 2 SELECTOR SWITCH

2 INOPERATIVE

3 TEST LIGHT

4 MODE C SELECTOR SWITCH

5 MASTER SWITCH

6 TEST SWITCH

7 IDENT SWITCH

8 3/A CODE SELECTORS

9 MODE 3/A SELECTOR SWITCH

10 MODE 1 SELECTOR SWITCH

11 INOPERATIVE

12 INOPERATIVE

13 INOPERATIVE

3.19. LIGHTING SYSTEM

The aircraft lighting system consists of internal and external lighting. The internal lighting comprises auxiliary cockpit lighting, spot/map reading lights (not functional in DCS: C-101), storm lights, console panel lights and integrated instrument lights. The external aircraft lighting consists of an anti-collision light and formation, position and landing lights. The internal lighting is controlled from a panel located on the right console of each cockpit. The external lighting controls are incorporated in the front cockpit panel only.

In DCS: C-101, the pilot is equipped with a personal pocket light torch, which is switched on with the key combination (RCTRL+RSHIFT+L).

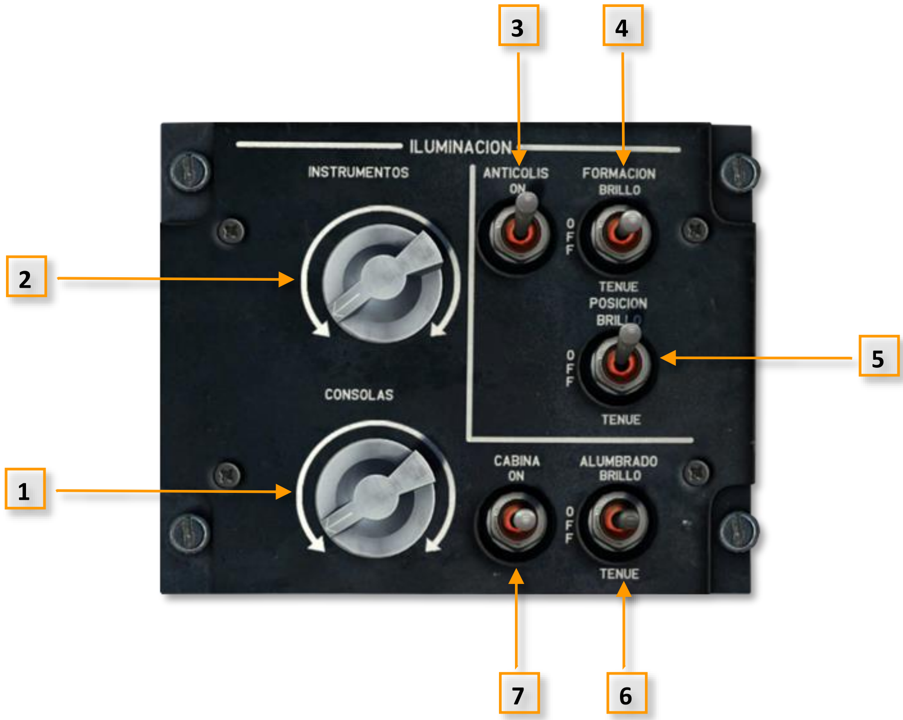


Figure 3-83 Front cockpit lighting panel

1 CONSOLE LIGHTS SWITCH

2 INTEGRAL INSTRUMENT LIGHT SWITCH

3 ANTI-COLLISION LIGHT SWITCH

4 FORMATION LIGHTS SWITCH

5 POSITION LIGHTS SWITCH

6 AUXILIARY LIGHTS SWITCH

7 STORM LIGHTS SWITCH

The red auxiliary lights are energized by the 28V DC essential bus through the circuit breaker labeled ALUMBRADO. Two levels of brightness can be selected through the auxiliary light switch, which has three positions, BRILLO (BRIGHT), OFF and TENUE (DIM).

The storm lights, two in each cockpit, are white high intensity lights that counter the dazzling effect of lightning flashes. They are energized by the 28V DC secondary bus through a circuit breaker labeled ILUM INSTR LUZ CAB Y ANTICOLIS (LIGHTS: INSTR. CPT and ANTI-COLL).

The console panel lights are energized by the 115V AC bus through a circuit breaker labeled LUZ CONSOLAS (CONSOLE LTS).

The integral instrument lights are energized by the 28V DC bus through the same circuit breaker as the console lights.

The formation lights are energized by the 115V AC bus through a circuit breaker labeled LUZ FORM (FORM LTS). The switch provides two levels of lighting intensity, BRILLO (BRIGHT) and TENUE (DIM).

The position and silhouette lights consist of a green right wing tip light, a red left wing tip light and white tail light plus a white silhouette light on either side of the center fuselage. They are energized by the 28V DC primary bus through a circuit breaker labeled LUZ POSICION FARO DERECHA (POS LT, RH LDG LT).

The anti-collision light is located in the upper vertical stabilizer. It is energized by the 28V DC secondary bus through the circuit breaker labeled ILUM INSTR LUZ CAB Y ANTICOLIS.

There is a retractable landing light under each wing. They are energized by the 28V DC primary bus through the circuit breakers labeled LUZ POSICION FARO DERECHA and FARO IZQ. (LH LDG LT). Each light is controlled by a switch located on the lower left of the instrument panels. They have three positions labeled DENTRO (RETRACT), RODAJE (TAXI) and ATERRIZAJE (LAND).

Figure 3-84 C-101 Royal Jordanian Air Force

3.20. MISCELLANEOUS EQUIPMENT

Map Case

A map case is located in the right console of each cockpit.

Figure 3-85 Map case

Mirror

There is a rear view mirror mounted on the front cockpit right windshield frame.

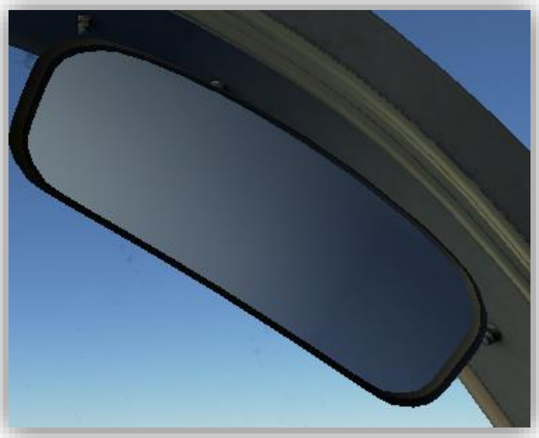


Figure 3-86 Mirror

Instrument Flight Training Blackout Curtains

The rear cockpit can be equipped with blackout curtains for instrument flight training.

Figure 3-87 Blackout curtains

NORMAL PROCEDURES

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4. NORMAL PROCEDURES

The normal procedures in DCS: C-101EB and therefore in this manual start with the interior inspection. All previous checks like flight limitations, flight planning, takeoff and landing data card, weight and balance and before exterior inspection and exterior inspection are considered performed.

Note: (A)/(B) in the checklists below stand for front/rear cockpit respectively.

4.1. INTERIOR INSPECTION

1 EJECTION SEAT PINS	INSERTED

2 (B) EJECTION SEQUENCE VALVE	AS REQUIRED

3 LEG RESTRAINTS SURVIVAL KIT HARNESSES RUDDER PEDALS	ADJUSTED ATTACHED ADJUSTED ADJUSTED

LEFT CONSOLE

4 CIRCUIT BREAKERS	ALL IN
Check the reason for any disconnected circuit breaker before reconnecting it.	

5 EMERGENCY PITCH TRIM GUARD	IN

6 EMERGENCY TRIM BREAKER	IN

7 THROTTLE	FULL RANGE AND STOP
Take the throttle out of STOP, check its full range of travel and leave it in STOP.	

8 IGNITION	OFF

9 START SWITCH	NORMAL

10 GPU	CONNECT
Press LEFT SHIFT + P to connect the GPU to the airplane. It will be ready to provide electrical power later on when the Korry is pressed.	

11 TRANSFER PUMP SWITCHES	(A) OFF (B) ANT (FRONT)

LEFT PANEL

12 LANDING LIGHT SWITCHES	(A) IN (B) ANT (FRONT)

13 (A) STALL WARNING SWITCH	ON

14 PARKING BRAKE	(A) SET (B) RELEASE

CENTRAL CONSOLE

15 ACCELEROMETER	1 G
Reset the accelerometer to 1 G.	

16 UHF RADIO	OFF

17 (A) UHF ANTENNAS	AUT

18 TARSYN	COMPASS

19 ALTIMETER	AIRFIELD ELEVATION

20 CLOCK	SET

21 EMERGENCY HORIZON	LOCKED

22 (A) IFF	OFF

RIGHT PANEL

23 (A) INVERTER SWITCH	OFF

24 (A) GENERATOR SWITCH	OFF

25 (A) BUS TIE SWITCH	OFF

26 (A) BATTERY SWITCH	OFF

RIGHT CONSOLE

27 (A) CABIN ALTIMETER	SET
Check that it is set to the airfield elevation.	

