Mirage F1

Restricted

FLIGHT MANUAL

AIRCRAFT OPERATING INSTRUCTIONS

1F-F1K50AZ-1-1

Restricted

TABLE OF CONTENTS

AVIONS MARCEL DASSAULT BREGUET AVIATION F 6117	MIRAGE F1 AIRCRAFT PART NUMBER : F1

PHYSICAL CHARACTERISTICS

Clean aircraft gross take-off weight comprising :

- empty weight equipped	7824 kg (17, 249 lbs)
- pilot	95 kg (209 lbs)
- fuel - TR0 (JP1)*	3476 kg (7663 lbs)
- shells	145 kg (320 lbs)
	11, 540 kg (25, 441 lbs)

Overall dimensions :

- length	15. 25 m (50. 03 ft)
- span	8. 44 m (27. 69 ft)
- height (clean aircraft - fully fuelled)	4. 49 m (14. 73 ft)

U/C :

- wheelbase (clean aircraft - fully fuelled)	4. 87 m (15. 98 ft)
- track	2. 48 m (8. 14 ft)

Propulsion :

- SNECMA ATAR 9 K50 jet engine
  test bed thrust :

- Full power dry	4770 daN (10, 725 lbs)
- Max. A/B	6830 daN (15, 355 lbs)

*Reference specific gravity of fuel : 0. 79

TECHNICAL CHARACTERISTICS

Clean aircraft permissible load factor :

- in subsonic flight M < 0. 95	- 3/+7. 2
- in supersonic flight M > 1	- 3/+6
Maximum speed	700 kt between 0 and 20, 000 ft 750 kt above 20, 000 ft
Mach number limit	2. 10
*Ceiling	55, 000 ft

*High altitude equipment is not part of aircraft specifications. Service ceiling is 50, 000 ft.

0,10 - PURPOSE OF MANUAL

The Manual of Operating Instructions consists of three books as follows :

- 1 : Aircraft Operating Instructions
- 2 : NWS Operating Instructions
- 3 : Performance

The purpose of the Manual of Aircraft Operating Instructions is to give :

- technical information concerning the descriptions and operation of the aircraft which is essential for its correct use
- normal procedures
- limitations
- emergency procedures
- flight characteristics

The manual is therefore not overburdened by theoretical considerations, or by technical or construction details, which do not directly concern the use of the aircraft. For complete information concerning complex systems, reference will be made whenever necessary to the general or specific technical documentation concerned.

CAUTION

ONLY THE PROCEDURES DESCRIBED IN THE MANUAL OF OPERATING INSTRUCTIONS ARE AUTHORIZED.
THE OPERATIONS OR CONFIGURATIONS NOT EXPLICITLY DEALT WITH IN THIS MANUAL ARE THEREFORE PROHIBITED.

0,20 - REVISION PROCEDURE

0,20.1 - IDENTIFICATION OF PAGES

Each page is identified by :

- the Manual No at the top R/H corner of the R/H page and at the top L/H corner of the L/H page
- the issue date of the page in the lower L/H corner (front page) and in the lower R/H corner (back page)
- the page No in the lower R/H corner (front page) and in the lower L/H corner (back page)

The page No is made up as follows :

- a first digit followed by a point indicates the Section No
- one or more digits followed by a dash indicates the Sub-Section No
- one or two other digits indicates the rank of the page within the Sub-Section
- the illustrations are numbered (from 1 to x) within each Sub-Section.

0,20.2 - UPDATING PRINCIPLE OF THE DOCUMENTATION

The updating takes place in two stages i.e. :

- Issuing of Supplements temporarily incorporated into the documentation.
- Revisions proper which consist in incorporating definitely into the documentation new information or previously issued in the form of Supplements (change of pages or addition of new pages).

0,20.3 - REVISION TO THE MANUALS

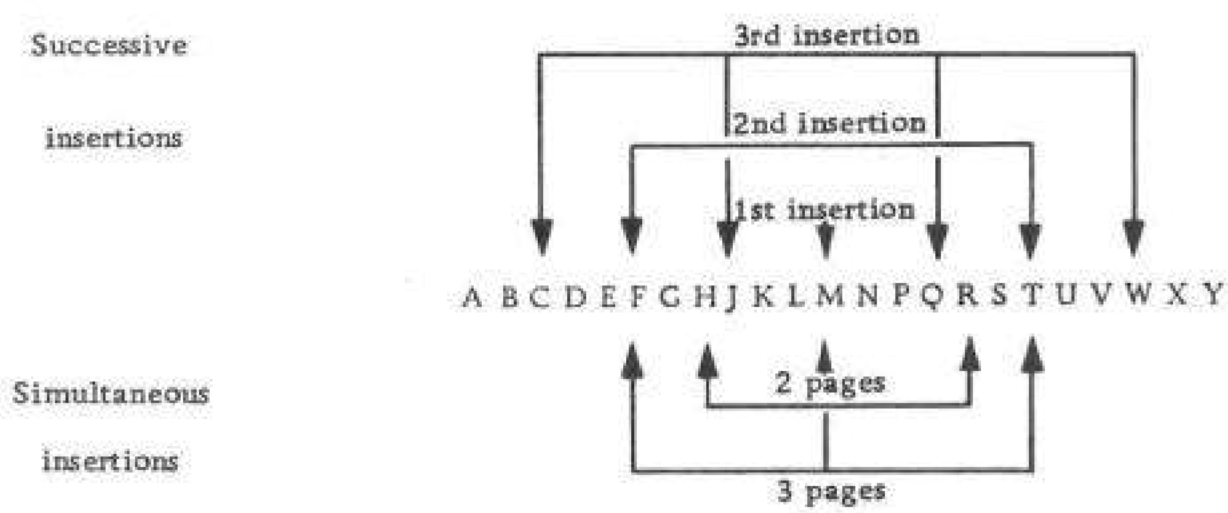
1 - Procedure

Revision involves two operations :
- insertion of new pages and replacement of changed pages,
- systematic replacement of the title page and list of effective pages.

2 - Page numbering

First case - Addition of one or more new pages following the last page of a Sub-Section.
The pages are numbered in the normal order.

Second case - Insertion of one or more new pages between two existing pages.
The new page(s) bears the number of the preceding page followed by a capital letter, with the exception of letters I, O and Z.
The letters are chosen in every case so as to provide for maximum further insertions unless the initial numbering sequence is changed.
The principle is illustrated in the table below :



Example :

Assuming that several pages are to be inserted in succession between pages 6 and 7. The first one will be numbered 6M, the second one 6F if it is to be placed before 6M, or 6T if it is to be placed after 6M. Similarly, if it is necessary to insert a third page later on, its number will be 6F or 6T, 6C or 6J, 6Q or 6W as applicable.

Assuming that the following are to be inserted simultaneously :
- 2 pages : they will be numbered 6H and 6R.
- 3 pages : they will be numbered 6F, 6M and 6T.

Third case : Insertion of a new page resulting from the application of an official modification. The principle consists in showing, simultaneously, in the documentation the two states : after modification and before modification.

(a) The revision is inserted, according to the procedure explained above, without changing the page numbering : thus a new page will supersede the previous page.

(b) If the fact of introducing the two states (after and before modification) increases the number of pages, the solution will be as follows :

- both pages, before and after modification, will bear the same number. The revised page will show the note "Post-Mod. X" above the page number (which means that modification X is applied). The two pages will be listed in the List of Effective Pages, with "Post-Mod. X" appearing above the page number of the new page.

REMARK : In general, these two pages will be given different dates.

(c) In the case where an entire paragraph or a Section is modified to a great extent by a revision (majority of revised pages), the entirely revised paragraph will be found first then the entire paragraph not revised. The two paragraphs (or Sections) will be shown in the Table of Contents.

The pages not revised will be deleted only at the time of a future revision once the modification has been applied on all aircraft.

3 - Identification of revised texts

The revisions to the text, addition or deletion, are identified by a vertical line on the L/H side.

The entirely revised pages are identified by a vertical line in the lower L/H corner.

0,30 - BREAKDOWNS

0,30.1 - FLIGHT MANUAL BREAKDOWN

Section \ Sub-section		10	15	20	25	30	35
0	INTRODUCTION	Purpose of Manual		Revision to Manual		Breakdowns	
1	DESCRIPTION OPERATION	Airframe	Electrical System	Fuel System	Jet Engine	Hydraulic System and Brake Chute	Fligh Contr and Flying ... / Autop
2	NORMAL PROCEDURES	Before Starting	Starting Taxiing Takeoff		Normal Flight		Use of Autopi
3	LIMITATIONS	Clean Aircraft	Electrical	With Stores	Engine		
4	EMERGENCY PROCEDURES	Takeoff and Landing	Electrical System	Fuel System	Engine	Hydraulic System	Fligh Contr and Flying ... / Autop
5	FLIGHT CHARACTER-ISTICS AND EXTREME WEATHER OPERATION	High Angles of Attack Spins			Specific Landings		

	35	40	45	50	55	60	65	70	75	80
vns		Abbrevia-tions and Symbols Used								
lic n ute	Flight Controls and Flying Aids Autopilot	Hydraulic Utility Systems	Flight Instrument Systems	Cockpit Layout	Pilot's Equipment and Associated Systems	Warning Systems	Radio System	Navigation System	Operational Equipment	Armament
	Use of Autopilot	Return to Parking Area								
		Elements Extended								
ic n	Flight Controls and Flying Aids Autopilot	Hydraulic Utility Systems	Flight Instrument Systems		Pilot's Equipment and Associated Systems	Fire				
					Instructions for Starting and Taxiing Under Hot Conditions				Flight Refueling	Specific Store Carriage Instructions

0,40 - ABBREVIATIONS AND SYMBOLS USED

% / rpm	Engine Speed Read on RPM Indicator
M	: Mach Number Indicated by Mach/Airspeed Indicator
IAS	: Speed Indicated by Mach/Airspeed Indicator
ΔP	: Pressure Differential
Hp	: Pressure-Altitude
ft	: Foot (Feet)
kt	: Knot (Knots)
i	: Angle of Attack Indicated by Angle-of-Attack Indicator
~	: Approximately
α	: Control Stick Travel
$\frac{\alpha}{1}$	: Full Travel
$\frac{\alpha}{2}$	: Half Travel

Warning Horn

Switch

Circuit Breaker

Manually-Operated Valve

Electrically-Operated Valve

Electric Relay

Time-Delay Relay

Pushbutton

Mechanical Pump

Electrical Pump

Non-Return Valve
(the arrow indicates direction of flow)

Dual Feed Valve

One-Winding Torque Motor

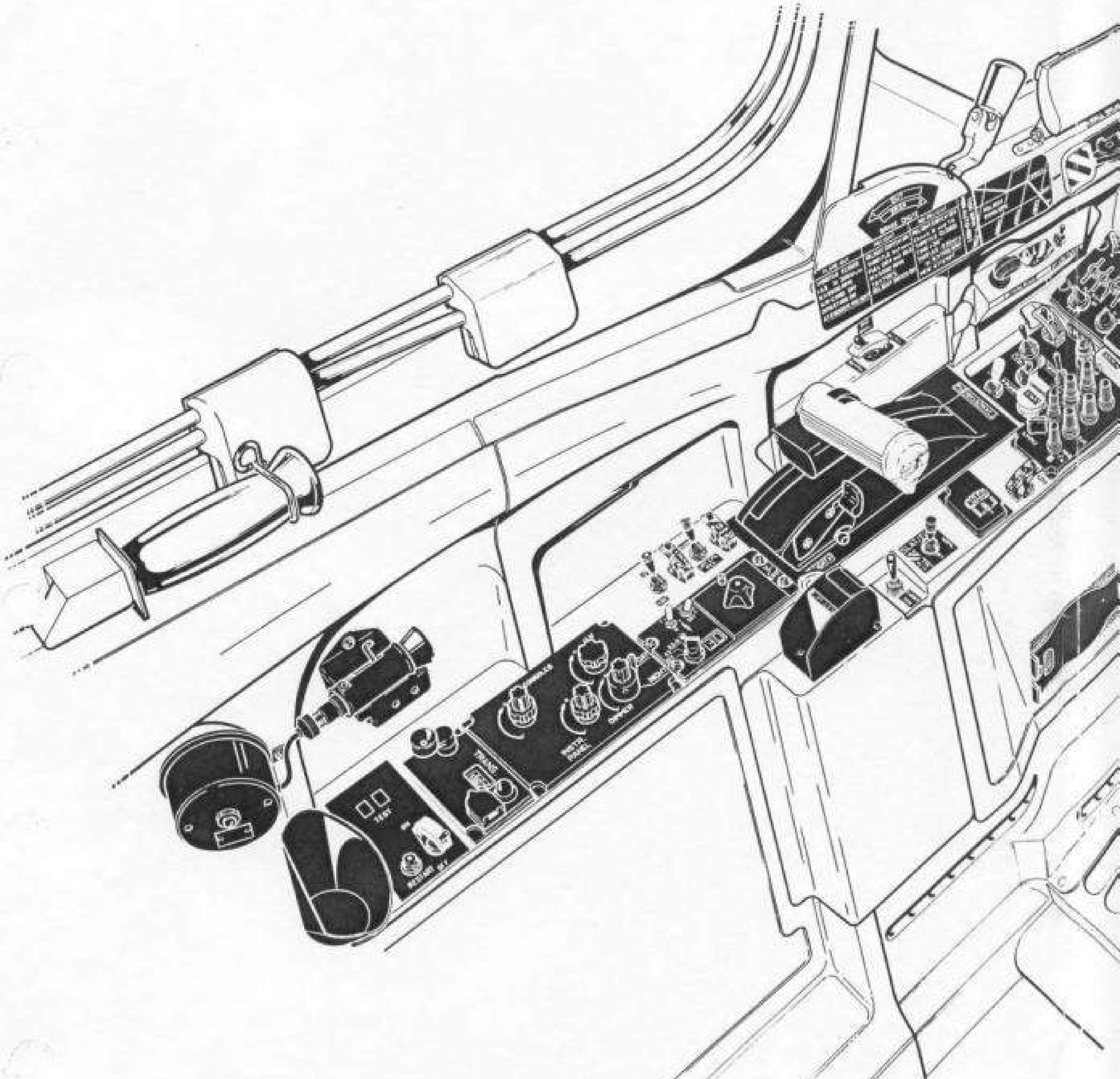
Two-Winding Torque Motor

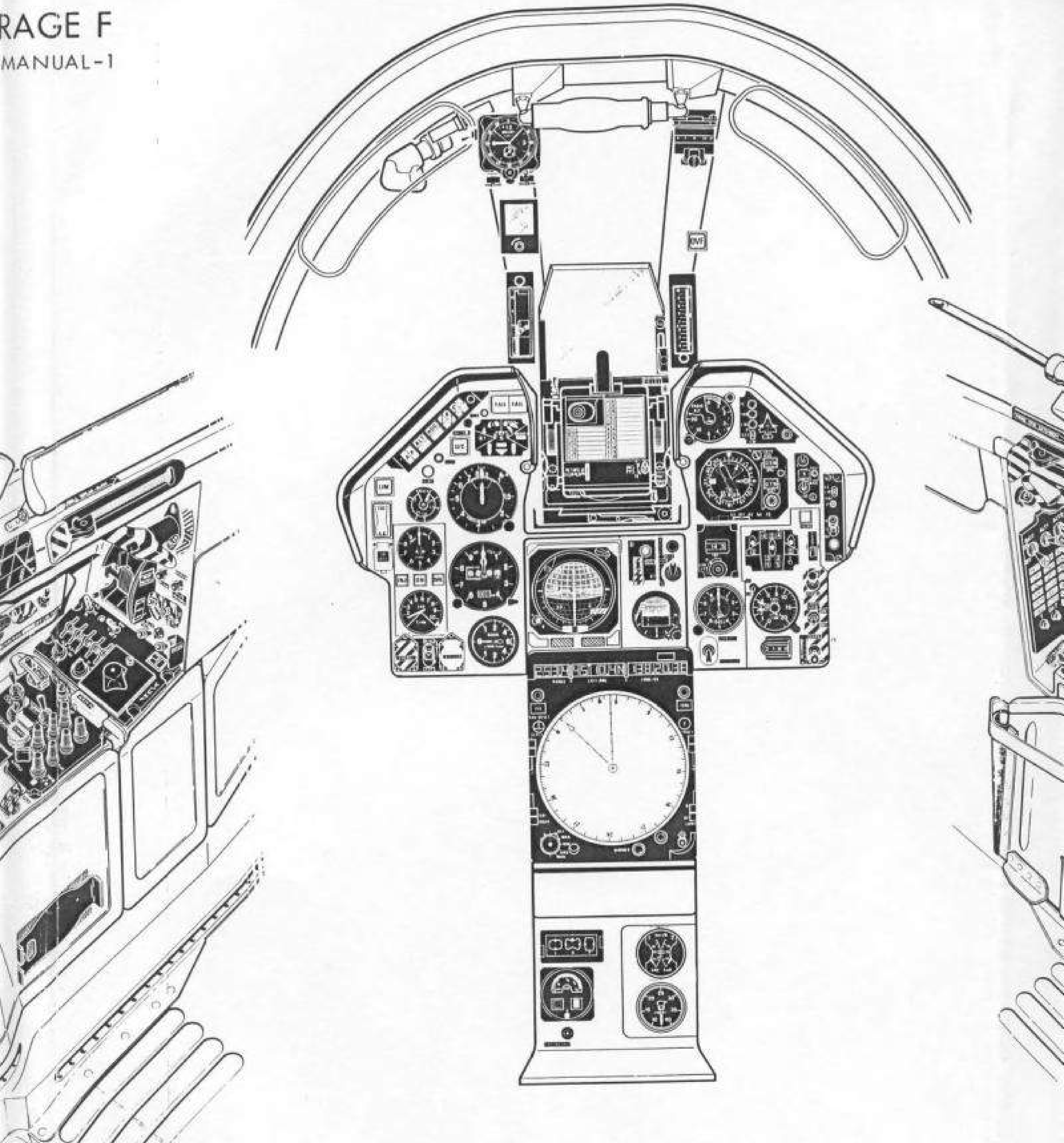
One-Way Restrictor Valve
(small arrow)