28 INTERIOR LIGHT SWITCHES	OFF

29 (A) POSITION LIGHTS SWITCH	BRIGHT

30 (A) ANTI-COLLISION LIGHT SWITCH	ON

31 VOR CONTROL PANEL	OFF

32 (A) TACAN CONTROL PANEL	OFF

33 OXYGEN VALVE LEVER	OPEN

34 VHF COMM CONTROL PANEL	OFF

35 (B) OXYGEN FAILURE WARNING SWITCH	BOTH

36 AUDIO CONTROL PANEL	AS REQUIRED
In normal flight, at least the rotaries for INT, UHF, VHF, HOT MIC and HOT MIC TALK are raised, and the selector switch is set in VHF or UHF.	

37 (A) AIR CONDITIONING SWITCH	OFF

38 (A) TEMPERATURE SELECTOR SWITCH	AUTO

39 (A) FLOW SELECTOR	CABIN

40 (A) MANUAL TEMPERATURE SELECTOR	12 O'CLOCK
Considering the nose of the aircraft as twelve o'clock.	

41 EMERGENCY VENTILATION SWITCH	OFF

4.2. BEFORE START

1 BATTERY SWITCH	ON

2 BATTERY VOLTAGE	CHECK
Check the voltage for each battery separately - it should be 24V.	

3 GPU	ON
The GPU connects to the secondary bus. GPU ON illuminates in the switch. Battery isolation switches illuminate. Batteries and generator disconnect automatically.	

4 ESSENTIAL BUS TRANSFER SWITCH	ON and then OFF
Check the connection of the essential bus to the secondary bus (indicator switch illuminated ON), and to the primary bus (indicator switch extinguished). Leave in this position.	

5 BUS TIE SWITCH	ON
The secondary bus connects to the primary bus, both receive current from the GPU.	

6 INVERTER SWITCH	STANDBY

7 INTERCOM	CHECK OPEN
This was already done in the interior inspection.	

8 SEATS AND PEDALS	ADJUSTED
The proper seating position is one that allows the front pilot to see the bulkhead flushed with the top of the fault lights upper frame. Also, the pitot tube is just seen above the nose. The rear pilot must ensure that his seat is set, so his head is below the level of the canopy breakers to avoid injuries during an ejection.	

9 IGNITION LIGHT	PRESS AND CHECK
Press to test.	

10 COMPUTER SWITCH	ON
Depress the korry, so the light is extinguished.	

11 FUEL PANEL	CHECK
a. Fuel Available Indicators	CHECK
A GREEN horizontal bar indicates fuel available, a RED horizontal bar indicates low fuel level.	
b. Fuel Quantity Switch	CHECK
If the fuel quantity selector switch illuminates FUS, the gauge indication corresponds to the contents of the fuselage tank. If the switch is extinguished, the gauge indication corresponds to the contents of the fuselage tank plus center wing tank. The required gauge indications are selected by depressing the switch cap.	
c. Transfer Pump Switches	OFF
Check the fuel pressure indicator displays a red horizontal bar to indicate low pressure. Depress the fuel quantity switch to indicate FUS tank contents (FUS displayed). Depress the TEST switch (front	

position only) and note the FUS light extinguishes and the quantity gauge indicates the fuselage plus center wing tank contents.	
d. Transfer Pump Switches	AUTO - MAN - OFF
Alternately connect each fuel pump in tanks which contain fuel. As each pump is connected in both MAN and AUTO positions, note satisfactory pressure is indicated by the display of a green horizontal bar in the fuel pressure indicator, then switch OFF.	

12 TRANSFER PUMP SWITCHES	AUTO
After each pump has been checked independently, leave the required switches in AUTO. Only connect those pumps in tanks with green indications showing the presence of fuel.	

13 FUEL QUANTITY SELECTOR	FUS
Korry illuminates FUS.	

14 BOOST PUMP SWITCH	ON
When the korry is extinguished, the boost pump is energized when the power lever is advanced from STOP during engine start.	

15 FUEL SHUTOFF VALVE SWITCH	OPEN
When the korry is extinguished, the fuel shutoff valve is energized open. LLAV. COMB. (FUEL VALVE) light in warning/caution panel extinguishes.	

16 TRIPLE TEST	STALL WARNING, FUEL FLOW, FIRE WARNING
a. Stall Warning	CHECK
Set the switch to SIST (TEST). The AVIS. PERD. (STALL) caution panel light comes on. After eight seconds pedals start to vibrate and after 10 seconds the caution panel light goes out. Set the switch to TRANS (RESET) to verify that the transmission between the AoA probe and the system is correct, the stall warning lights again. Leave it in neutral position.	
b. Fuel flow/fuel used indicator	CHECK
Hold the indicator TEST button for about 30 seconds until the totalizer shows 10. The indication of the flow meter will be 1200 lb/h. Reset the totalizer.	
c. Fire Detection	CHECK
Press the Master FIRE warning, check that the FIRE warning light, the red FIRE light in the warning panel and an acoustic warning activate.	

17 VOLTMETER	CHECK (28V)
Check at 28V DC from the GPU.	

18 WARNING/CAUTION PANEL	DIM/BRIGHT and TEST
Hold the warning/caution panel test switch to PRUEBA (TEST) and observe illumination of all the panel lights. Select TENUE/BRILLO (DIM/BRIGHT) as required.	

19 INVERTER SWITCH	NORMAL
When set to NORMAL, there will be a warning in case of inverter failure.	

4.4. START

1 4 RED, 1 AMBER, ITT<200°, 28V	

2 AREA	CLEAR

3 IGNITION SWITCH	START
Hold the switch to START for 2 seconds. Note the ignition lamp illuminates. Voltage equal to or higher than 15 V.	

4 AT 10% N2: POWER LEVER	IDLE
Check: a. N1 indication before 20% N2 b. ITT and oil pressure rise within 10 seconds c. Fuel flow stabilized at 200 lb/h d. Hydraulic pressure in green arc at 3000 psi e. Ignition lamp off at 50% N2	

5 ENGINE INSTRUMENTS	STABILIZED
N1: 29-33% N2: 58-71%	

4.5. AFTER START

1 GPU	OFF
Observe the battery lights extinguish.	

2 GPU	UNPLUG

3 GENERATOR	RESET/ON
Pass through RESET before setting to ON. XGENCC (GENERATOR) warning panel light extinguishes.	

4 GENERATOR TEST	CHECK
Hold the switch alternately to GF and OV. Check that in each position the red XGENCC (GENERATOR) warning panel light illuminates.	

5 NAV and COMMS EQUIPMENT	AS REQUIRED
Connect UHF, VOR, TACAN and VHF as required.	

6 STANDBY ARTIFICIAL HORIZON	UNCAGE

7 IFF	STBY

8 HYDRAULIC PRESSURE	GREEN (3000 PSI)

9 AIRBRAKE	CHECK and IN
Extend the speed brake and note the indicator light illuminates OUT. Retract and note the light indicates IN.	

10 FLAPS	DOWN and TAKEOFF
Set flaps to TAKEOFF and DOWN, check correct indications. Leave them in TAKEOFF.	

11 AILERONS	CHECK
Ensure correct aileron movement as well as full and free travel.	

12 TRIM TONE BREAKER	IN
A tone will be heard while trimming when the breaker is in.	

13 PITCH TRIM	CHECK and SET
Trim up to the maximum extension. Start to trim down. While holding the trim down, open the emergency pitch trim guard. Observe that the control stick trim stops working. Check the emergency trim upward and downward. Close the guard, continue trimming down until full extension. Trim up until an indication of -1.5 for takeoff.	

14 TRIM TONE BREAKER	AS REQUIRED
Note that with trim tone breaker pulled out, the emergency trim guard will not cut out a malfunction of auto-trimming due to speed brake use.	

15 AILERON TRIM	CHECK and 0
Check that aileron trim works to both sides and leave it at neutral.	

16 PITOT HEAT and PROBE	CHECK and AS REQUIRED
Check the pitot and AoA probe heat and leave it as required.	

17 STALL WARNING SWITCH	ON

18 ENGINE ANTI-ICE	CHECK and AS REQUIRED
Depress the anti-ice switch and observe ON illuminates. The amber anti-ice caution panel light appears briefly until the pneumatic pressure required to turn off the warning is reached.	

19 ENGINE COMPUTER	CHECK and ON
Check that oil temperature is above 30°C. Disconnect the computer and observe that engine parameters vary slightly and remain within normal parameters. Advance the throttle to 75% N2, watch normal engine response. Return the throttle to IDLE and reconnect the computer.	