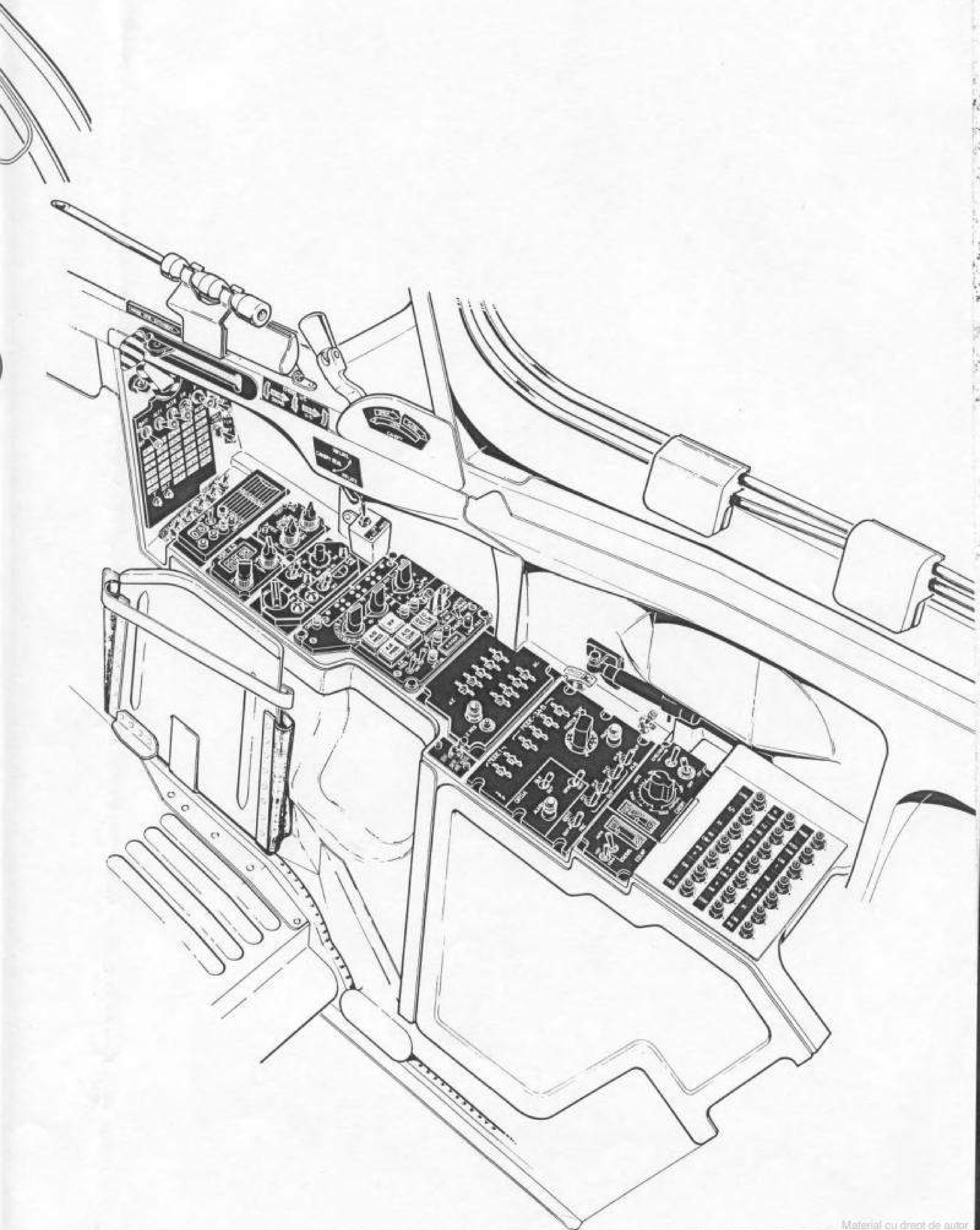
Pressure Tapping

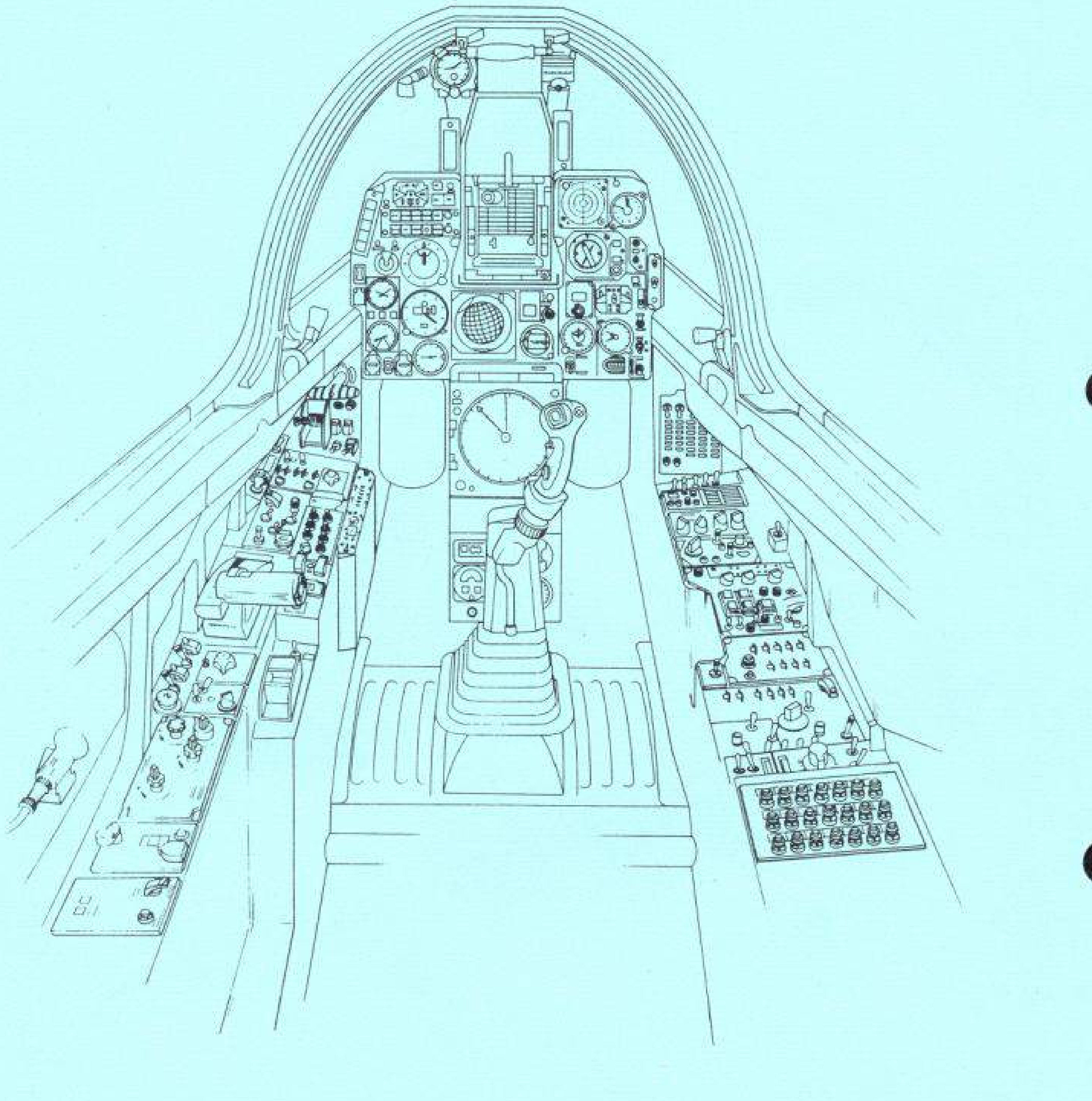
Pressure Reducing Valve

COCKPIT









COCKPIT LAYOUT
(POST/SAAF/MOD/MIR/151, 187, 521)

Section 1

DESCRIPTION - OPERATION

TABLE OF CONTENTS

FIGURES

Page

FIGURES

1,10 — AIRFRAME

1.10 - AIRFRAME

1.10.1 - INTRODUCING THE AIRCRAFT

The MIRAGE F1 AZ, manufactured by AVIONS MARCEL DASSAULT - BREGUET AVIATION, is a tactical support aircraft.

Primarily designed for AIR-GROUND missions, the aircraft is also capable of AIR-AIR missions. It is a single seat aircraft characterized by a high, low-aspect ratio, swept-back wing comprising high-lift devices, and by a low stabilator.

The characteristics of the airframe are as follows:

Wing area .... 25 m² (269 sq. ft)
Wing loading .... 385 kg/m² to 600 kg/m2 (79 to 123 lbs/sq. ft)
Maximum L/D ratio

clean	10	i=7°	LAS	for W = 10t (22,045 lbs)	~280 kt at 30,000 ft ~270 kt at 10,000 ft
				for W = 9t (19,840 lbs)	~265 kt at 30,000 ft ~255 kt at 10,000 ft
with auto slats	8.5	i=7.5°	LAS	for W = 10t (22,045 lbs)	~265 kt at 30,000 ft ~255 kt at 10,000 ft
				for W = 9t (19,840 lbs)	~250 kt at 30,000 ft ~245 kt at 10,000 ft

all down [4.5] (1000 litres (220 Imp. gals - 264 U.S. gals) remaining and W ~ 8.750 t (19,290 lbs)

i=9.5° LAS ~ 150 kt at 1500 ft

The aircraft is equipped with a tricycle undercarriage having medium-pressure twin wheels and a steerable nose wheel.

1.10.2 - LOADING CONFIGURATIONS

The aircraft attachment stations permit numerous loading configurations (one multiple under-fuselage station and four stations under each wing).
The operational equipment of the aircraft permits:

- air data navigation
- AIR GROUND firing (bombs, rockets, guns, air/ground missiles)
- AIR-AIR firing (guns, air/air missiles)
- enemy interception detection.
- chaff and flare dispensing

1.10.3 MAJOR COMPONENTS

The airframe is composed of the following major components:

- THE FUSELAGE which is of four-spar, monocoque construction, and consists of:

  - a forward body comprising: the equipped nose cone
    the cockpit (see figure page xi)
    the aft section (equipment bay and nose wheel well)

  - a main body comprising: the engine and its air intake ducts
    the main aircraft ancillaries
    the two main U/C legs
    a gun bays and their ammunition
    the airbrakes
    the fuel tanks

- **THE TWO INDEPENDENT WINGS,** which are of single-spar construction, are fitted in high position into the sides of the fuselage, and consist of:

  - a box forming a structural fuel tank
  - a leading edge carrying moving slats
  - a trailing edge carrying flaps and ailerons
  - spoilers on the wing upper surface

- **THE FIN,** which is of single-spar construction, fitted into the fuselage and having a structural box. The trailing edge carries the rudder

- **THE TWO STABILATOR SURFACES,** which are pivoted about shafts fitted into the fuselage.

1,10 - AIRFRAME

1,10,1 - INTRODUCING THE AIRCRAFT

The MIRAGE F1 AZ, manufactured by AVIONS MARCEL DASSAULT - BREGUET AVIATION, is a tactical support aircraft.

Primarily designed for AIR-GROUND missions, the aircraft is also capable of AIR-AIR missions. It is a single seat aircraft characterized by a high, low-aspect ratio, swept-back wing comprising high-lift devices, and by a low stabilator.

The characteristics of the airframe are as follows :

Wing area................ 25 m2 (269 sq. ft)
Wing loading .... 385 kg/m2 to 600 kg/m2 (79 to 123 lbs/sq. ft)
Maximum L/D ratio

clean	10	i = 7°	IAS	for W = 10 t (22, 045 lbs)	~280 kt at 30, 000 ft ~270 kt at 10, 000 ft
				for W = 9 t (19, 840 lbs)	~265 kt at 30, 000 ft ~255 kt at 10, 000 ft
with auto slats	8.5	i = 7.5°	IAS	for W = 10 t (22, 045 lbs)	~265 kt at 30, 000 ft ~255 kt at 10, 000 ft
				for W = 9 t (19, 840 lbs)	~250 kt at 30, 000 ft ~245 kt at 10, 000 ft

all down 4.5 (1000 litres(220 Imp. gals - 264 U.S. gals)remaining and W ~ 8. 750 t (19, 290 lbs)

i = 9.5° IAS ~ 150 kt at 1500 ft

The aircraft is equipped with a tricycle undercarriage having medium-pressure twin wheels and a steerable nose wheel.

1,10,2 - LOADING CONFIGURATIONS

The aircraft attachment stations permit numerous loading configurations (one multiple underfuselage station and three stations under each wing).
The operational equipment of the aircraft permits :

- air data navigation
- AIR GROUND firing (bombs, rockets, guns, air/ground missiles)
- AIR-AIR firing (guns, air/air missiles)
- enemy interception detection.

1,10.3 - MAJOR COMPONENTS

The airframe is composed of the following major components :

- THE FUSELAGE, which is of four-spar, monocoque construction, and consists of :
  - a forward body comprising : the equipped nose cone
    the cockpit (see figure page xi)
    the aft section (equipment bay and nose wheel well)
  - a main body comprising : the engine and its air intake ducts
    the main aircraft ancillaries
    the two main U/C legs
    the gun bays and their ammunition
    the airbrakes
    the fuel tanks
- THE TWO INDEPENDENT WINGS, which are of single-spar construction, are fitted in high position into the sides of the fuselage, and consist of :
  - a box forming a structural fuel tank
  - a leading edge carrying moving slats
  - a trailing edge carrying flaps and ailerons
  - spoilers on the wing upper surface
- THE FIN, which is of single-spar construction, fitted into the fuselage and having a structural box
  The trailing edge carries the rudder
- THE TWO STABILATOR SURFACES, which are pivoted about shafts fitted into the fuselage.