20 LIGHTS	CHECK and AS REQUIRED
Adjust the lighting as required. On night flights, landing lights will be checked. Set interior lighting. Set exterior lighting.	

21 INSTRUMENTS	CHECK
Check all navigation equipment in case of instrument flight.	

22 OXYGEN	100% and NORMAL

23 CANOPY	CLOSE and LOCK
BLOC. CAB (CANOPY) warning panel light extinguishes.	

24 AIR CONDITIONING	RESET and ON

25 SEAT PIN	REMOVE and SHOW
Remove the seat pin, show it to the technician and stow it.	

Request taxi clearance. Check that the area is clear before starting to taxi.

4.6. TAXI

Remove wheel chocks, 50% N1, release parking brake, check brakes. Throttle idle during turns.

1 FLIGHT CONTROLS	CHECK
Check full and free travel.	

2 ENGINE and FLIGHT INSTRUMENTS	CHECK
Check all indications for normal operation and within limits.	

3 TRANSFER PUMPS BOOST PUMP and FUEL SHUTOFF VALVE FUS	AUTO KORRY OFF ON

4 SPEED BRAKE FLAPS	IN TAKEOFF

5 LANDING GEAR LIGHTS WARNING/CAUTION LIGHTS	THREE GREEN OFF

6 SHOULDER HARNESS	CHECK
Check the harness is locked.	

7 TRIMS	-1.5 and 0
Pitch must be at -1.5° and bank at 0°	

4.6. BEFORE TAKEOFF

1 CANOPIES	CLOSED and LOCKED
Check the red BLOC. CAB (CANOPY) warning panel light is extinguished.	

2 ANTI-SKID	CHECK and ON
Set to OFF, check brakes and set to ON. Check the anti-skid switch does not illuminate OFF or ANTI-SKID. The switch should be extinguished.	

3 ALTIMETER	QNH
Set current S.L. atmospheric pressure in the barometric scale window.	

4 PITOT HEAT SWITCH	ON

5 SEAT PIN	REMOVED

6 IGNITION SWITCH	CONTINUOUS
Set the ignition switch to IGNIC. CONT (CONT IGN).	

7 IFF	CODE and NORM

8 FLOW SELECTOR	CABIN

9 NAVIGATIONAL AIDS	APP/SID
Select required navaids for the approach/standard instrument departure.	

Request ATC clearance. Check that the area is clear before entering the runway.

4.7. TAKEOFF

1 ADI	CHECK

2 DIRECTIONAL GYRO	COMPASS and RWY HDG
Check directional gyro with magnetic compass and runway heading.	

3 ANTI-ICE	AS REQUIRED

4 ENGINE RUNUP	N_1, N_2, ITT, OIL TEMP, FF, VOLT
Apply brakes and advance throttle to MAX. Check % N_1, % N_2, ITT, oil temperature, fuel flow and voltage for normal indications and within limits.	

Release brakes, rudder becomes effective at 40 kts, rotate at 105 kts, gear up at 120 kts and with positive rate of climb, flaps and lights retraction at 125 kts.

4.8. CROSSWIND TAKEOFF

In heavy crosswinds, the rudder is less effective in directional control and more differential braking is required in compensation. During the ground roll, hold aileron into wind. At liftoff, counteract drift by crabbing into the wind and neutralizing the ailerons.

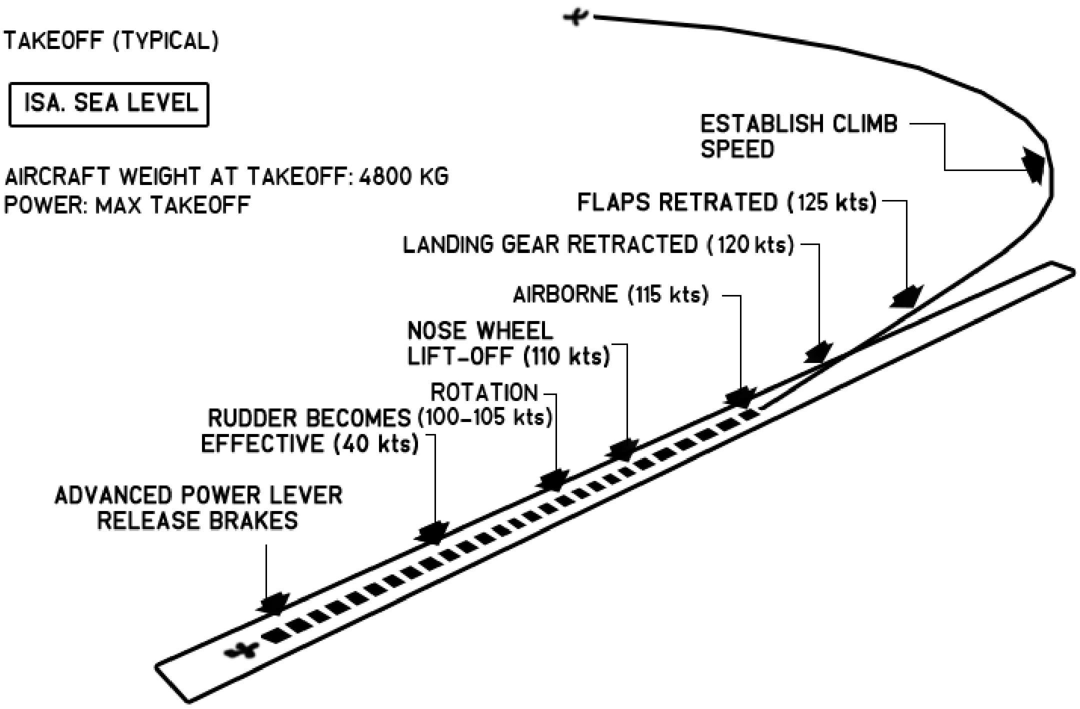


Figure 4-1 Typical takeoff pattern

4.9. CLIMB

6000 ft CLIMBING

1 IGNITION	OFF

2 ALTIMETER	AS REQUIRED
Set standard pressure (1013,25 mb) when passing transition altitude.	

3 Ferry flight: CENTER WING transfer pumps	OFF
In ferry flights, disconnect the center wing transfer pumps until outer wing tanks are empty.	

10000 ft CLIMBING

1 ANTI-ICE	AS REQUIRED

2 OXYGEN	CHECK
Verify correct pressure indication and oxygen flow.	

3 CABIN ALTITUDE	8000 ft

4 ENGINE INSTRUMENTS	CHECK
Check all indications for normal operation and within limits.	

5 HYDRAULIC	CHECK

6 VOLTAGE	CHECK

7 FUEL	CHECK
Check fuel flow, pressure and quantity. Check wing tank fuel pumps as required.	

4.10. CRUISE

Perform the following checks at frequent intervals (15 min approx.).

1 OXYGEN	CHECK

2 CABIN ALTITUDE	CHECK

3 ENGINE INSTRUMENTS	CHECK

4 HYDRAULIC	CHECK

5 VOLTAGE	CHECK

6 FUEL	CHECK

4.11. DESCENT

Rapid descents generally cause the most severe condensation problems. It is therefore recommended to select maximum cockpit temperature compatible with crew comfort before commencing descent, especially in a rapid descent. The air-conditioning panel flow selector should be set to CRISTAL (WINDSHIELD) for protection against windshield and canopy fogging.

1 ADI	CHECK

2 DIRECTIONAL GYRO	CHECK with COMPASS

3 IGNITION	CONTINUOUS

4 ANTI-ICE	AS REQUIRED

5 ALTIMETER	AS REQUIRED
Set QNH when passing transition level. QFE (pressure at airfield elevation) might be required in some particular airspaces like Russian airspace.	

6 FLOW SELECTOR SWITCH	AS REQUIRED

7 OXYGEN	CHECK

8 ENGINE, FLIGHT and NAV INSTRUMENTS	CHECK

9 PITOT HEAT	ON

10 FUEL	CHECK

4.12. BEFORE LANDING

1 IGNITION	CONTINUOUS

2 HYDRAULIC PRESSURE	GREEN (3000 PSI)

3 ALTIMETER	QNH

4 ANTISKID	ON

5 In IFR approach: MK BUTTON	OUT

4.13. LANDING

For landings on runways of non-critical length, aerodynamic braking may be used to conserve brakes and tires. Flare the aircraft at 110 KIAS over the threshold and touch down at 95 KIAS on the main landing gear. Hold the nose wheel off the runway by progressive application of aft stick until, when fully aft, the nose wheel smoothly lowers to contact the runway. Apply brakes and counteract yaw and maintain directional control by use of rudder in combination with differential braking. Rudder effectiveness decreases with diminishing rollout speed.