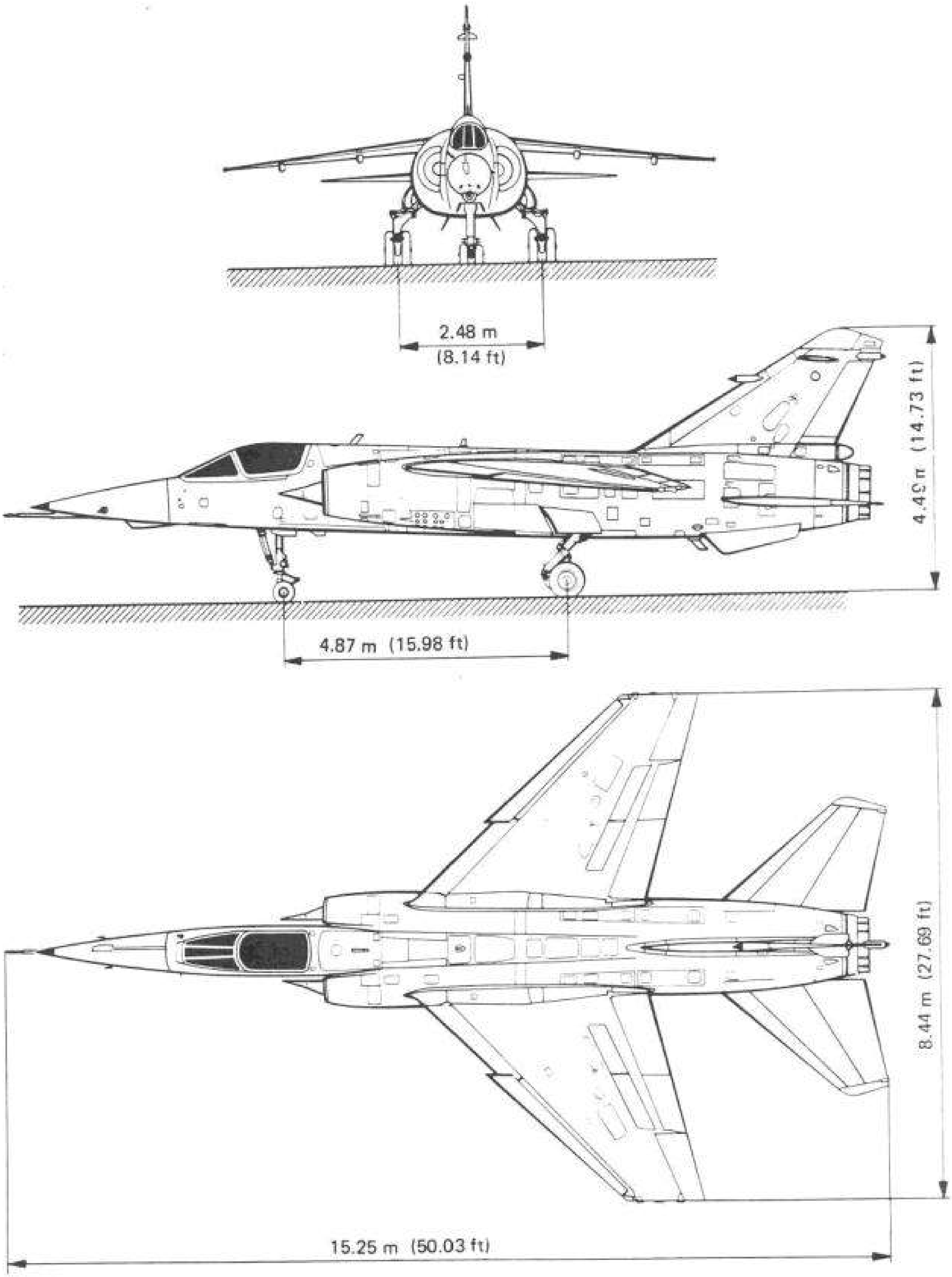
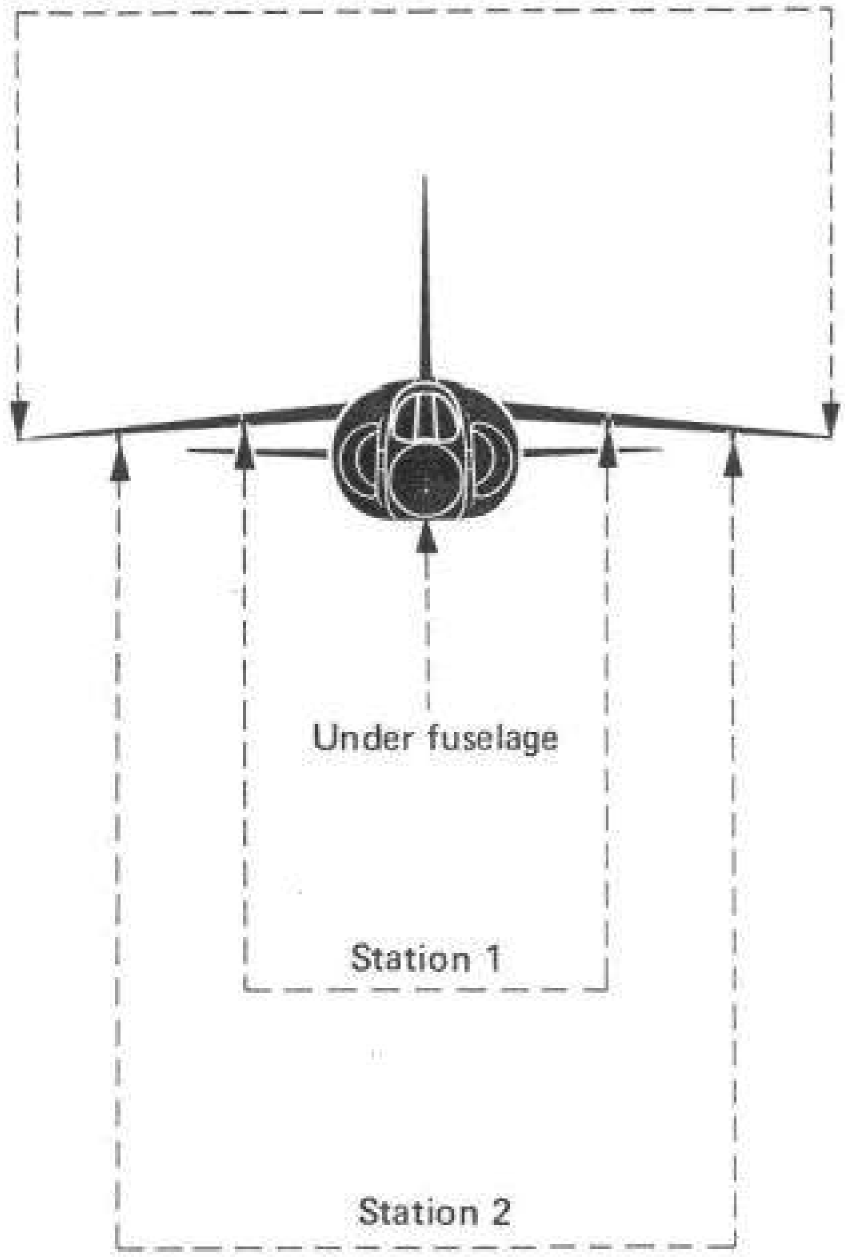


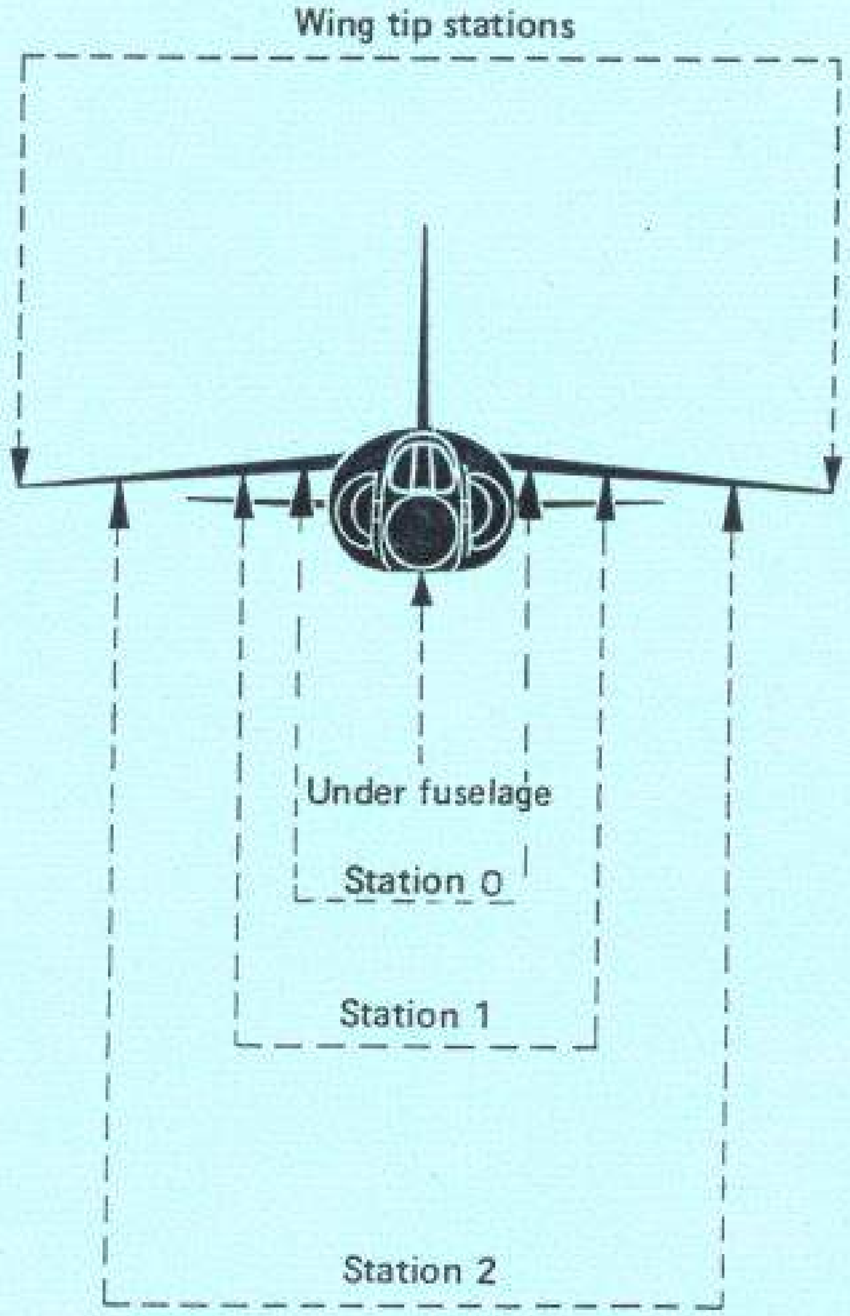
FIGURE 1 - THREE-VIEW DRAWING



Store mounting stations are shown above :

APPROVED LOADINGS AND ASSOCIATED CONFIGURATIONS
ARE DEFINED IN BOOK 3

FIGURE 2 – STORE MOUNTING CAPABILITIES



Store mounting stations are shown above:

APPROVED LOADINGS AND ASSOCIATED CONFIGURATIONS ARE DEFINED IN BOOK 3

FIGURE 2 — STORE MOUNTING CAPABILITIES

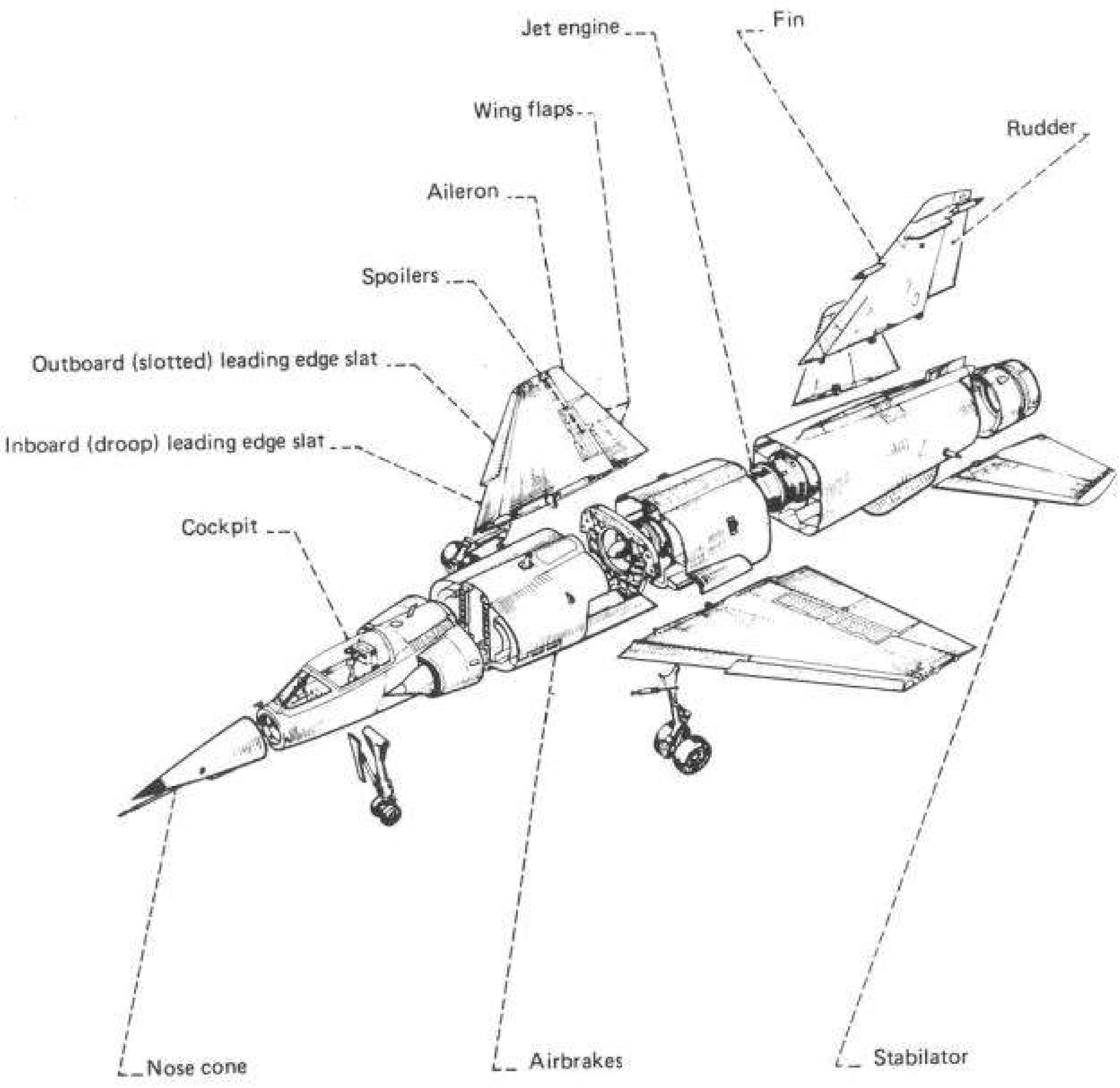


FIGURE 3 - MAJOR COMPONENTS

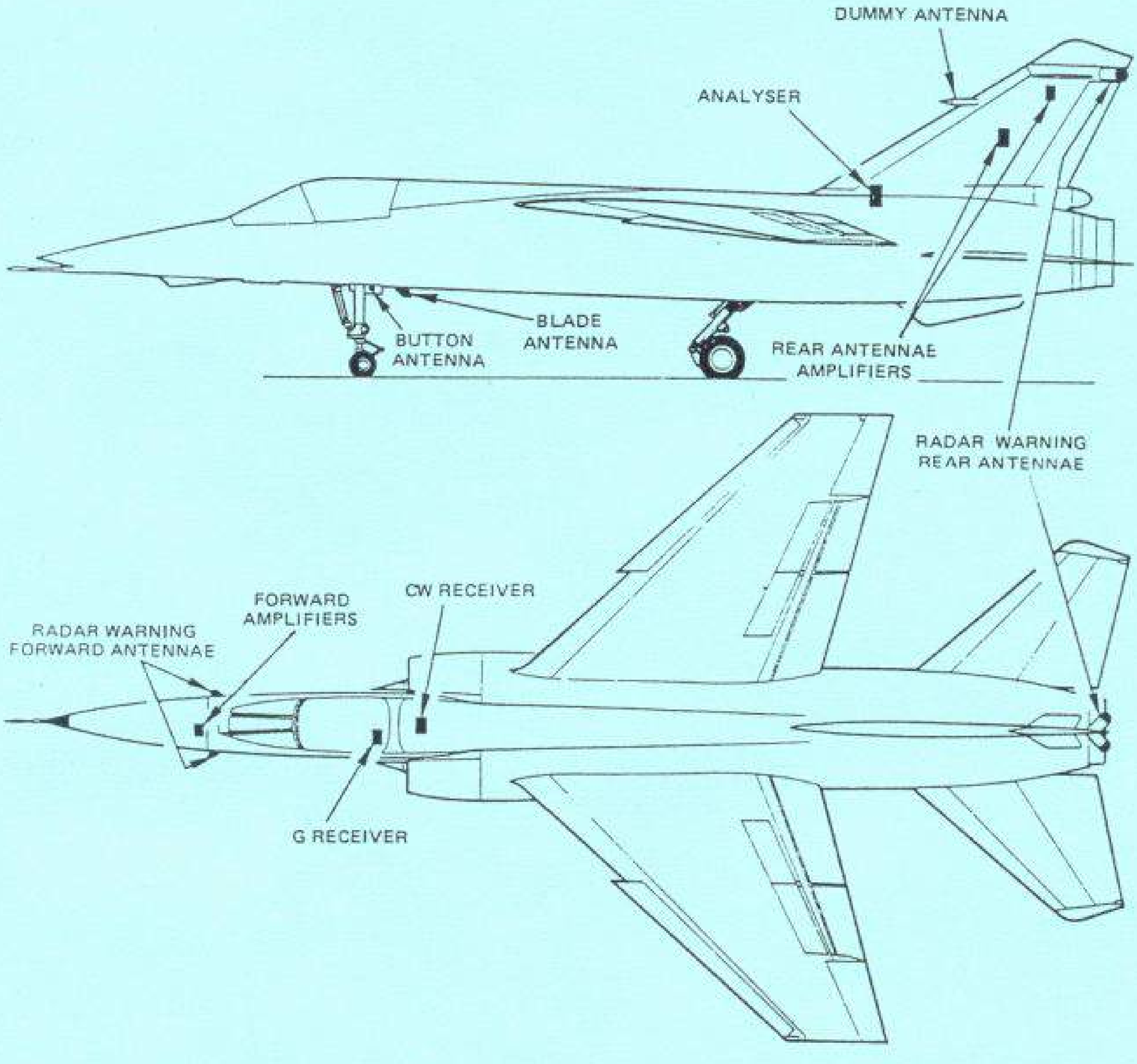


FIGURE 4A GENERAL LAYOUT RADAR WARNING (POST/SAAF/MOD/MIR/187)