4.14. CROSSWIND LANDING

A sideslip into wind is recommended to counteract drift and maintain alignment with the runway centerline. In strong crosswinds, a combination of sideslip and crab may be used. The wings must be level at touchdown. After touchdown, hold ailerons into wind and maintain directional control with rudder in combination with differential braking.

Figure 4-2 C-101 Patrulla Águila 1985

LANDING PATTERN (TYPICAL)

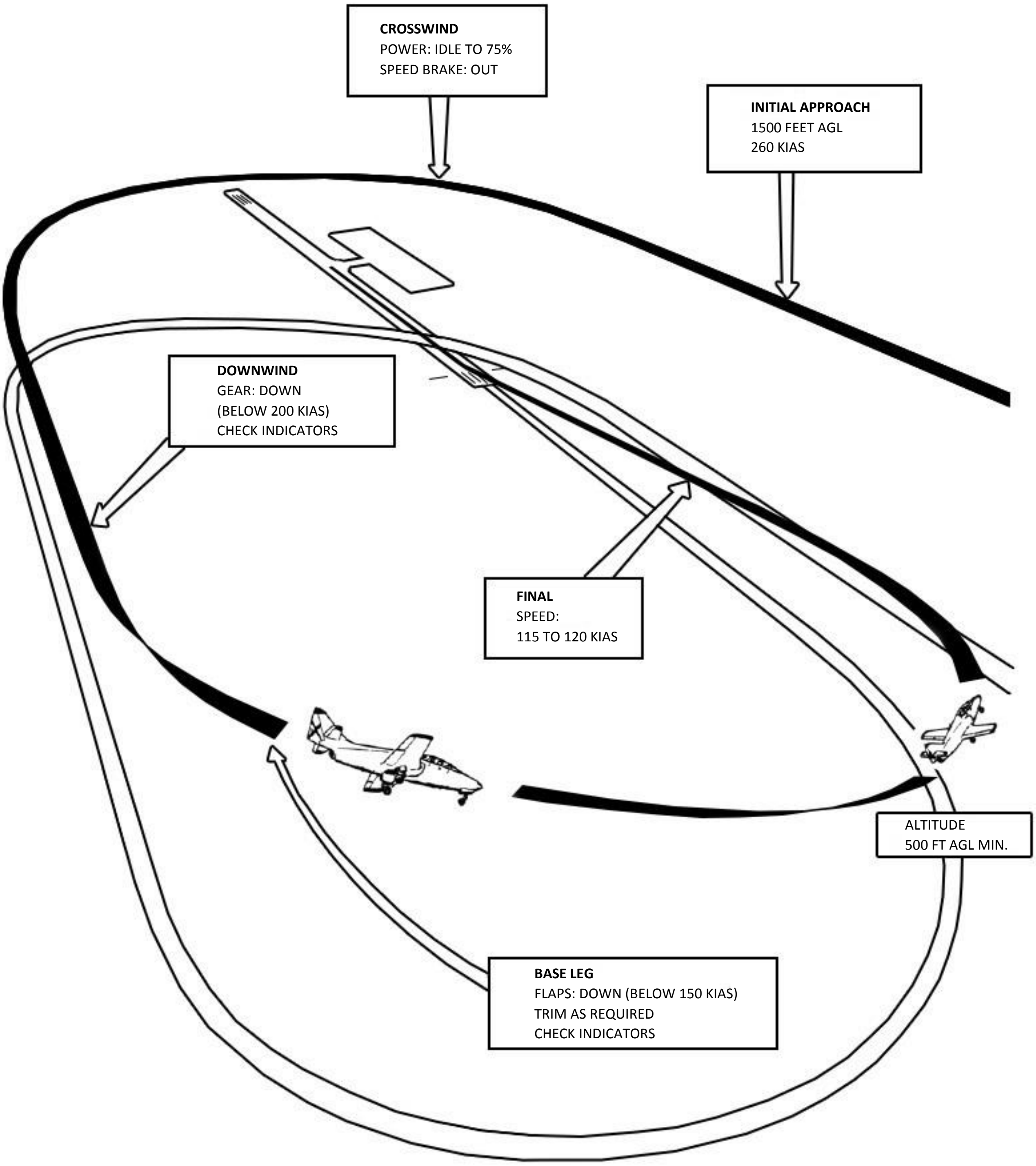


Figure 4-3 Typical landing pattern

4.15. MISSED APPROACH

1 POWER LEVER	MAX

2 SPEED BRAKE	IN

3 TRIM	AS REQUIRED

4 GEAR	UP
Retract the gear when a positive rate of climb is established.	

5 FLAPS	UP

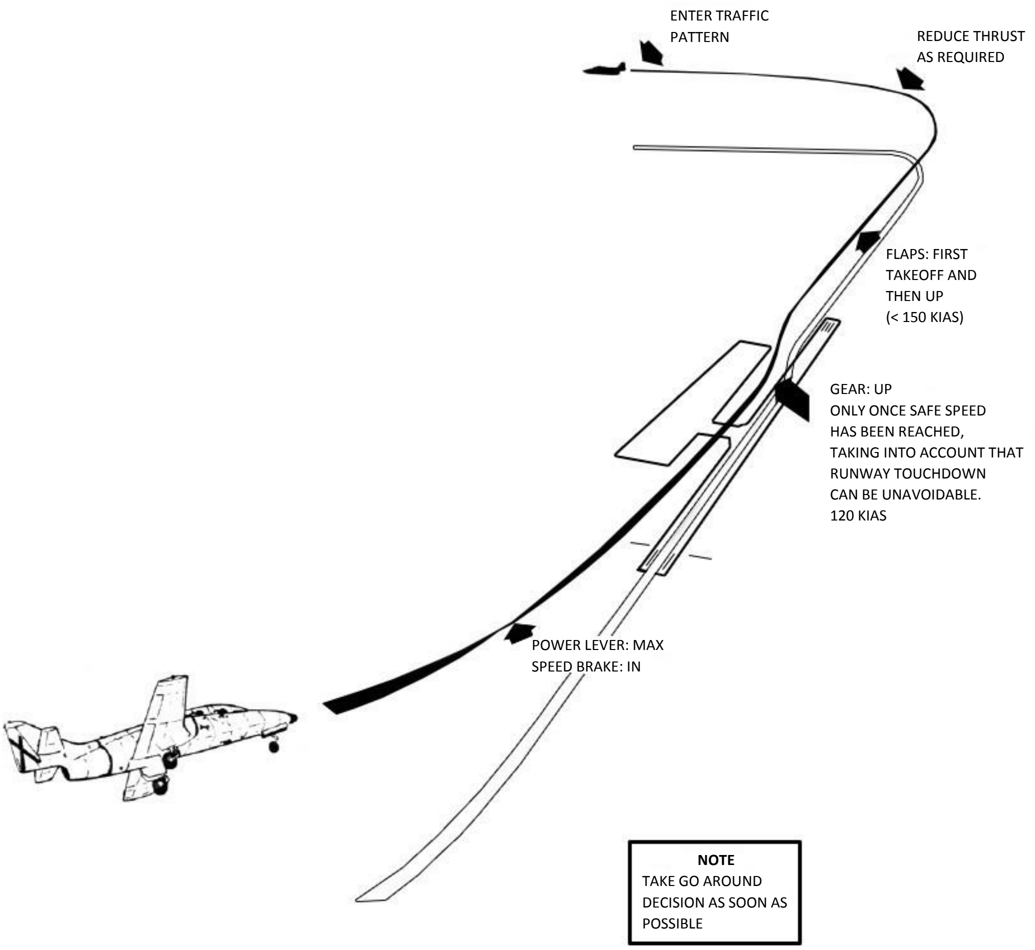


Figure 4-4 Missed approach

4.16. AFTER LANDING

1 SEAT PIN	INSERT

2 PITOT HEAT	OFF

3 ANTI-ICE	OFF

4 IGNITION	OFF

5 LANDING LIGHTS	AS REQUIRED

6 SPEED BRAKE	IN

7 FLAPS	UP

8 IFF	OFF

9 VOR	OFF

10 TACAN	OFF

4.17. PARKING

1 WHEEL CHOCKS	IN PLACE

2 PARKING BRAKE	SET/AS REQUIRED
After heavy braking do not set the parking brake until a suitable brake cooling time has elapsed.	