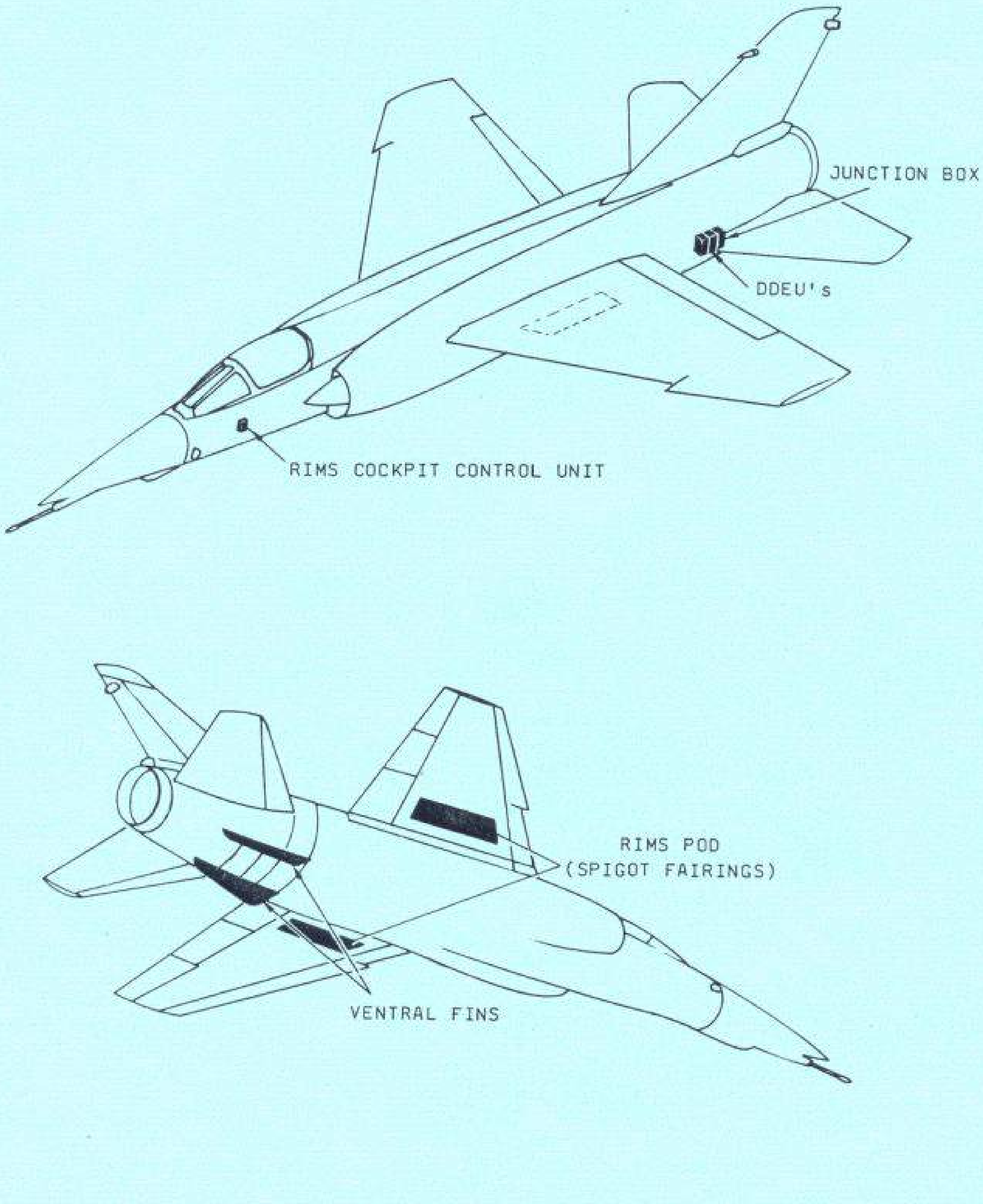


FIGURE 4B RADAR AND INFRA-RED MISLEADING SYSTEM (POST/SAAF/MODS/MIR 151, 521)

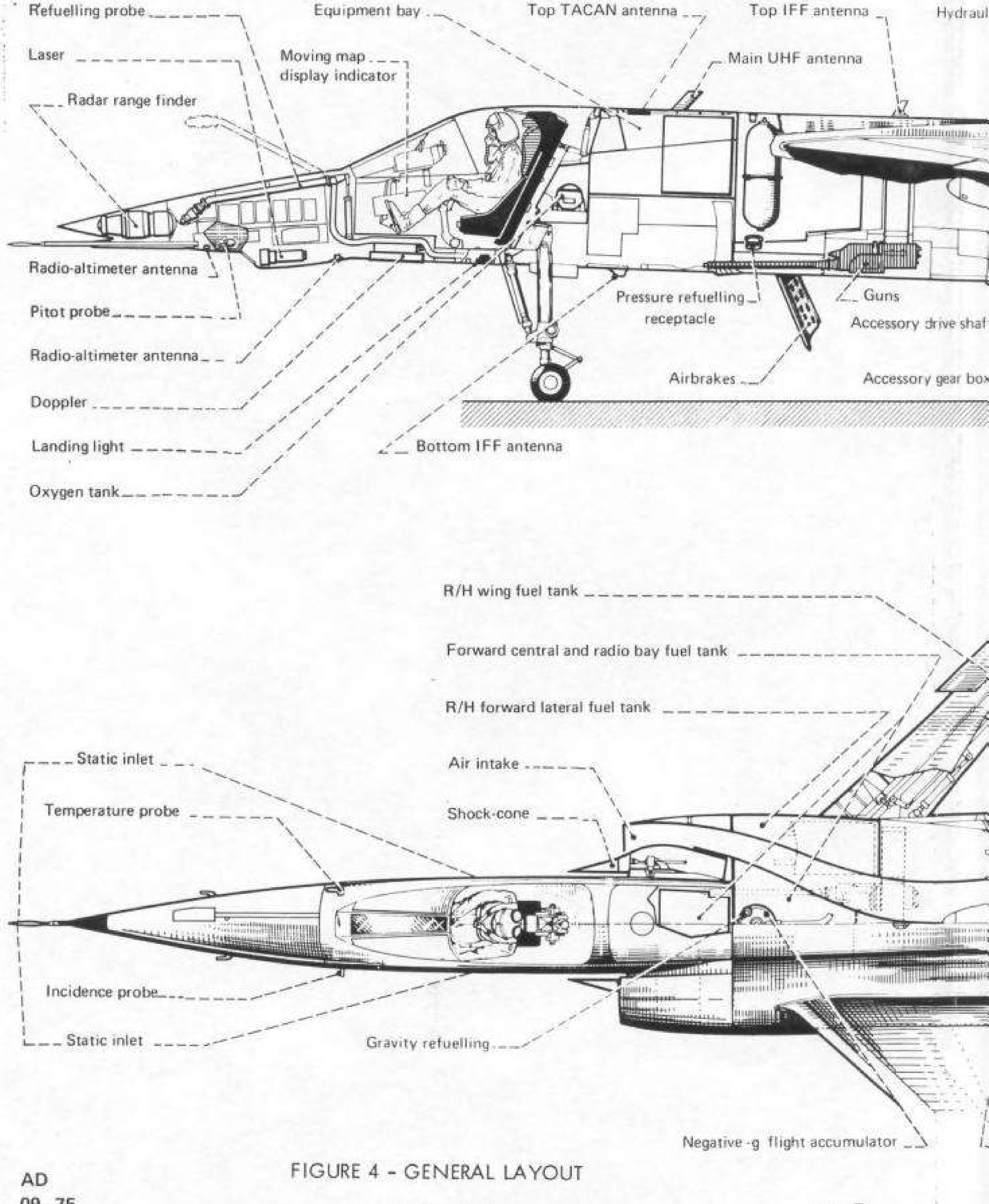
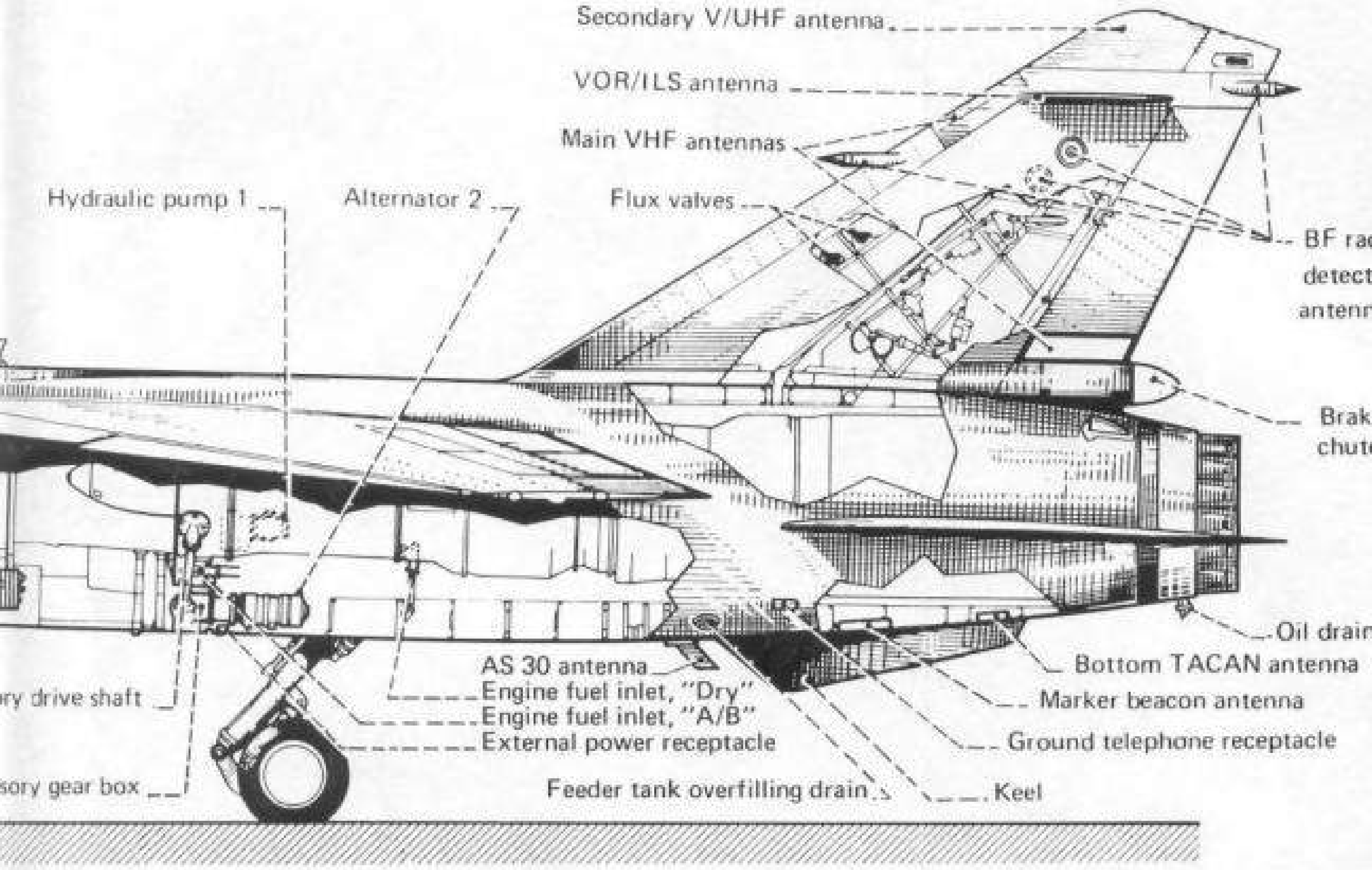
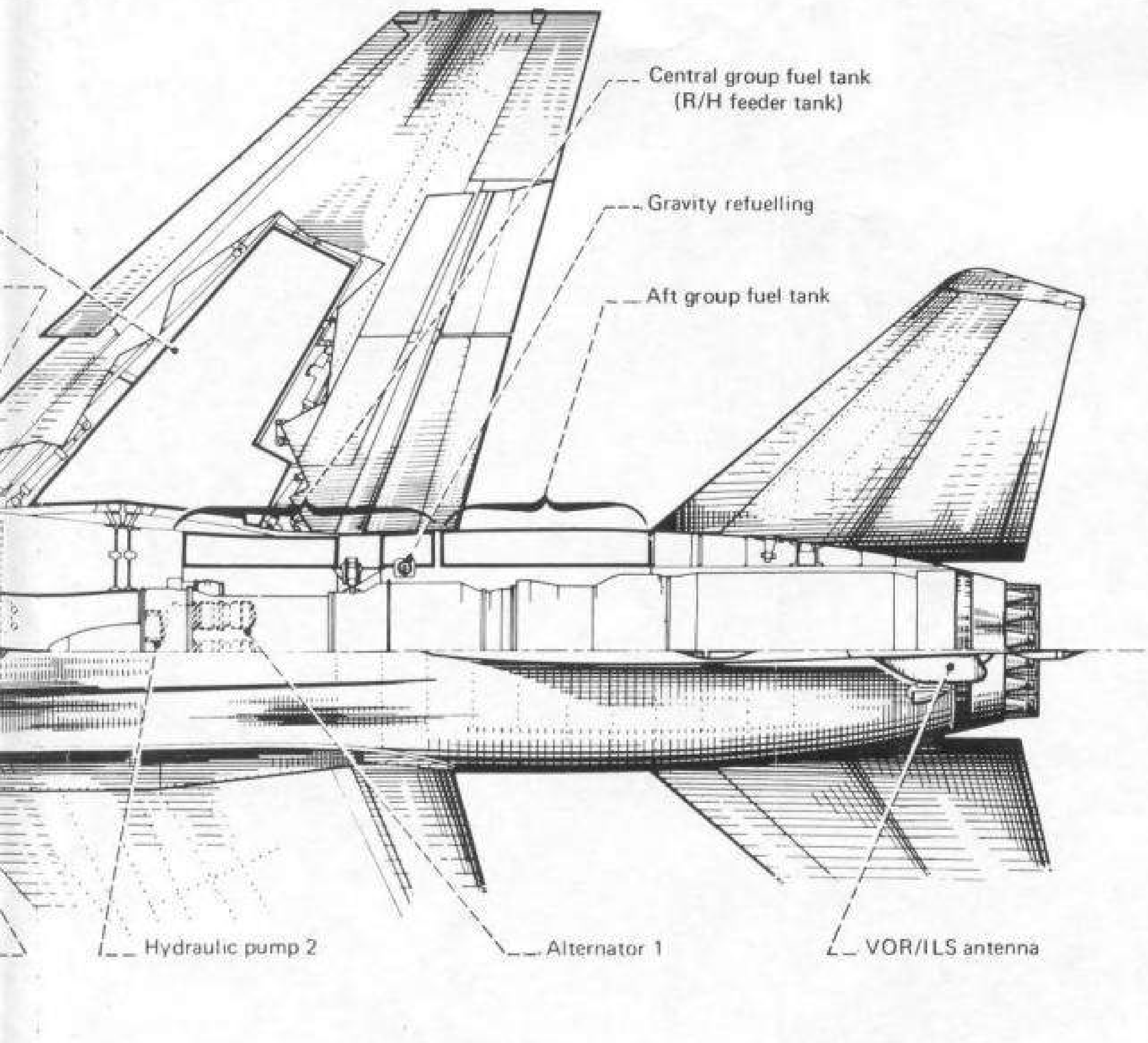


FIGURE 4 - GENERAL LAYOUT


Secondary V/UHF antenna
VOR/ILS antenna
Main VHF antennas
Hydraulic pump 1
Alternator 2
Flux valves
BF radar detector antennas
Brake chute
Oil drain
Bottom TACAN antenna
AS 30 antenna
Engine fuel inlet, "Dry"
Engine fuel inlet, "A/B"
External power receptacle
Marker beacon antenna
Ground telephone receptacle
ory drive shaft
sory gear box
Feeder tank overfilling drain
Keel


Central group fuel tank (R/H feeder tank)
Gravity refuelling
Aft group fuel tank
Hydraulic pump 2
Alternator 1
VOR/ILS antenna

1,15 – ELECTRICAL SYSTEM

1, 15 - ELECTRICAL SYSTEM

1, 15-1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
BATTERY	Battery switch	2 positions	
	BATT light	Red	
ALTERNATOR 1	Alternator switch	2 positions	
	ALT. 1 light	Amber	
ALTERNATOR 2	Alternator switch	2 positions	
	ALT. 2 light	Amber	
	MODUL light	Red	
TRANSFORMER-RECTIFIERS	TR reset button		1 only for both TR's
	TR.1 TR.2 lights	Amber	1 light for each TR
INVERTER	Inverter selector switch	3 positions "INV" } steady positions "AUTO" } "RESET" spring-loaded position	
	EMG∿ light	Amber	
	Control circuit-breaker	"INV. CONT"	See Figure 1
	Power circuit-breaker	"INV. POW"	See Figure 1

1.15.2	-	DESCRIPTION	(POST SAAF MOD./MIR F1AZ 91-27 - Replacement of aircraft main nickel cadmium battery with sealed lead acid battery).
	-	One 24V 36 Ah battery	Connected as a buffer battery in the DC system.