3 POWER LEVER	IDLE
Maintain the power lever in IDLE (<38 N_1) for a minimum of 2 minutes before shutdown.	

4 SPEED BRAKE	AS REQUIRED

5 FLAPS	DOWN and then UP

6 STANDBY HORIZON	CAGED

7 UHF, VHF RADIOS	OFF

8 AIR CONDITIONING	OFF

9 CANOPY	OPEN

10 FUEL BOOST PUMP SWITCH	OFF
Depress the switch and check that it illuminates OFF.	

11 FUEL TRANSFER PUMP SWITCHES	OFF
Check that each fuel transfer pressure indicator displays a horizontal red bar.	

12 POWER LEVER	STOP

Check minimum spool down times:
N_2 → 15 seconds
N_1 → 50 seconds

13 FUEL SHUTOFF VALVE SWITCH	OFF
Depress the switch and check that it illuminates OFF.	

14 INVERTER SWITCH	OFF

15 GENERATOR SWITCH	OFF

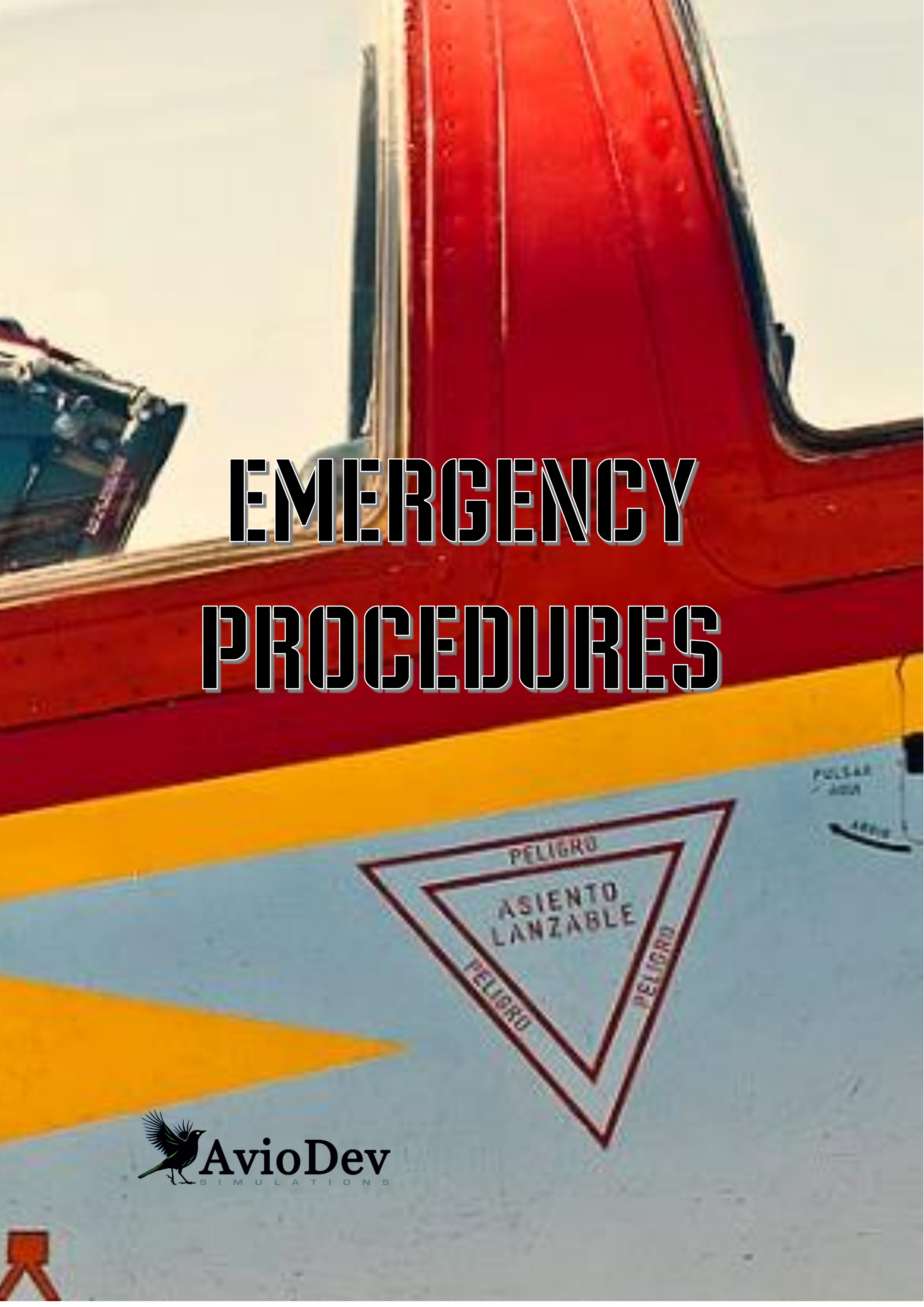
16 BUS TIE SWITCH	OFF

17 BATTERY SWITCH	OFF
Set the switch to OFF at 0% N_1.	

18 ILLUMINATION	OFF
Anti-collision OFF Exterior illumination OFF Interior illumination OFF	

19 OXYGEN VALVES	OFF

EMERGENCY PROCEDURES



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5. EMERGENCY PROCEDURES

5.1. WHEEL BRAKE FAILURE

Brake failure will occur as a result of complete hydraulic pressure loss.

1 PARKING/EMERGENCY BRAKE	APPLY

5.2. REJECTED TAKEOFF

1 POWER LEVER	IDLE

2 BRAKES	NORMAL or EMERGENCY

5.3. ENGINE FAILURE/FIRE DURING TAKEOFF

If takeoff is refused:

1 POWER LEVER	IDLE

2 BRAKES	EMERGENCY

If takeoff is continued:

1 POWER LEVER	MAX

5.4. EJECTION

1 CORRECT POSTURE	ADOPT

2 EJECTION SEAT FIRING HANDLE	PULL
WARNING: It is essential that the pilot in the rear cockpit keeps his head below the canopy breakers. Failure to do this could result in severe or fatal injuries.	

5.5. ENGINE FIRE IN FLIGHT

1 POWER LEVER	IDLE

2 POWER LEVER	STOP

3 FUEL SHUTOFF VALVE	CLOSE

If the fire continues:

4 EJECT IMMEDIATELY

5.6. ENGINE DAMAGED IN FLIGHT

1 POWER LEVER	IDLE

2 DO NOT ATTEMPT A RESTART

5.7. IN-FLIGHT RESTART

1 POWER LEVER	IDLE

2 IGNITION	START

5.8. OUT-OF-CONTROL RECOVERY

If sufficient altitude is available:

1 STICK and RUDDER	NEUTRAL
Recovery from most out-of-control situations can be effected rapidly by neutralizing the control stick and the rudder.	

2 POWER LEVER	IDLE (unless at low altitude)
The power lever should be retarded to IDLE to reduce the possibility of engine flame-out unless at low altitude where thrust may be needed for recovery.	

Recovery from an out-of-control condition may result in a minimum loss of altitude of 800 - 1500 feet. Avoid buffeting during recovery.

Without sufficient altitude to recover:

3 EJECT IMMEDIATELY

5.9. MAXIMUM GLIDE DISTANCE

Maximum glide distance is attained in clean configuration (flaps, speed brake and gear retracted) and maintaining the recommended gliding airspeeds from the following table, which results in the best glide angle (L/D max).

Rule of thumb: the aircraft will glide 2 nautical miles each 1000 feet of altitude.