1,15.2 - DESCRIPTION

The aircraft electrical power is produced by :

- Two alternators, three-phase, 400 Hz, 115/200 V AC, 15 kVA, installed on the accessory gearbox; they include an electromechanical device whose output rotates at constant speed and whose mechanical part is a two-speed gearbox provided with automatic change of gears at about 5200 ± 50 rpm during engine acceleration or deceleration.
  Each alternator supplies a power system.
- Two 100 A transformer-rectifiers, each supplying the necessary power for the 28 V DC system.
- One 40 Ah battery connected as a buffer battery in the DC system.

In addition :
A switching box enables an emergency AC system to be supplied either by the alternators or by the DC system through a static inverter.
A standby receptacle enables certain equipment items to be energized and preheated on the ground.
An external AC power receptacle enables the systems to be supplied from an auxiliary power unit.

The power distribution mainly comprises four systems :

- AC system 1, which is normally supplied by alternator 1.
- AC system 2, which is normally supplied by alternator 2.
- The emergency AC system, which is normally supplied by alternator 1.
- The DC system, which is normally supplied by the transformer-rectifiers and the buffer battery, and comprises :
  - a direct battery system
  - a main system
  - a utility subsystem, with automatic load shedding in case of failure of both alternators.

1,15.3 - OPERATION

The current supplied by the alternators is permanently monitored for voltage and frequency by protection boxes which isolate the defective alternator and transfer its load to the other alternator.
The remaining alternator then supplies both systems.
After starting, the alternators cut in only when they have reached their frequency and voltage thresholds (at approximately 2800 engine rpm). It is recommended to avoid engine rpm between 5500 and 6000 (alternator gear change).
A three-phase static switching box detects any lack of current in system 1 and instantaneously switches the emergency AC system power supply to the inverter.

1 - STARTING

As the alternators have not yet cut in, the emergency AC system is supplied by the inverter and the EMG.∿ light is on.

After the engine is started and the alternators have cut in, the inverter selector is set to «RESET» and instantaneously switches the emergency AC system power supply to system 1. The EMG.∿ light goes out.

When the external power receptacle is connected, the alternators are isolated (battery switch "ON" ; light is out) and the two AC systems are supplied.

NOTE :

- The external power receptacle has priority over the alternators.
- As the aircraft is equipped with transformer-rectifiers, there is no external DC power receptacle.
- When the engine starts, the BATT light comes on (the battery is isolated).

2 - RESETTING

The «BATT» and «ALT» switches and the «INV» selector are used to reset the equipment items concerned in case of tripping-out.
The "TR" button is used to reset the transformer-rectifiers.

Resetting is performed as follows :

- for the battery and the alternators : turn the corresponding switches («BATT», «ALT.1» or «ALT.2») «OFF», then back «ON»
- for the transformer-rectifier : depress the «TR» button
- for the inverter : set the «INV» selector to «RESET», then back to «AUTO».

Several attempts may be necessary (See para. 4,15, SECTION 4).
The lights on the failure warning panel go out as soon as resetting is effective.

1,15.4 - FAILURES

BATT light on + warning horn

The battery is disconnected from the main system, but can continue to supply its own bus.
When the battery is exhausted, the inflight relight system is inoperative.
If the failure is followed by :

- the failure of both transformer-rectifiers : there is no more DC power
- or the failure of both alternators : there is a complete electrical failure.

ALT.1 light on : **EMG∼** light may come on

Alternator 1 no longer supplies its system.
Alternator 2 takes over the supply of AC systems 1 and 2.
The emergency system is automatically supplied by the inverter.

ALT.2 light on

Alternator 2 no longer supplies its system.
Alternator 1 takes over the supply of AC systems 1 and 2.

ALT.1 + **ALT.2** lights on : **EMG∼** light also comes on, as well as **TR.1** **TR.2** lights as soon as battery voltage drops < 25 volts
Both alternators no longer supply their systems.
The emergency system is automatically supplied by the inverter.
Automatic load shedding occurs in the utility DC subsystem.
The only source of electrical power is the battery, which has an endurance of at least 13 min with the electric pump not running.

EMG∼ light on

The emergency AC system is supplied by the inverter.

TR.1 or **TR.2** light on

Only the transformer-rectifier whose light is out is capable of supplying the DC systems.

TR.1 + **TR.2** lights on

Both transformer-rectifiers no longer supply the DC systems.
The only source of DC power is the battery.

MODUL light on + warning horn

Continuous illumination of this light indicates to the pilot excessive modulations of the vario-alternator driving torque with the risk of damage to their drive as the result of mechanical resonance of one vario-alternator in relation to the other.
The mechanical coupling will be broken by the switch-off of an alternator ; the persistent warning thus only indicates a failure in the electronics associated with the light.

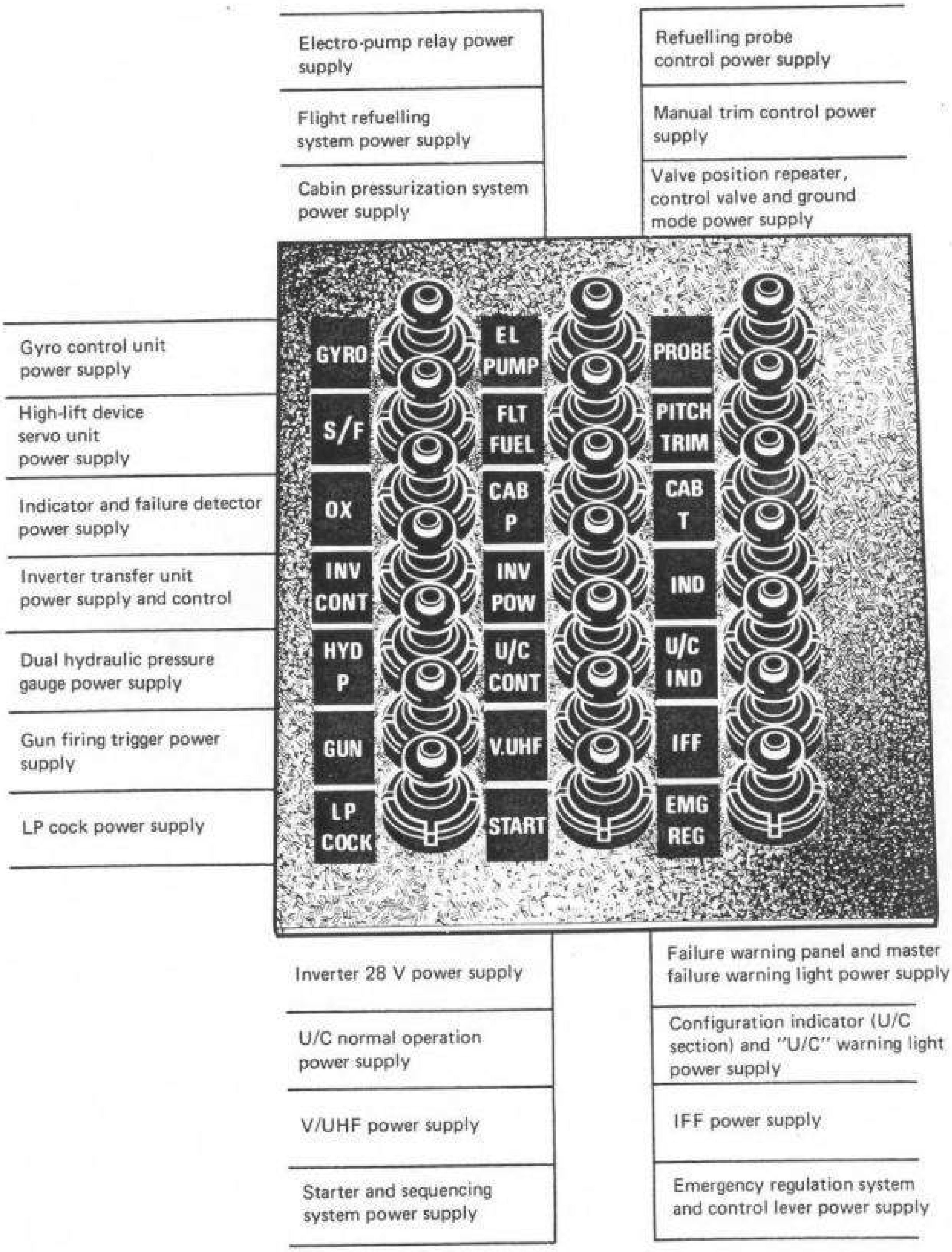


FIGURE 1 – CIRCUIT-BREAKER BOX

AC SYSTEM 2

L/H and R/H LP pumps
AIDA
TV815 amplifier (JPT regulation)
UV lights
Cabin temperature
Equipment temperature
Oxygen
Anti-skid system
Integral lighting
Landing light transformer
R/H pitot
Probe heating
Stbd andport wing missile heating
AS30 remote control
Laser demisting
Fatigue meter
V3 computation
Radio altimeter
Doppler
Radar warning
Air to surface

AC SYSTEM 1

Moving map display indicator
Gyro centre
TACAN
Autopilot
Sight
TR detection
MMU
Air data computor
Computing voltage (transformer 1 -See Book 2)
Navigation computor
Laser
Roll/Pitch amplifier
Bombing computor
RIMS

ANCILLARY DC SUB-SYSTEM

AS 30
Missile control
Missile safety
Stbd/Port missile readying
Autopilot
TACAN
Laser
AS 30 missile readying
Air to surface
Active countermeasures
Radar warning
RIMS
AIDA
Bombing computor
Radio-altimeter
Doppler
Sight
Navigation lights
Formation lights
VOR/ILS
Gyro centre
Navigation computor
Moving map display indicator

BATTERY SYSTEM

Starter
Ignition coil
Starting unit
Ignition switch
Battery control
External power receptacle control
Emergency jettisoning
Lead light
SE Selective and 550 missile Jettisoning
Radio selector unit power Supply (amplifier 2)
Radar warning

FIGURE 2A ELECTRICAL POWER GENERATION DISTRIBUTION SYSTEM
(POST/SAAF/MOD/MIR/151, 187, 246, 269)

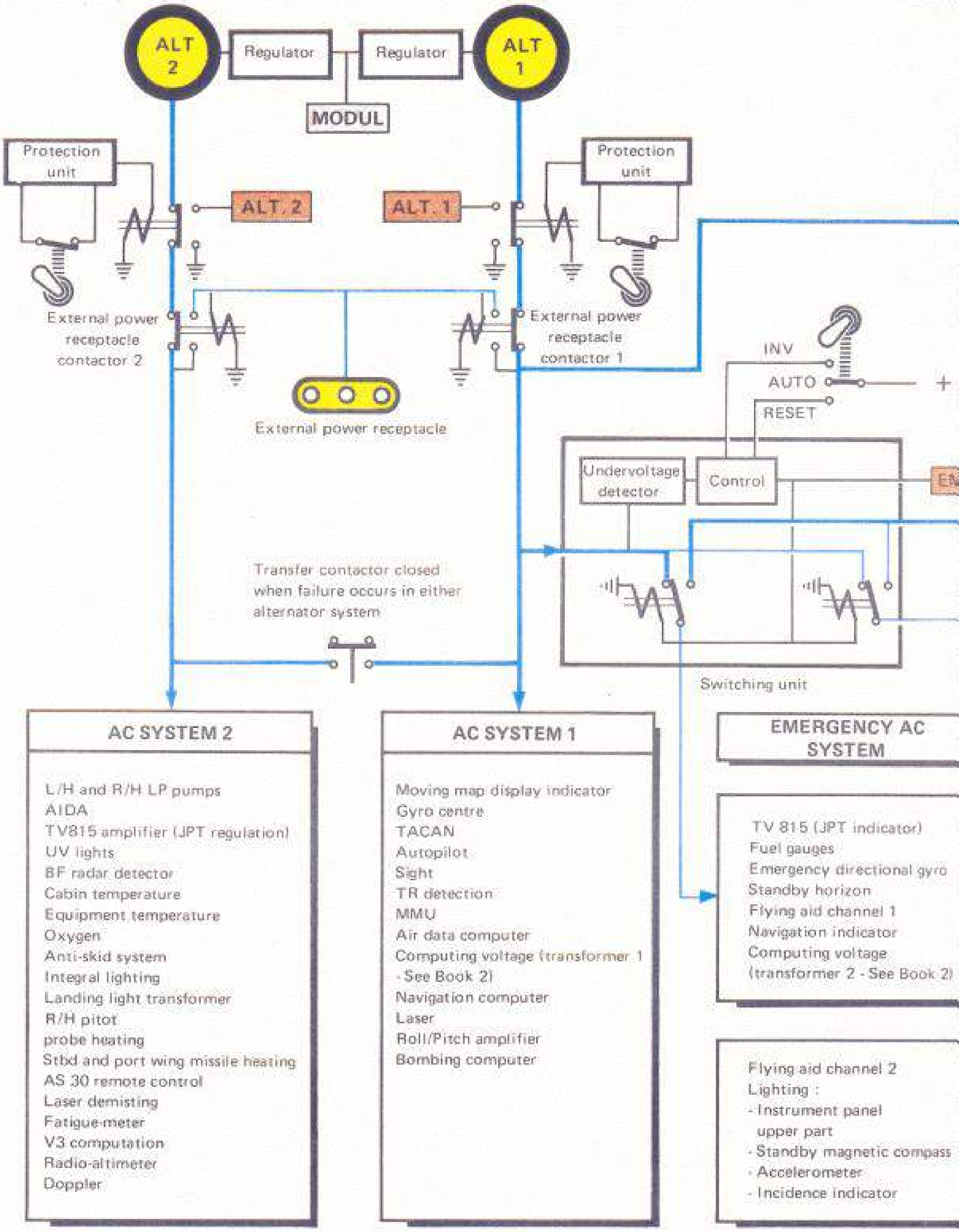
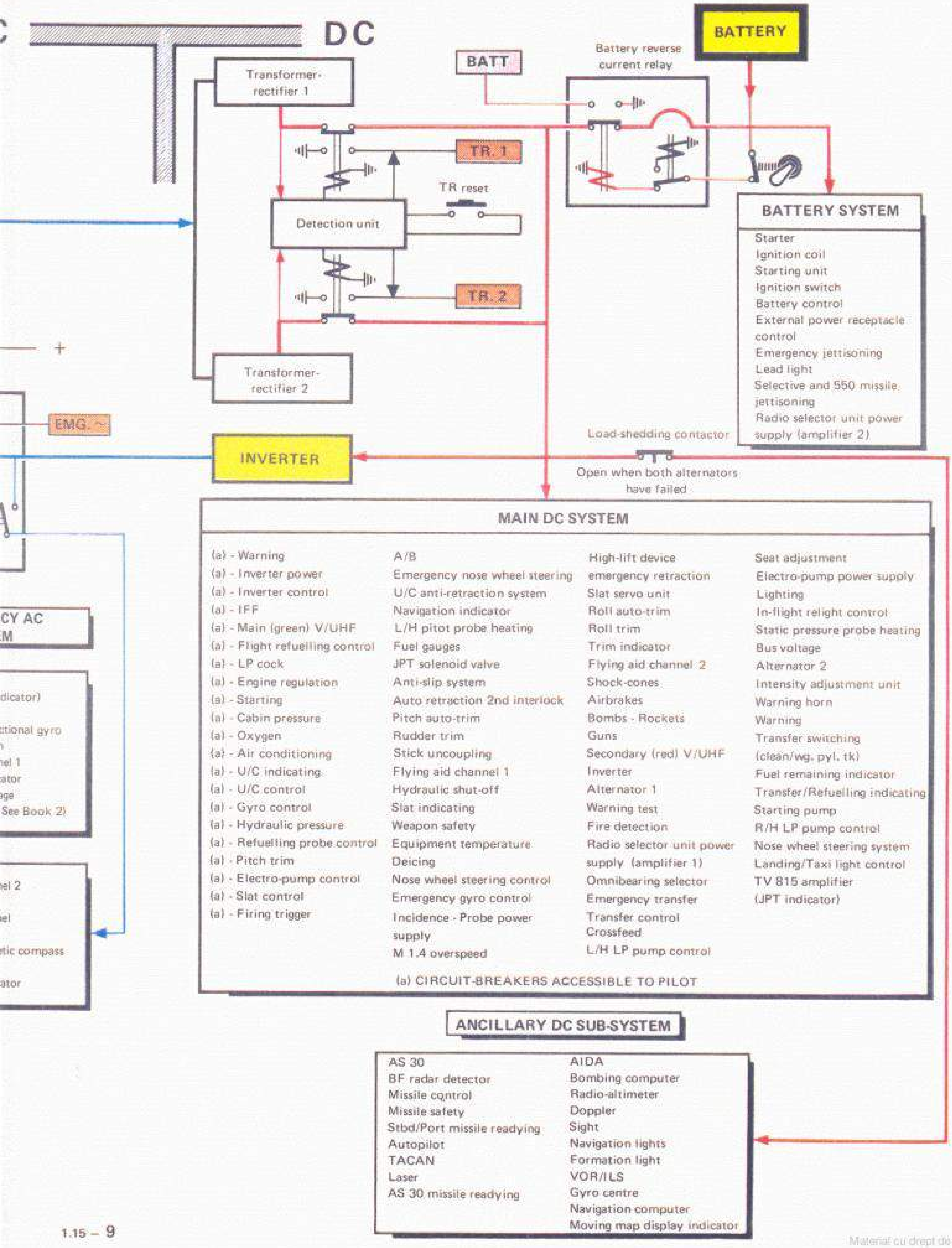