FUEL REMAINING IN LBS	GLIDE SPEED IN KCAS
350	125
950	130
1650	135
2300	140
3000	145
3600	150

Figure 5-1 Best glide speed

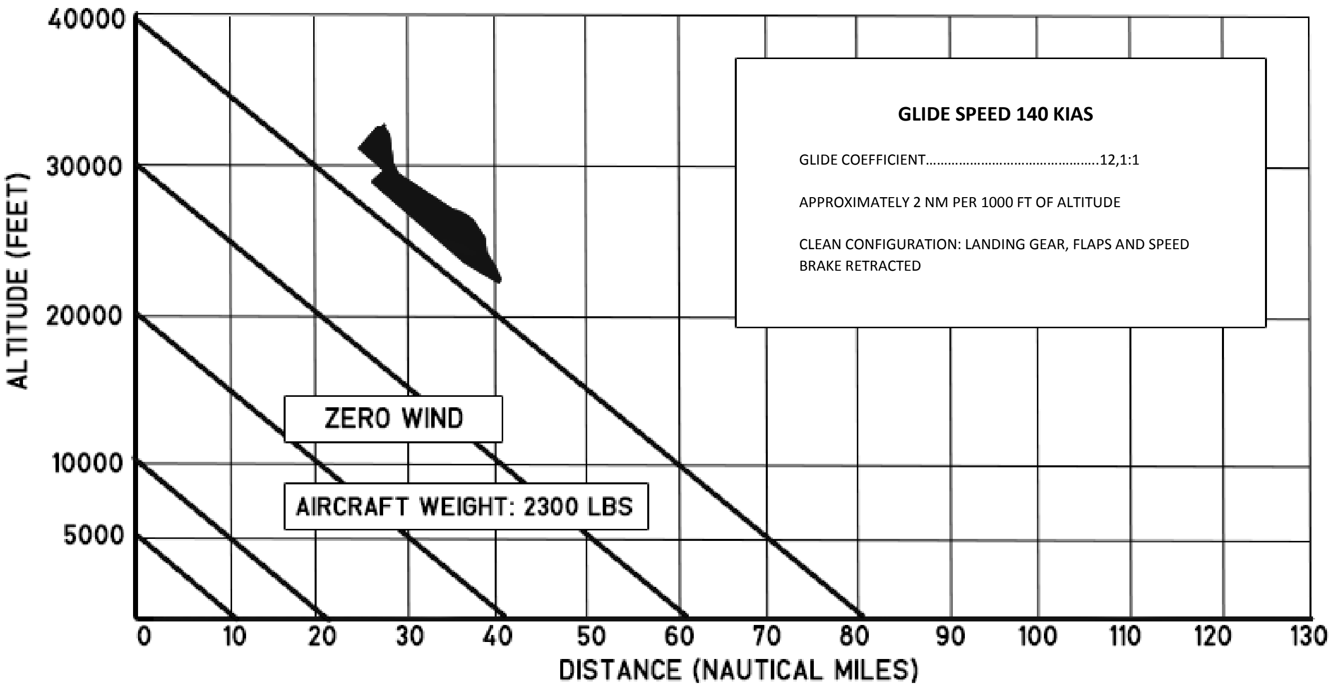

Figure 5-2 Maximum gliding distance

5.10. EMERGENCY GEAR EXTENSION

1 AIRSPEED	BELOW 150 KIAS
2 LANDING GEAR (TREN) CIRCUIT BREAKER	OPEN
3 EMERGENCY GEAR EXTENSION HANDLE	PULL

5.11. HYDRAULIC SYSTEM FAILURE

PRES. HDR. (HYD PRES) warning light illuminates in red when the pressure drops below 2000 psi. The following conditions result:

- Loss of Aileron Servo-actuator. (After accumulator pressure is exhausted).
- Speed brake inoperative.
- Landing gear extension by emergency pneumatic system only.
- Landing gear cannot be retracted.
- Flaps inoperative.
- Emergency braking only. Normal braking inoperative.
- Anti-Skid inoperative.

If a hydraulic system failure occurs:

1 LAND AS SOON AS PRACTICAL

2 LANDING GEAR	EMERGENCY EXTENSION
See emergency gear extension procedure.	

3 FLAPLESS APPROACH
See flame-out landing speeds table. Do not fly below those speeds.

5.12. FLAME-OUT LANDING

FLAME-OUT APPROACH SPEEDS		
FUEL REMAINING lb	SPEED AT POINTS ① ② ③ KIAS	SPEED AT POINT ④ KIAS
355	135	120
1020	140	125
1677	145	130
2340	150	135
3000	155	140

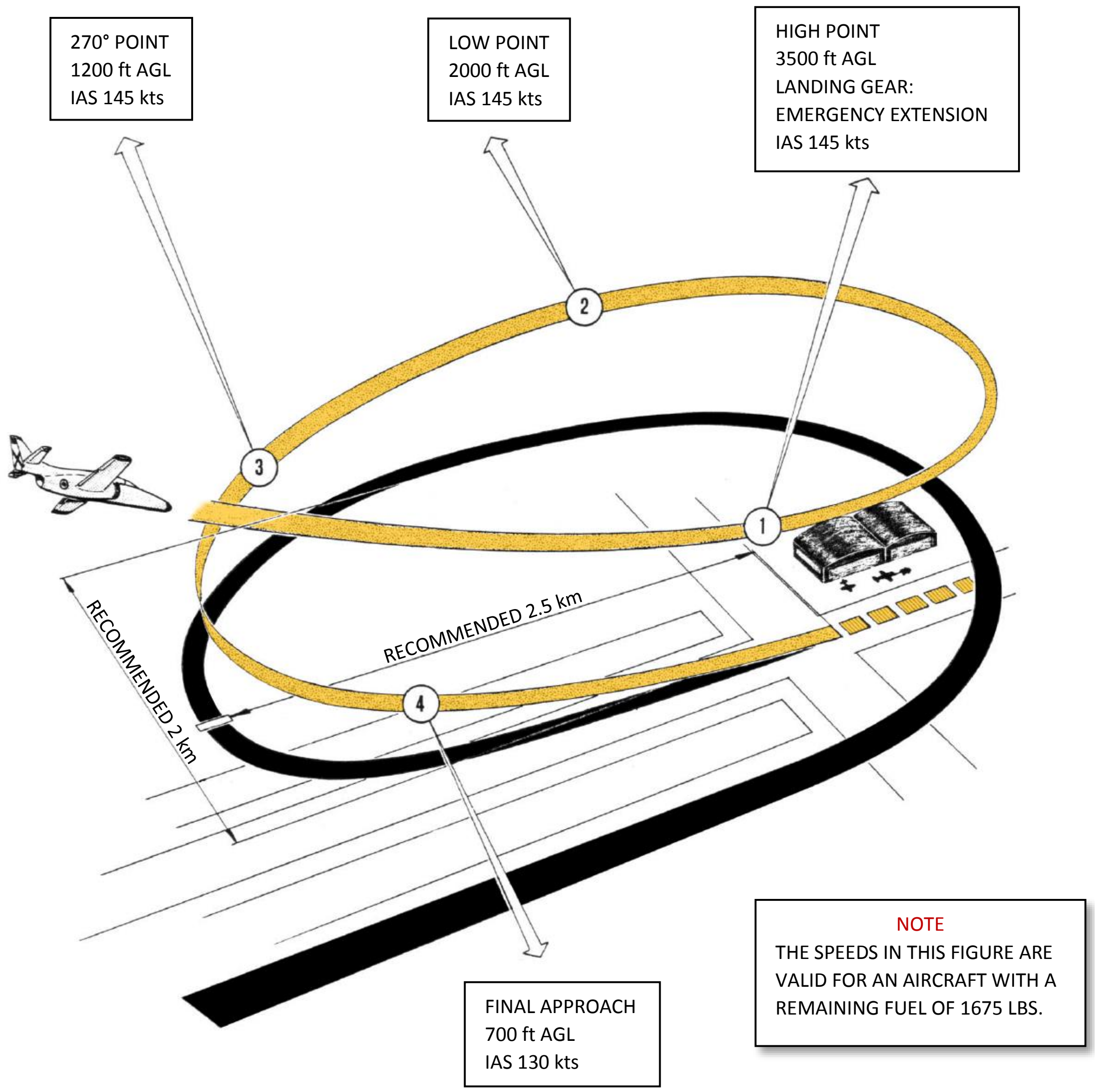

Figure 5-3 Typical flame-out approach pattern

5.13. LANDING WITH HYDRAULIC FAILURE

1 USE EMERGENCY BRAKING SYTEM
Differential braking is not possible using the emergency braking system. Equal pressure is simultaneously applied to both wheel brakes on brake application.

5.14. LANDING WITH BRAKE FAILURE

1 EMERGENCY BRAKE HANDLE	PULL
Differential braking not available.	

If runway excursion is inevitable and terrain is not favorable:

1 CRASH BUTTON	PUSH

2 GEAR	RETRACT

OPERATING LIMITATIONS

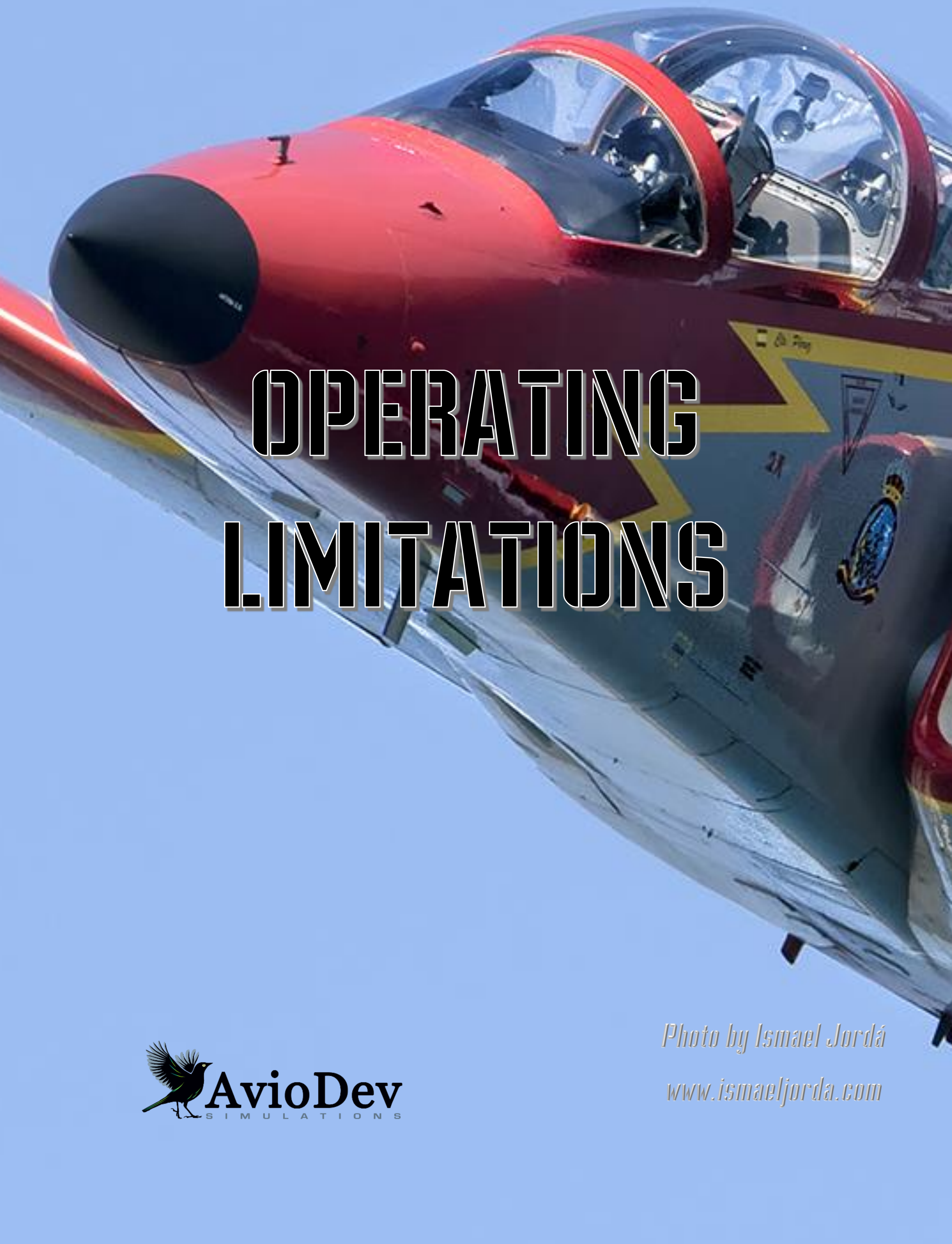

Photo by Ismael Jordá

www.ismaeljorda.com

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6. OPERATING LIMITATIONS

The minimum crew required to operate the aircraft is one pilot occupying the front cockpit.

Instruments are provided with markings that represent the corresponding system limitations.

In general, their meaning is as follows:

Green arc: normal operation range.

Yellow arc: transient operation range.

Red mark: never exceed limit.

LIMITATIONS

ITT		
	ITT DURING START	
		860°C
	ITT LIMITATIONS	
		860°C for 5 min during takeoff 796-832°C for 30 min 795°C maximum continuous

OIL		
	OIL PRESSURE	
		IDLE between 25 and 46 psi NORMAL between 38 and 46 psi MAXIMUM 55 psi for 3 min
	OIL TEMPERATURE	
		30°C MINIMUM 127°C MAXIMUM until 30000 ft 149°C MAXIMUM for 2 min at any altitude

HYDRAULIC		
	HYDRAULIC PRESSURE	
		NORMAL 2850-3050 psi TRANSIENT 3050-3600 psi MAXIMUM 3600 psi

SPEED LIMITATIONS	
	FLAPS TAKEOFF 190 kts FLAPS DOWN 150 kts LANDING GEAR 200 kts LANDING LIGHTS 200 kts

MAX with outer wing tanks empty: Mach 0.8 or 450 kts MAX with outer wing tanks full: Mach 0.7 or 350 kts MAX with aileron servo-actuators inoperative: Mach 0.65 or 300 kts

ACCELERATION LIMITATIONS
POSITIVE +7.5 Gs NEGATIVE -3.9 Gs Without servo-actuators: +5 Gs Unsymmetrical maneuvers: +5 Gs In zero or negative-G flight: 30 seconds

GROUND START CYCLES
First start attempt: 30 sec ON, 1 min OFF Second start attempt: 30 sec ON, 1 min OFF Third start attempt: 30 sec ON, 30 min OFF

AIRSTART CYCLES
Allow a minimum of 10 seconds between start attempts to allow accumulated fuel in the combustion chamber to drain.

Figure 6-1 C-101 Patrulla Águila

FLIGHT CHARACTERISTICS

Photo by Ismael Jordá
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7. FLIGHT CHARACTERISTICS

Maximum speed is Mach 0.8 or 450 KIAS and maximum ceiling can be up to 45000 feet, depending on aircraft weight. The aircraft presents longitudinal and directional stability within the CG range in any internal load configuration. Stability is neutral in the lateral axis, thus eliminating special pilot techniques other than a frequent reference to the lateral attitude. Maneuverability is high, ailerons are hydraulically powered by servo-actuators which permit rather high roll rates. Pitch trim is by action of the horizontal stabilizer and roll trim by differential aileron deflection, both are electrically operated. The speed brake provides rapid deceleration and is operable at all aircraft speeds and attitudes.

7.1. STALLS

A stall can be entered without requiring full control stick back pressure. Pre-stall buffet is felt at about 5 KIAS before the stall with flaps and gear retracted, while the stall warning system activates at 10-15 KIAS above the stall in level flight. With the control stick fully back and centered, the roll oscillations are more pronounced.

Aileron and rudder remain effective during the post-stall regime, and the aircraft remains controllable, unless full aileron and/or rudder are applied. Recovery response is effected immediately by centering the flight controls.

Accelerated stalls are preceded by a clear aerodynamic buffet. The aircraft does not present any adverse characteristics during the approach to the stall or the recovery, which is performed by releasing control stick pressure.

STALL SPEEDS - KIAS						
FLAPS POSITION (°)	GEAR	BANK ANGLE (°)	REMAINING FUEL - KG			
			1015	2115	3220	4100
0	RETRACTED	0	97	103	108	113
		30	104	110	116	121
		45	115	122	129	134
		60	137	145	153	159
10	EXTENDED	0	91	96	102	106
		30	98	104	109	113
		45	108	115	121	126
		60	129	136	144	149
30	EXTENDED	0	84	90	94	98
		30	91	96	101	105
		45	100	106	112	117
		60	119	127	133	139

Figure 7-1 Stall speeds

7.2. SPINS

Inadvertent spins are unlikely. To enter a spin, the control stick and rudder must be deliberately held at full travel. In a normal spin, the aircraft assumes a nose down attitude with slow angular velocity. A flat spin (high angle of attack) is difficult to enter and can only be maintained momentarily. The procedure to deliberately enter a spin is the following:

1) Control Stick – Fully Back
2) Rudder – Full Travel
3) Ailerons – Centered

Engine thrust has little effect on spin characteristics or recovery, neither does the spin cause engine flame-out or surge.

Spin recovery can be accomplished by centering stick and rudder; recovery is rapid and altitude loss does not normally exceed 2000'. In case of a more abrupt spin, the recovery can be forced by applying opposite rudder to the direction of rotation and simultaneously pushing the control stick forward.

Entering an inverted spin is unlikely. In case of loss of control, it may be difficult to determine the direction of rotation. It may be useful to observe the turn needle of the turn and bank indicator as it always indicates the direction of spin rotation. The recovery is accomplished by pulling the control stick fully back and simultaneously applying and holding full rudder opposite to the direction of the turn.

7.3. SIDE SLIPS

The controls permit slipping with excellent recovery characteristics achieved by centering the controls.

7.4. SPEED BRAKE

Speed brake extension causes a nose-up moment that increases with airspeed. A switch in the speed brake circuit automatically activates the pitch trim to compensate for the moment change thus eliminating manual trim input or control stick forces.

7.5. DIVES

No difficulties arise at maximum diving speed as stability is not noticeably influenced by compressibility. Aerodynamic buffeting appears at Mach numbers close to the limit, becoming strong at Mach 0.8. The recommended dive recovery procedure consists of: power reduction, speed brake extension and pull-up with elevators.

Take into account that altitude loss during recovery can be very high. For example: near 5000 ft at 4 Gs and near 4000 ft at 6 Gs, in both cases at maximum airspeed and with 1015 lbs of remaining fuel.


ALL WEATHER
OPERATION
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8. ALL WEATHER OPERATION

The aircraft is fully equipped for instrument flight in all weather conditions.

In case of ice accretion, the aircraft weight increases, aerodynamic qualities reduce, visibility restricts and engine operation can be affected. Nevertheless, the aircraft does not lose flying characteristics rapidly and thus permits time to leave the icing area or select a level free of ice accretion.

The engine is provided with an effective anti-ice system. Windshield and canopy can be heated to avoid mist and freezing. Ignition should be set to continuous when using engine anti-ice.

The aircraft is also equipped with a rain repellent system that can be used in case of heavy rain.

8.1. INSTRUMENT FLIGHT PROCEDURES

AFTER ENGINE START

1) Radios – Check
2) IFF – STBY
3) ADI – Check
4) Flight Director – Check

BEFORE INSTRUMENT TAKEOFF

1) IFF – As required
2) Align the aircraft with the runway centerline. Check HSI heading against known runway magnetic heading.
3) HSI Heading Bug – Set below the heading index.
4) Flight Director Mode Selector – Press HDG. Check the vertical ADI bar is centered.
5) Flight Director Mode Selector – Press PAT. Check the horizontal bar appears and set initial pitch desired.
6) Ignition Switch – IGNIC. CONT (CONT IGN)
7) Engine Anti-Ice Switch – As Required
8) Windshield and Canopy De-Misting – As Required
9) Pitot Heat – As Required
10) Altimeter – Set
11) Engine & Flight Instruments – Check

INSTRUMENT TAKEOFF

1) Hold the aircraft on the brakes and advance the power lever to maximum takeoff power.
2) Release the brakes and maintain directional control.
3) Rotate at 110 knots, so the nose wheel leaves the runway at around 115 knots.
4) Set the climb attitude with wings level (command bars centered).
5) With positive climb (check altimeter and vertical speed indicator) retract the landing gear (minimum retraction speed 125 KIAS). Check gear indicators.
6) Raise flaps (retraction speed 130 - 190 KIAS).

INSTRUMENT CLIMB

1) Establish initial climb from sea level at 215 KIAS. Decrease airspeed by 5 knots each 5000 feet.
2) Check all engine indications are normal and within limitations.

INSTRUMENT DESCENT

See TACAN and VOR patterns in following figures:

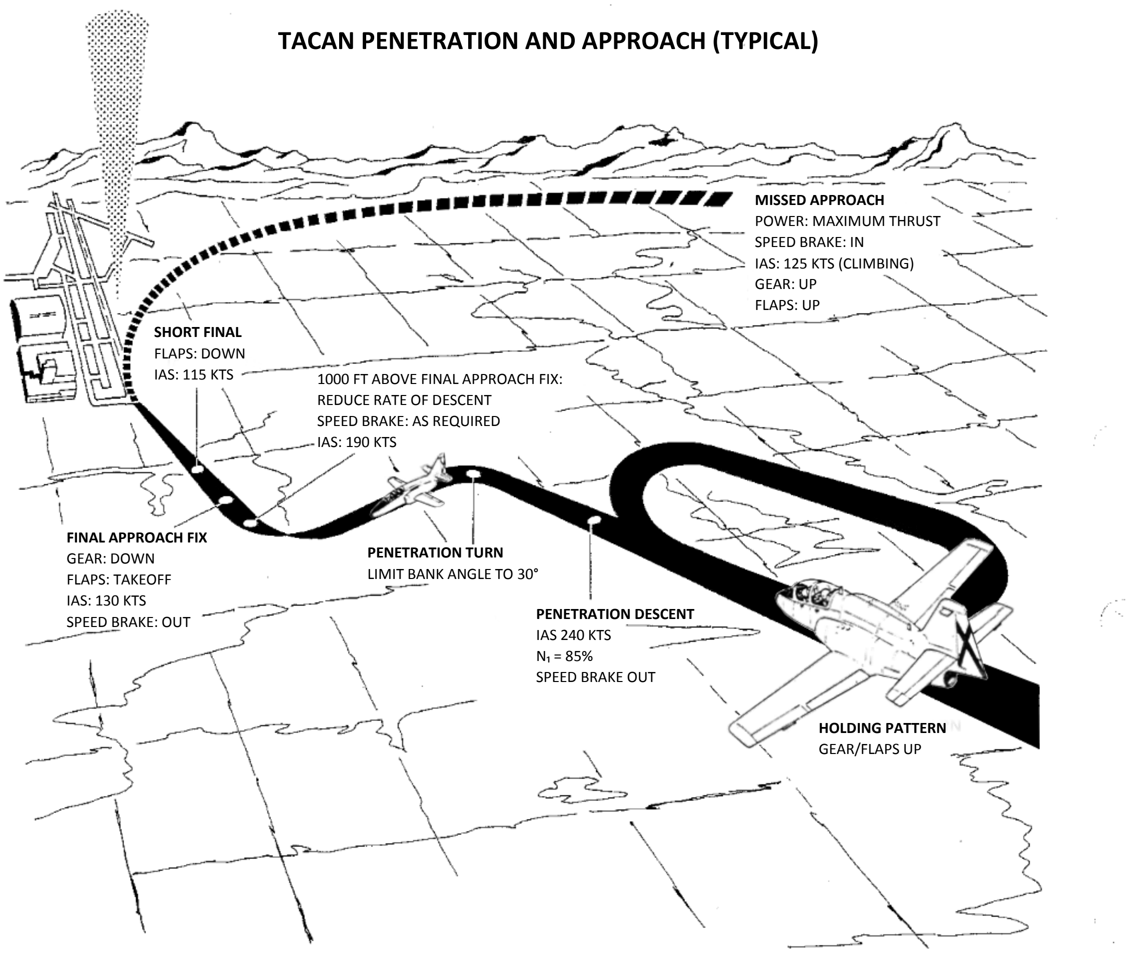

Figure 8-1 TACAN penetration

VOR PENETRATION AND APPROACH (TYPICAL)

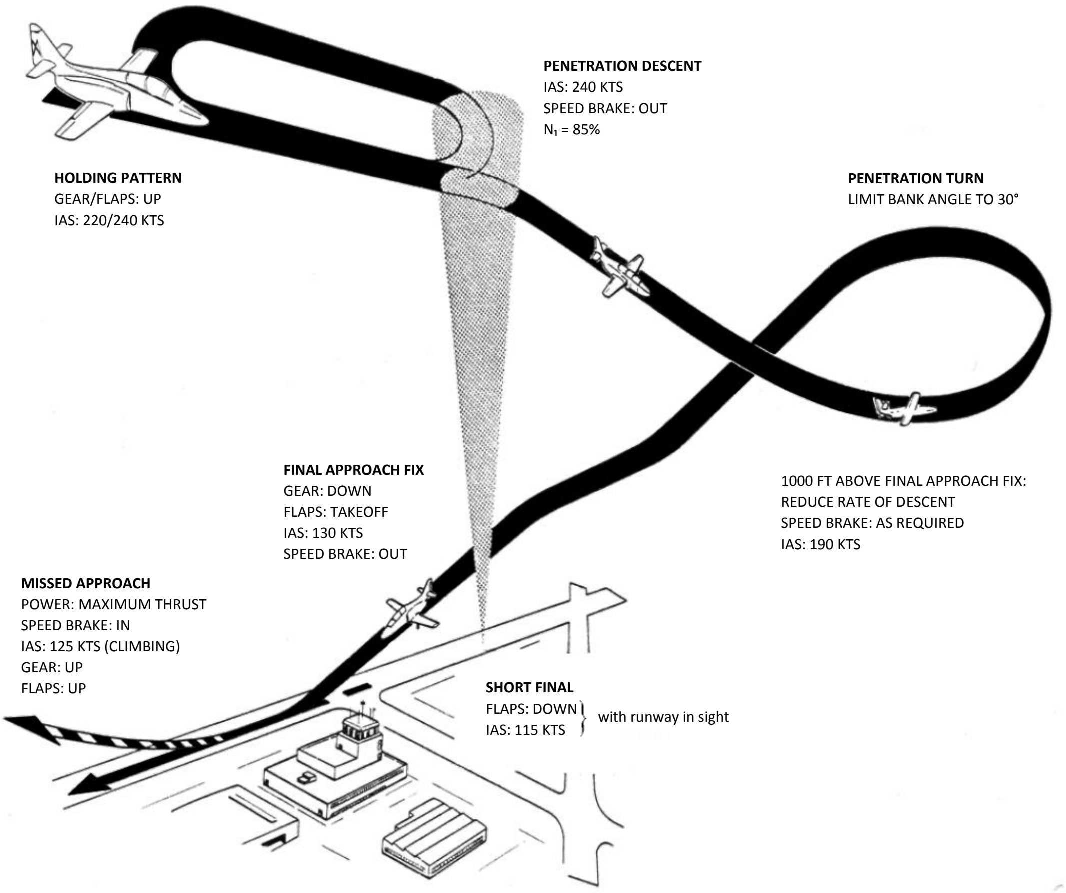

Figure 8-2 VOR penetration

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SOURCES

- C-101EB manual from Spanish Air Force
- C-101CC manual
- “Conocer el C-101” (César Piquer Martínez´s book)

LINKS

- https://www.facebook.com/Aviodev
- http://www.digitalcombatsimulator.com
- http://forums.eagle.ru

C-101CC annex will be added later when releasing the module