FIGURE 2 - ELECTRICAL POWER GENERATION AND DISTRIBUTION SYSTEM


DC
Transformer-rectifier 1
BATT
BATTERY
Battery reverse current relay
TR. 1
TR reset
Detection unit
TR. 2
Transformer-rectifier 2
EMG. ~
INVERTER
Load-shedding contactor
Open when both alternators have failed
BATTERY SYSTEM
Starter
Ignition coil
Starting unit
Ignition switch
Battery control
External power receptacle control
Emergency jettisoning
Lead light
Selective and 550 missile jettisoning
Radio selector unit power supply (amplifier 2)
MAIN DC SYSTEM
(a) - Warning
(a) - Inverter power
(a) - Inverter control
(a) - IFF
(a) - Main (green) V/UHF
(a) - Flight refuelling control
(a) - LP cock
(a) - Engine regulation
(a) - Starting
(a) - Cabin pressure
(a) - Oxygen
(a) - Air conditioning
(a) - U/C indicating
(a) - U/C control
(a) - Gyro control
(a) - Hydraulic pressure
(a) - Refuelling probe control
(a) - Pitch trim
(a) - Electro-pump control
(a) - Slat control
(a) - Firing trigger
A/B
Emergency nose wheel steering
U/C anti-retraction system
Navigation indicator
L/H pitot probe heating
Fuel gauges
JPT solenoid valve
Anti-slip system
Auto retraction 2nd interlock
Pitch auto-trim
Rudder trim
Stick uncoupling
Flying aid channel 1
Hydraulic shut-off
Slat indicating
Weapon safety
Equipment temperature
Deicing
Nose wheel steering control
Emergency gyro control
Incidence - Probe power supply
M 1.4 overspeed
High-lift device emergency retraction
Slat servo unit
Roll auto-trim
Roll trim
Trim indicator
Flying aid channel 2
Shock-cones
Airbrakes
Bombs - Rockets
Guns
Secondary (red) V/UHF
Inverter
Alternator 1
Warning test
Fire detection
Radio selector unit power supply (amplifier 1)
Omnibearing selector
Emergency transfer
Transfer control
Crossfeed
L/H LP pump control
Seat adjustment
Electro-pump power supply
Lighting
In-flight relight control
Static pressure probe heating
Bus voltage
Alternator 2
Intensity adjustment unit
Warning horn
Warning
Transfer switching (clean/wg. pyl. tk)
Fuel remaining indicator
Transfer/Refuelling indicating
Starting pump
R/H LP pump control
Nose wheel steering system
Landing/Taxi light control
TV 815 amplifier
(JPT indicator)
(a) CIRCUIT-BREAKERS ACCESSIBLE TO PILOT
ANCILLARY DC SUB-SYSTEM
AS 30
BF radar detector
Missile control
Missile safety
Stbd/Port missile readying
Autopilot
TACAN
Laser
AS 30 missile readying
AIDA
Bombing computer
Radio-altimeter
Doppler
Sight
Navigation lights
Formation light
VOR/ILS
Gyro centre
Navigation computer
Moving map display indicator

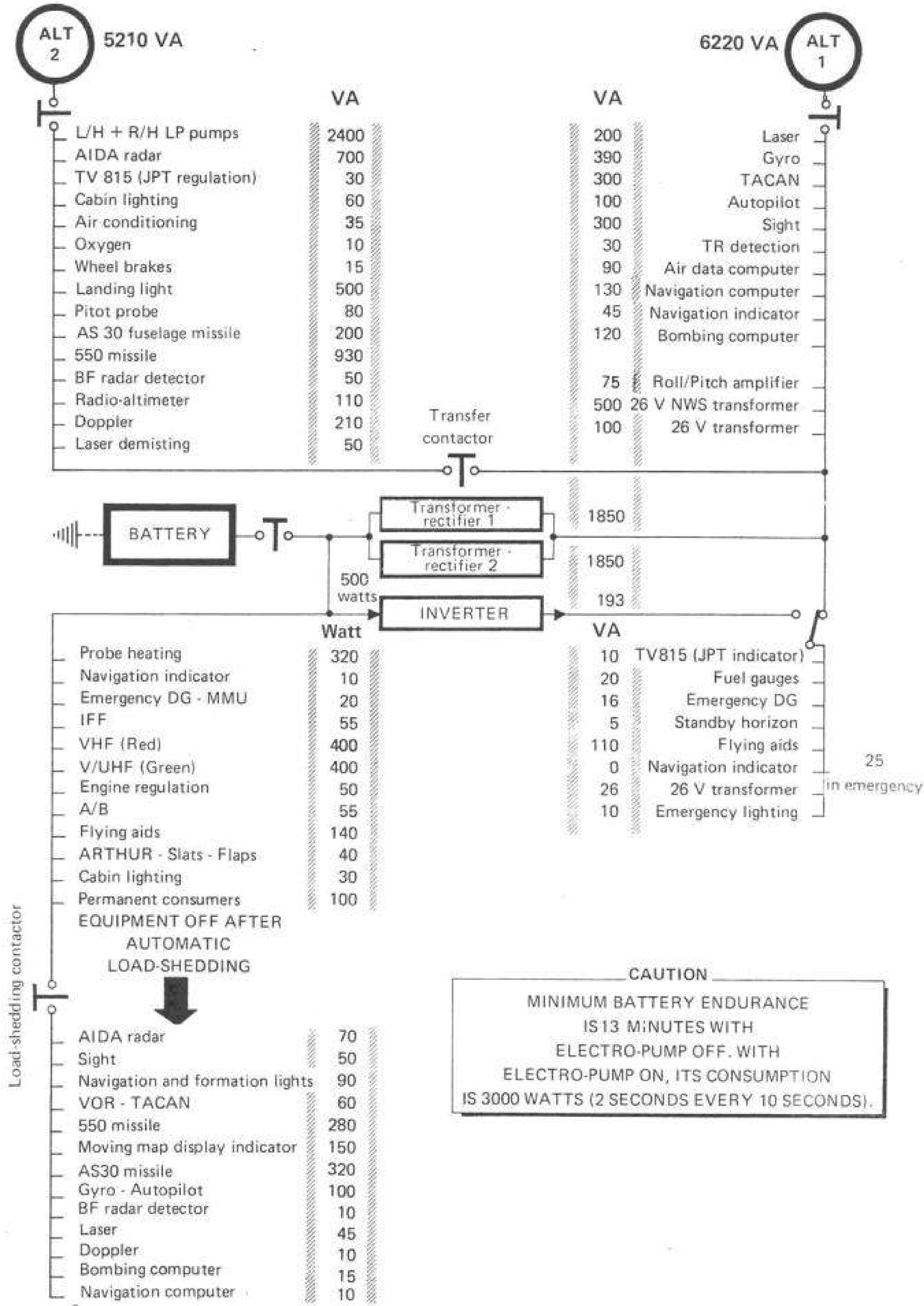


FIGURE 3 - ELECTRICAL LOAD BREAKDOWN

FIGURE 4 – ELECTRICAL SYSTEM
CONTROLS AND INDICATORS

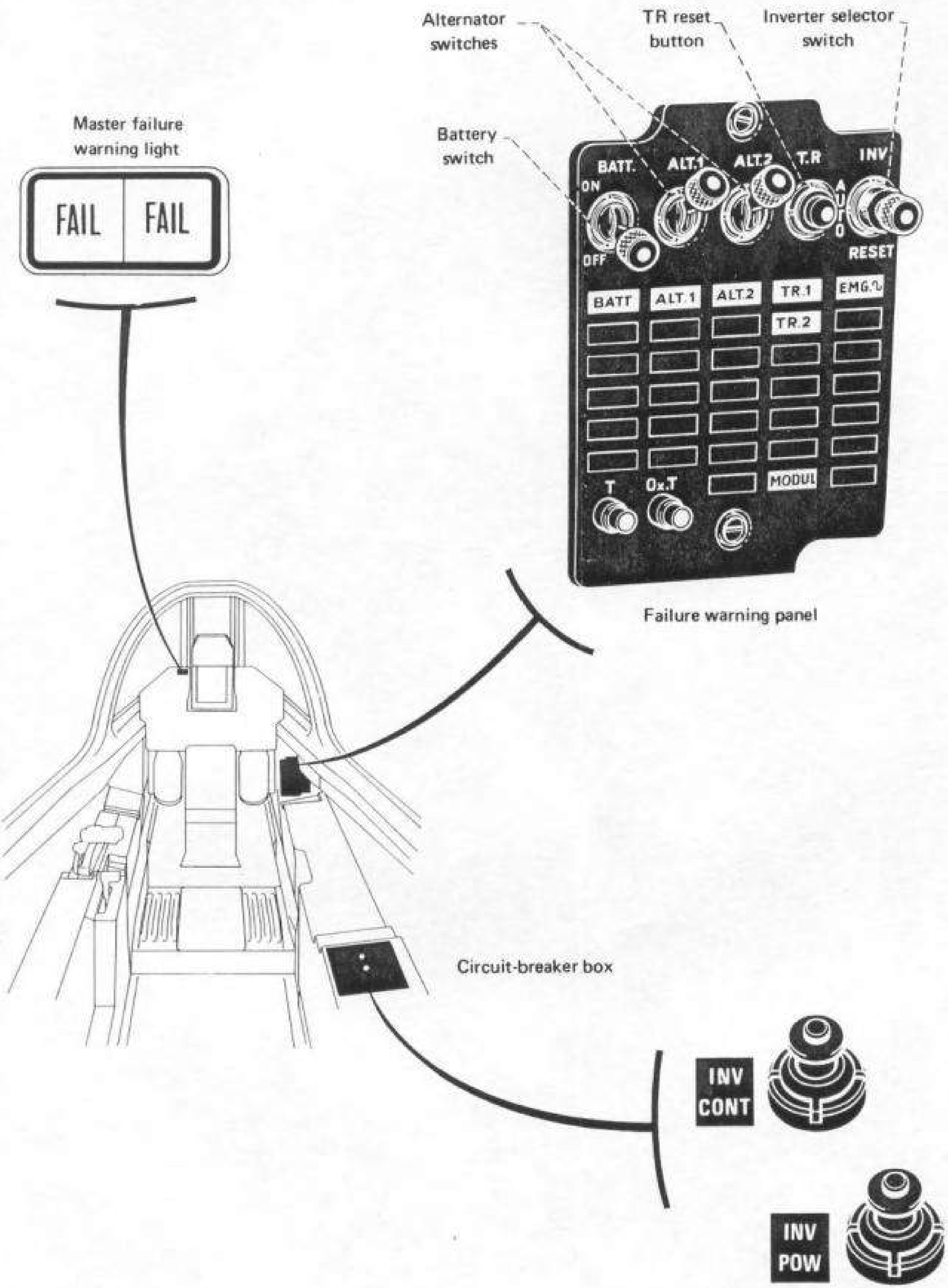


FIGURE 4 - ELECTRICAL SYSTEM CONTROLS AND INDICATORS

1,20 – FUEL SYSTEM

1, 20. 2 - DESCRIPTION

The tanks, the fuel system and the engine are designed to use TR0 (JP1) and TR4 (JP4) fuel. (See Note)
The aircraft fuel system comprises a R/H system and a L/H system, which are normally isolated from each other by a crossfeed cock.
All the fuselage and wing tanks are structural tanks.

The fuselage tanks are divided into three groups :
- forward group
- central group, forming the feeder tanks
- aft group

The aircraft can also carry three 1200-litre (264 Imp. gal - 317 U. S. gal) pylon tanks (1155 l - 254 Imp. gals - 305 U. S. gals of usable fuel).
On the ground, refuelling is normally carried out under pressure at a single point. Emergency refuelling of the fuselage tanks is effected by gravity (two ports). In flight, refuelling is accomplished through a retracting nose probe.

The various groups of tanks and the pylon tanks are transferred into the feeder tanks by the pressure of the air bled from the engine compressor.
Theoretically, the fuel level drop is identical in the R/H and L/H systems.
The engine fuel supply is provided by two electric LP pumps (AC) installed at the bottom point of the feeder tanks.

Another electric LP pump (DC) is used for starting and in-flight relight.
This pump cuts out automatically when the R/H LP pump is energized.
A negative-g flight accumulator, located in the forward central tank, provides the engine with a supply of approximately 15 seconds at full power dry.

Capacities

Forward group (L/H lateral : 545 l (120 Imp. gals - 144 U. S. gals), central : 585 l (129 Imp. gals - 155 U. S. gals), radio bay : 110 l (24 Imp. gals - 29 U. S. gals), R/H lateral : 545 l (120 Imp. gals - 144 U. S. gals))	1785 l (393 Imp. gals - 472 U. S. gals)
Feeder tanks (L/H and R/H) 2 x 532. 5 l (117 Imp. gals - 141 U. S. gals)	1065 l (234 Imp. gals - 281 U. S. gals)
Aft group (L/H and R/H) 2 x 560 l (123 Imp. gals - 148 U. S. gals)	1120 l (246 Imp. gals - 296 U. S. gals)
Wing tanks (L/H and R/H, ungauged) 2 x 190 l (42 Imp. gals - 50 U.S. gals)	380 l (84 Imp. gals - 100 U.S. gals)
Negative-g flight accumulator (ungauged) 60 l (13 Imp. gals - 16 U.S. gals)	60 l (13 Imp. gals - 16 U. S. gals)
Total, Internal	4410 l (970 Imp. gals -1165 U. S. gals)

This total represents the usable capacity of the tanks and corresponds to a refuelling with the use of the forward and af tank topping-up buttons, which enable the capacity to be increased by 60 litres (13 Imp. gals - 16 U. S. gals).
Without the use of these buttons, there are 4350 litres (957 Imp. gals - 1149 U. S. gals) usable (figure retained for normal use).

A dual fuel gauge indicates the fuel quantity contained :
- in the L/H and R/H fuselage tanks, or
- in the L/H and R/H feeder tanks only

according to the position of the "F-FT" (fuselage-feeder tank) selector switch.

A fuel remaining indicator subtracts from the total fuel quantity (preset before engine start) the amount of fuel which is consumed by the engine (dry or A/B operation). Therefore, it gives at all times the total quantity of remaining fuel.
It can be reset in flight in case of pylon tank jettisoning.
Its power supply comes from the main DC system.

NOTE : Change in fuel grade affects an adjustable parameter : fuel density.
Density : When changing fuel grade, it is necessary to adjust the density correctors (on the main FCU andon the A/B FCU) in order to restore original engine performance. Failing to alter the density corrector settings would result in slightly reduced performance, specially at intermediate engine speeds.
Starting injection pressure : The starting injection pressure being the same ($1.1^{+0.2}_{-0.1}$ bar ($16^{+2.9}_{-1.4}$ psi)), whichever fuel is used (TR0 or TR4) (JP1 or JP4), the in-flight relight envelope also remains the same.

1,20.3 - OPERATION

1- ENGINE SUPPLY

The pumps supply the engine through a common supply line to which the negative-G flight accumulator is connected in parallel.

An LP main cock enables the LP fuel supply to the engine and the afterburner to be shut off.

An AB main cock enables the fuel supply to the afterburner only to be shut off.

2- FUEL TRANSFER

Fuel transfer is fully automatic.
The transfer sequence is monitored on the fuel transfer indicator.
The fuel transfer indicator consists of an aircraft outline with the fuel tanks represented by indicator lights. When a fuel tank is empty, the associated indicator light comes on. Electrical power for the fuel transfer indicator comes from the main DC system. The fuel transfer indicator is provided with a test button. Whenever a pylon tank is not fitted, the associated indicator light is out.

Two fuselage tank transfer sequences are possible. They enable variations of the aircraft center of gravity to be reduced according to the configuration (clean or with pylon tanks).

The tank selection (1, 2, 3, 4, 5 or 1, 3, 2, 5, 4) is made by means of a selector switch controlling a selector valve slaved to the LP fuel pressure.

NOTE : Whenever one or several pylon tanks are carried, full or empty, set the fuel transfer sequence selector switch to «WG. PYL. TK».

The pylon tanks are transferred first.

The levels in the feeder tanks are maintained constant during transfer by valves slaved to floats.

Self-sealing air valves, located at the bottom of each tank, close the corresponding transfer lines as soon as the tank is empty ; the corresponding end-of-transfer light comes on (due to lack of pressure).
For tank 3 and for the pylon tanks, the light is illuminated by a float switch.

An emergency transfer system enables transfer by gravity, if required, of the aft lateral tanks to the feeder tanks. Transfer takes place when the emergency fuel transfer switch is on ; the LP fuel pressure then acts on slaved valves which allow the fuel to be transferred.

A crossfeed valve permits interconnection of the two feeder tanks.

REMARK :

- As the crossfeed system balances the feeder tanks only, the «CROSSFEED» valve must be used only in case of large asymmetry read on the fuel gages in «FT» position (Usually, this asymmetry is due to the LP pumps ; it may also be due, in some cases, to malfunction of the transfer sequence slide-valve selector valve).
  When flying with wing pylon tanks, if end of transfer of one of these tanks occurs too soon (as indicated by fuel remaining indicator and fuel transfer indicator), open the crossfeed valve until end of transfer of the other tank, then close the crossfeed valve. In this case, asymmetrical transfer of the fuselage tanks will also probably occur. Depending on the extent of this transfer asymmetry, use the crossfeed valve in the same manner.
- In normal use, the «CROSSFEED» switch in the «ON» position will only create an asymmetry by increasing transfer on the side where a float valve is higher than that on the other side.
- In case of abnormality in the transfer sequence on one side, use of the «CROSSFEED» switch, if justified, should be resorted to only after the failure has been perfectly analyzed. Improper use of the «CROSSFEED» switch may aggravate the trouble.

3 - TRANSFER SEQUENCE

A - Selector switch on "CLEAN"

Tanks on transfer	Feeder tanks	Feeder tank gauges steady	Lights on
	Upon starting The feeder tanks are full .... The crossfeed cock is closed.	2 x 532.5 litres (2 x 117 Imp. gals) (2 x 141 U.S. gals)	
Pylon .... then wing	Immediately after starting The level drops in the feeder tanks ; the upper float valves are uncovered and permit transfer of the pylon tanks and .... the wing tanks	2 x 520 litres (2 x 114 Imp. gals) (2 x 137 U.S. gals)	
	When these tanks are empty .... Their self-sealing air valves close.	....	ooo then 1
Forward central ..	The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting transfer of fuel from the forward central tank	2 x 490 litres (2 x 108 Imp. gals) (2 x 129 U.S. gals)	
	When the forward central tank is empty .... Its self-sealing air valve closes.	....	2
Aft lateral	The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting transfer of part of the fuel from the aft lateral tanks	2 x 390 litres (2 x 86 Imp. gals) (2 x 103 U.S. gals)	
	When these tanks are empty (by 2/3) .... A float switch stops the transfer of these tanks.	....	3
Forward lateral...	The fuel in the feeder tanks is again consumed ; the next float valves are uncovered, permitting transfer of fuel from the forward lateral tanks	2 x 340 litres (2 x 75 Imp. gals) (2 x 90 U.S. gals)	
	When these tanks are empty .... Their self-sealing air valves close.	....	4
Aft lateral	The fuel in the feeder tanks is again consumed ; the lower float valves are uncovered, permitting transfer of the fuel remaining in the aft lateral tanks	2 x 290 litres (2 x 64 Imp. gals) (2 x 77 U.S. gals)	
	When these tanks are empty .... Their self-sealing air valves close. The fuel in the feeder tanks is again consumed ;	....	5
	As soon as a gauge reaches 250 litres (55 Imp. gals - 66 U.S. gals) or .... the aircraft is one minute from the landing pattern, the pilot opens the crossfeed cock.	....	500 L
	If the flight continues, the level in the feeder tanks drops to zero	2 x 0	L/H LP R/H LP
Negative-g flight accumulator	It remains the negative-g flight accumulator which can be used.		

B - Selector switch on "WG. PYL. TK"

The transfer principle is identical ; only the transfer sequence of the internal tanks changes and becomes : 1 - 3 - 2 - 5 - 4. The transfer levels in the feeder tanks remain the same.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

1,20.4 - FAILURES

LP. light on + warning horn

The engine fuel supply pressure is < 700 mb (10.15 psi).

L/H LP light on

The L/H pump discharge pressure is < 500 mb (7.25 psi).

R/H LP light on

The R/H pump discharge pressure is < 500 mb (7.25 psi).
The starting pump cuts in when the pilot cuts out the R/H pump.

L/H LP + R/H LP lights on

The discharge pressure of each pump is < 500 mb (7.25 psi).
In negative-g flight, the illumination of these two lights is normal.

500 L. light on

The level in one of the two feeder tanks is < 250 litres (55 Imp. gals - 66 U.S. gals).

500 L. light on and 5 out

If the gauge reading confirms the illumination of 500 L. :
part of the fuel in the aft lateral tanks has not been transferred.

1, 2, 3, 4, 5 lights on can indicate :

- normal end of transfer if the lights come on in the correct sequence
- transfer failure of one tank due to premature closing of its self-sealing air valve.

The non-illumination of these lights can indicate :

- normal transfer is taking place
- transfer failure due to a float valve being jammed closed :
  If it applies to one of tanks 1, 2 or 4, the fuel remaining in these tanks is lost.
  If it applies to one of tanks 3, it may be transferred normally with 5.
  If it applies to one of tanks 3 or 5, it may be transferred by using the emergency transfer system.
- indicating system failure.

TRANSFER FAILURE

1, 2, 4, 5 come on abnormally

- transfer failure due to lack of pressure
This failure necessitates the use of the emergency transfer system.

ASYMMETRY OF FEEDER TANK GAUGES with illumination of fuel transfer indicator lights in normal sequence

One pump is discharging more than the other.
When a feeder tank gauge stays at its maximum level, the float valve of the tank on transfer is jammed open.
Any asymmetry > 250 litres (55 Imp. gals - 66 U.S. gals) at end of transfer must be reported.

REFUELLING FAILURES

PROBE-IN-MOTION LIGHT REMAINS ON

The probe actuator has not reached its limit position. Consequently, the probe is not fully extended or retracted.

FEEDER TANK OVERFILLING LIGHT ILLUMINATED

Feeder tank overflow due to non-closing of the refuelling valve of a fuselage tank. There is a permanent fuel flow through the feeder tank overboard drains.

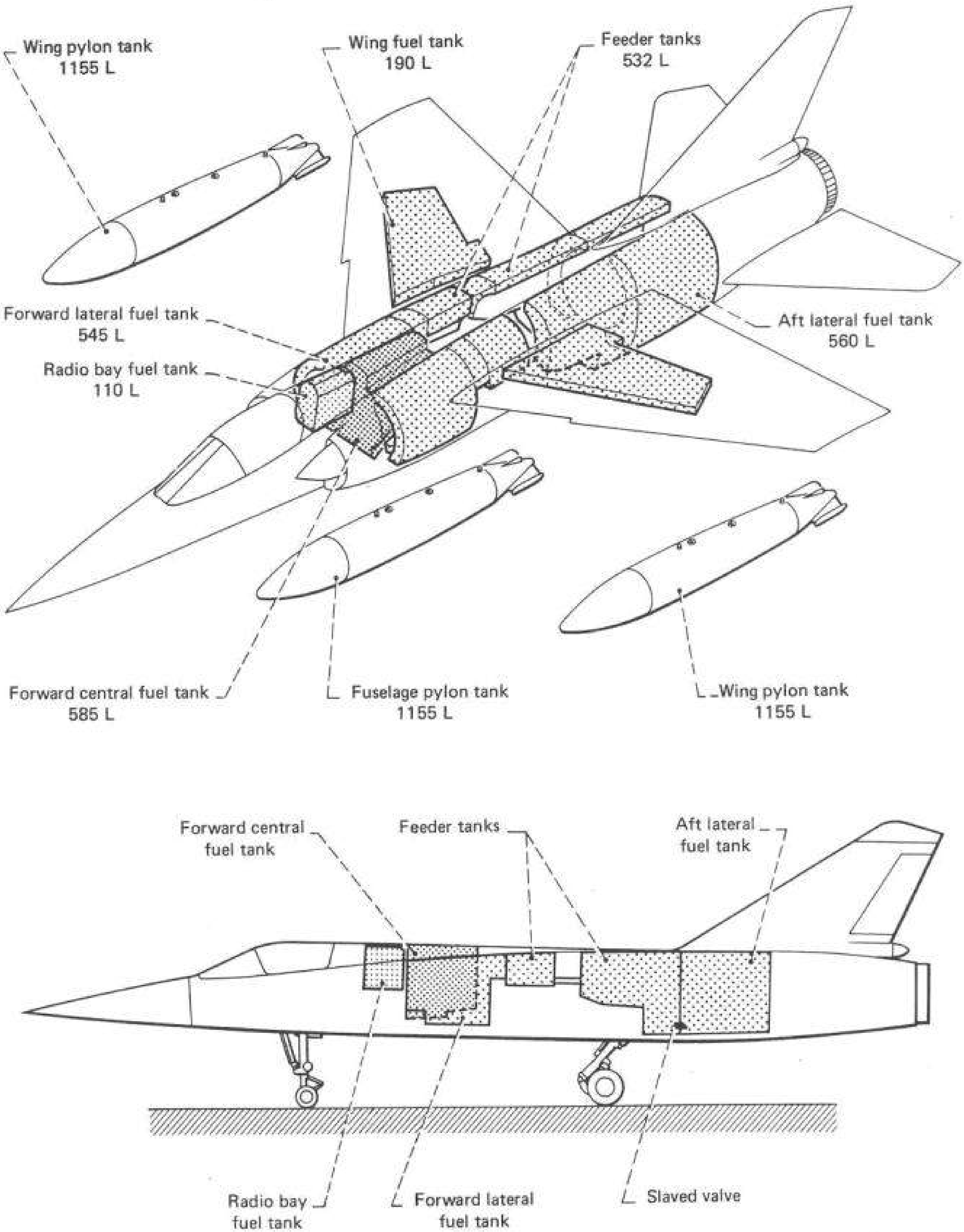


FIGURE 2M – FUEL TANK ARRANGEMENT

Fuel tank pressurization

Feeder tanks	: 90-130 mb (1.3-1.9 psi)
Wing/Fuselage tanks	: 440-480 mb (6.4-7.0 psi)
Radio bay tank	
Pylon tanks/Negative-g flight accumulator	: 850-890 mb (12.3-12.9 psi)

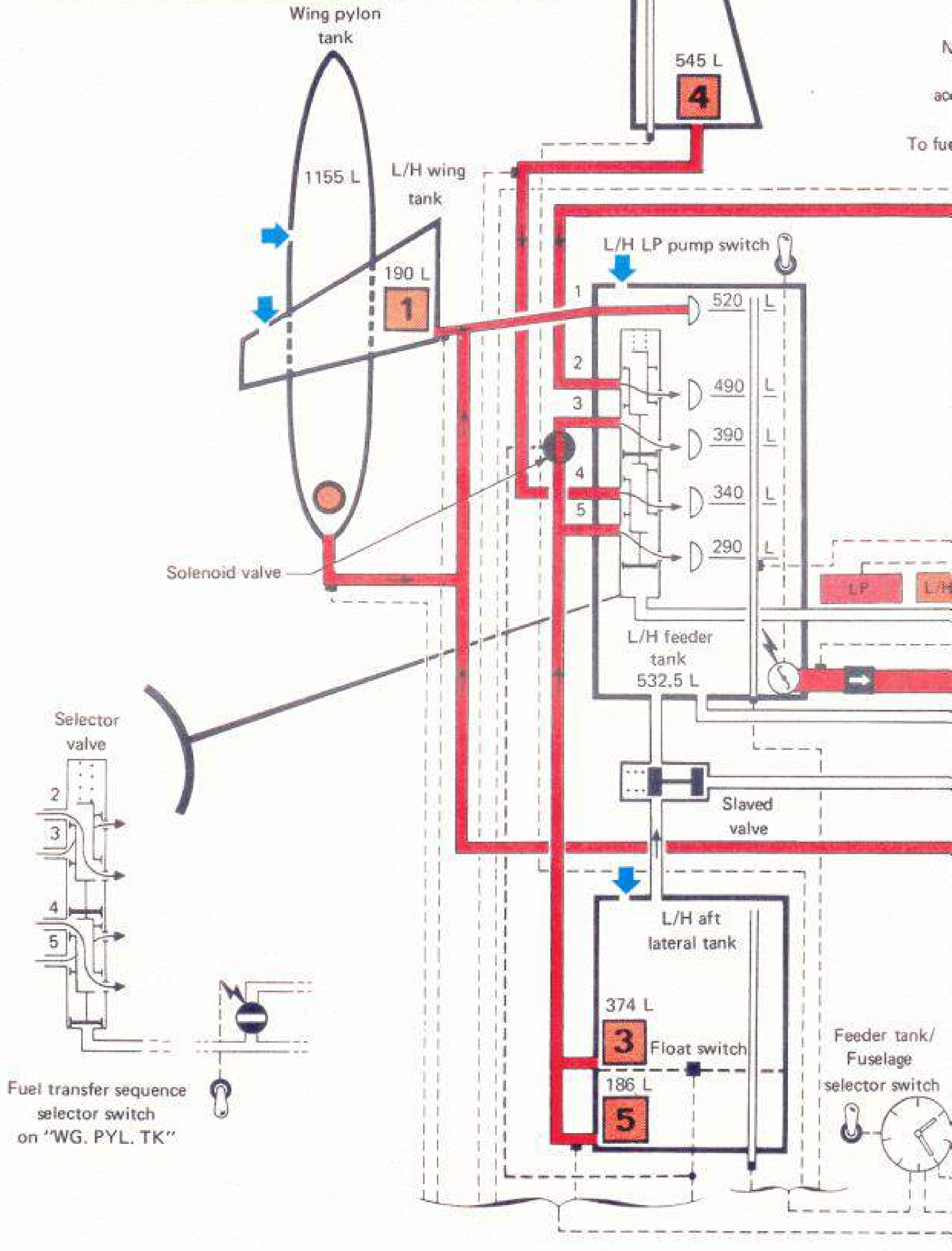
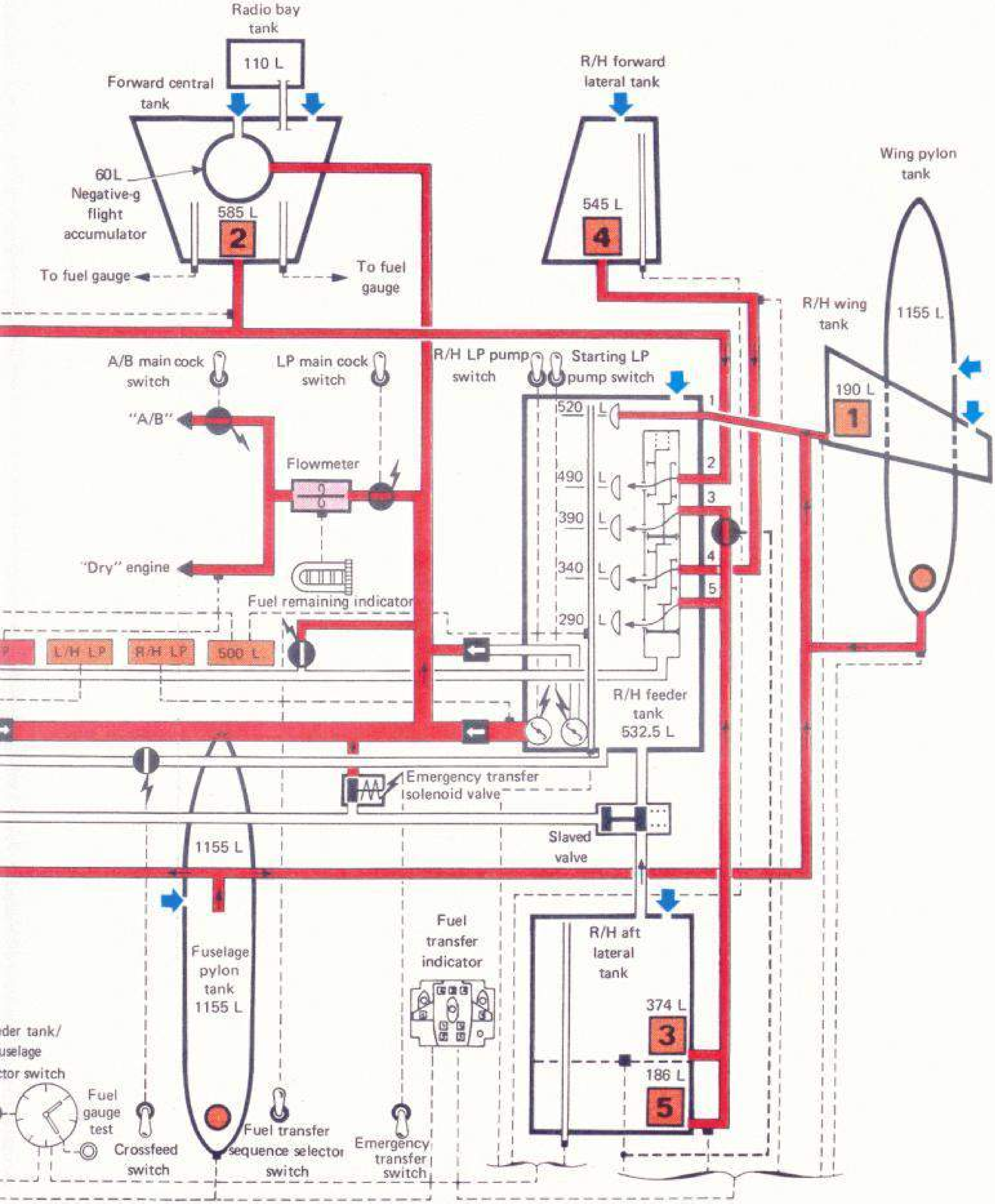


FIGURE 3 - FUEL SUPPLY AND TRANSFER SYSTEM


Radio bay tank
110 L
Forward central tank
60L Negative-g flight accumulator
585 L
2
To fuel gauge
To fuel gauge
R/H forward lateral tank
545 L
4
Wing pylon tank
1155 L
R/H wing tank
190 L
1
A/B main cock switch
LP main cock switch
R/H LP pump switch
Starting LP pump switch
"A/B"
Flowmeter
"Dry" engine
Fuel remaining indicator
L/H LP
R/H LP
500 L
520 L
490 L
390 L
340 L
290 L
1
2
3
4
5
R/H feeder tank 532.5 L
Emergency transfer solenoid valve
Slaved valve
1155 L
Fuselage pylon tank 1155 L
Fuel transfer indicator
R/H aft lateral tank
374 L
3
186 L
5
eder tank/ uselage ctor switch
Fuel gauge test
Crossfeed switch
Fuel transfer sequence selector switch
Emergency transfer switch

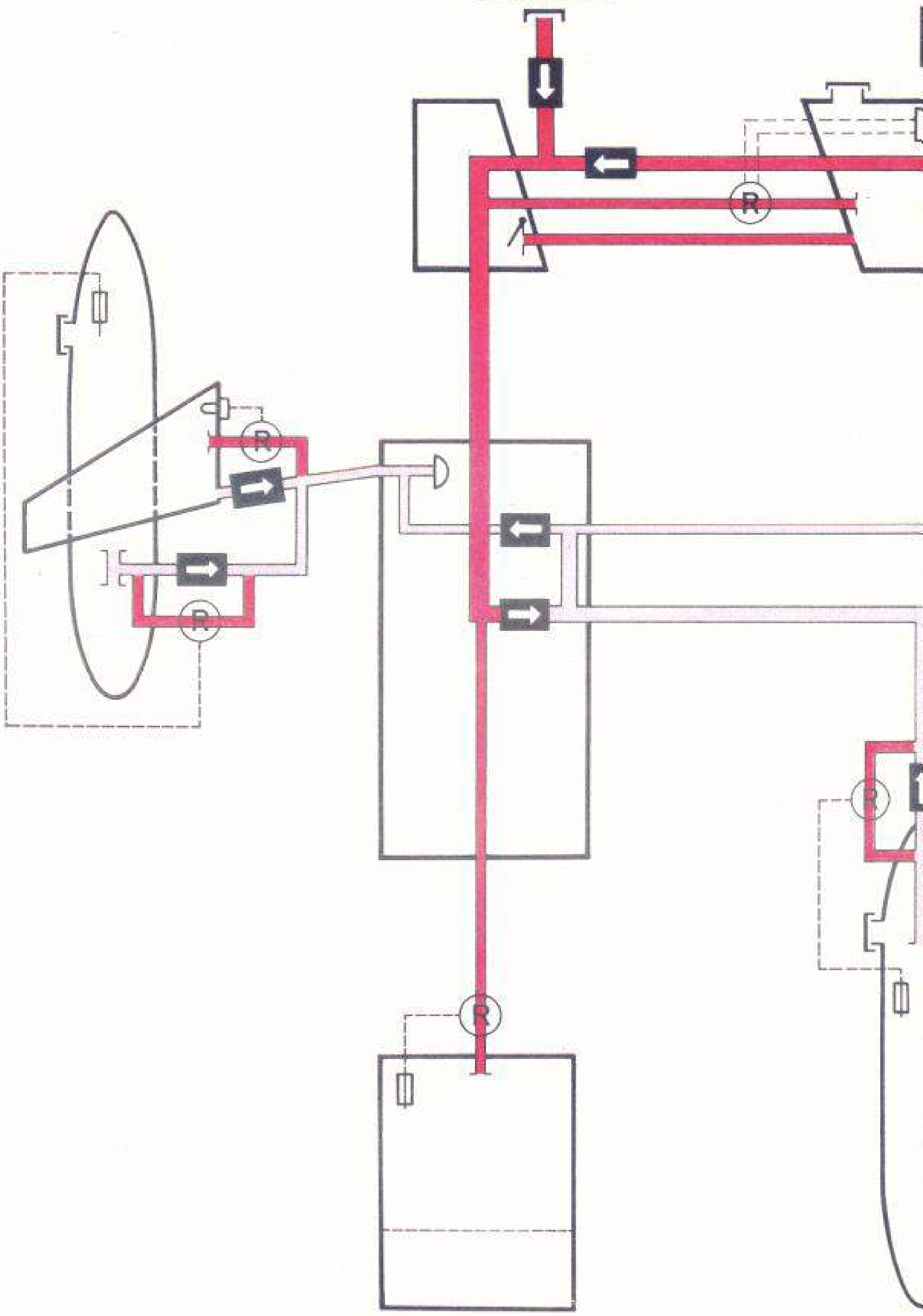
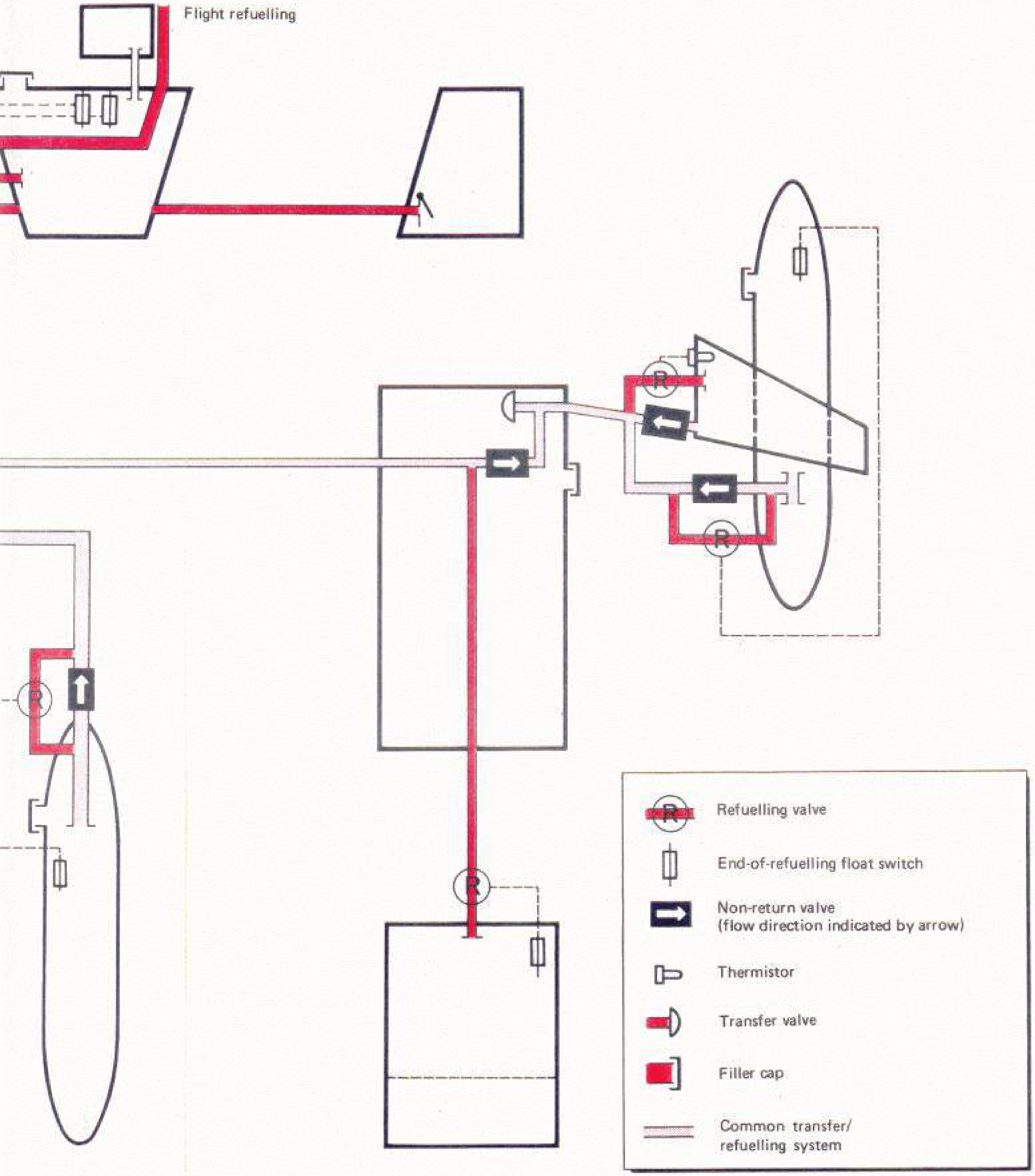


FIGURE 3M - FLIGHT REFUELLING SYSTEMS


Flight refuelling
Refuelling valve
End-of-refuelling float switch
Non-return valve
(flow direction indicated by arrow)
Thermistor
Transfer valve
Filler cap
Common transfer/
refuelling system

1, 25, 2 - DESCRIPTION

The aircraft is powered by a SNECMA ATAR 9K 50 single-spool turbojet engine. The engine test bed thrust is 6830 daN (15, 355 lbs).

1 - THE ENGINE comprises :

- A Microturbo "NOEL 015" turbo-starter powered by the aircraft battery.
- Three accessory drives driven by the reduction gearbox :
  . accessory angle drive
  . A/B pump drive
  . A/C accessory drive.
- A 9-stage axial flow compressor incorporating two automatically-controlled bleed-off valves.
- An annular combustion chamber fitted with :
  . 2 enrichment nozzles (starting)
  . 2 high-tension igniter plugs (starting and in-flight relight)
  . 20 fuel nozzles (normal operation)
  . 1 A/B ignition fuel nozzle
  . 20 burners.
- A 2-stage turbine.
- The exhaust duct including :
  . a junction section with two upstream manifolds, three A/B burner rings and the JPT measurement system (8 thermocouples)
  . an afterburner chamber and a ionization probe
  . a variable-area multi-flap nozzle actuated by high pressure oil actuators.
- Thrust is controlled through a single throttle lever which acts on :
  . the main FCU
  . the A/B FCU

  and automatically maintains a constant rotational speed and turbine inlet temperature.

The engine also comprises :

- A main regulation system, including :
  . the fuel regulation system
  . the RPM regulation system
  . the stop regulation system
  . the temperature regulation system
  . the overspeed system
  . a bleed-off valve system.
- An emergency regulation system
- An A/B system, including :
  . the A/B regulation system
  . the SRL (slam relight lighting) system
  . an A/B overboost system.
- A fuel dipper.

2 - FUEL SYSTEM

- Dry engine

  The LP fuel flows through the engine-driven HP pump and reaches the main FCU where it is metered through the throttle lever or the emergency regulation control lever. Then, through the main pressurizing and dump valve, this fuel is directed to the dual-orifice fuel nozzles which spray it into the combustion chamber.

- Afterburner

The LP fuel flows through the centrifugal pump, which is itself driven by the engine, then it reaches the A/B FCU where it is metered in relation to the A/B power. The A/B pressurizing and dump valve then directs the fuel to the burner rings and the upstream manifolds.

3 - OIL SYSTEM

It consists of two systems and a single oil tank.

- Lubrication oil

  - A main system, supplied by the oil tank, lubricates the turbo-jet engine assembly. The lubrication oil of bearings 2 and 3 is lost, which gives an oil consumption of 0,8 to 1,5 liter per hour. The main oil system has an endurance of approx. 6 hours (see VOLUME 3).
  - An emergency system, supplied by the emergency reserve in the oil tank, lubricates bearing 1 only for 20 minutes, irrespective of the power setting.

- Regulation oil

The LP oil pump supplies the main FCU.
The HP oil pump supplies :
- the exhaust nozzle actuators, which progressively close the exhaust nozzle from 6900 rpm,
- the overspeed system hydraulic control.

4 - AIR SYSTEM

Several systems supplied with P2 air tapped at the engine center casing, ensure :
- regulation system operation,
- flexible deflector anti-icing and cooling of certain engine components,
- cockpit and equipment bay air conditioning,
- fuel tank pressurization.

5 - AIR SUPPLY - PURPOSE OF SHOCK-CONES

Air supply is provided by two semi-circular lateral air intakes, in which automatically or manually adjustable shock-cones (mice) move longitudinally.
During engine run-up, during take-off and under certain flight conditions, additional air intake doors open under the effect of negative pressure in the inlet duct, thus improving the engine air supply.
In supersonic, the shock-cones are progressively moved forward so as to reduce the intake throat area and prevent the absorption of shock waves ; the shock-cone movement schedule is determined by the Mach number supplied by the air data computer.
The shock-cones are actuated by a hydraulic motor (system 1) controlled by a servo-valve supplied with DC current.

6 - ELECTRICAL SYSTEM

- Engine power supply
- 28 V DC : fed from battery or ground power unit.

The use of the ground power unit, during the turbo-starter operation, necessitates the protection of the electrical starting motor of the latter. This protection is obtained, in aircraft, by the automatic cutout of the ground power unit during the starting sequence.

- 400 Hz AC - 208 V (three-phase) and 115 V (single-phase)

This power supply (which is used only on the electronic regulation unit TV 815) is ensured in aircraft
. by the two 208 and 115 V alternators (normal operation),
. by a 115 V inverter (emergency operation, partial supply of the unit).

7- FIRE DETECTION

Overheat and fire detectors are placed in the engine area, close to «hot» points, and also in the AB area ; they control the illumination of the corresponding section of the dual fire warning light.
The system comprises a safety device which prevents untimely illumination of the fire warning light (open-circuit or grounding).
During fire detection system testing, pressing the «ENG-A.B» light tests not only the lamp but also the circuit.

8- CHARACTERISTICS

A - Normal Regulation

	Cockpit Instrument Readings		
Power Setting	Rotational Speed in rpm	JPT in °C on the Ground	in Flight
Idle*	2900 ± 100		
Military thrust	8400 ± 60	740 < JPT < 755	JPT < 760
Min. AB	8400 ± 60	740 < JPT < 755	JPT < 760
Max. AB	8400 ± 60	740 < JPT < 755	JPT < 760
with overspeed	8900 ± 60		JPT < 735

NOTE : In certain cases, for example with a cold engine, although the throttle is set to IDLE, the rotational speed of the engine may be below normal or vary between 2600 and 3200 rpm with small JPT variations. This phenomenon should disappear as soon as the engine is warmed up.
In flight, at idle, the JPT is below 200° C and cannot be read by the pilot.

B - Emergency Regulation

See SECTION 3, para. 3,25.8.

1,25.3 - OPERATION

1 - STARTING

An external power source is not necessary to start the engine.
However, an auxiliary power unit can be used to supply the utility systems ; the aircraft battery continuing to supply the starter.
The starter is a gas generator driven by a low-power electric motor. It includes an electric fuel pump, a regulation system and a number of interlocks.
The exhaust gases drive a free turbine which is made integral with the rotor of the engine through a releasable reduction gear (free wheel type drive).

Starting sequence

Starting takes place in four phases :

A - With the throttle set to STOP, the LP main cock open, the LP pumps on and the ignition/ventilation selector set to "IGN" "P" or "S", the pilot :
- lifts the starter button guard, which has the effect of starting the starting pump (extinction of the L P light on the failure warning panel)
- then depresses the starter button, which has the effect of :
  . supplying the starter electric fuel pump
  . supplying the electric motor and igniting the gas generator
  . triggering the crash recorder.

B - When the gas generator has reached a certain speed :
- the electric motor and starter ignition are cut off
- the starting solenoid valve of the engine opens and the starting fuel nozzles start to inject fuel
- the engine igniter plug is supplied
- the starting by-pass opens.

During this time, the free turbine gradually starts to drive the engine.

C - Between 300 and 600 rpm, the pilot moves the throttle to IDLE ; fuel reaches the main fuel nozzles under low pressure (because of the bypass which is open) : the engine accelerates and lights up a about 1200 rpm.

D - When the engine reaches 2150 rpm, a starting relay controlled by a pickoff (phonic wheel) stops all the operations described in A and B above and, in particular, closes the bypass.

Fuel flow increases and the engine accelerates under its own power until it reaches idling speed.

NOTE 1 : The best way to monitor the engine for proper starting is to listen to the various sequences which each produce a peculiar noise. This is very easy with some experience and facilitates interpretation of the indications provided by the RPM and JPT indicators.

NOTE 2 : Cold engine starting :
- Between 300 and 600 rpm, move the throttle slightly beyond the idle position. The metering valve opening command is then larger and valve operation faster.
- As soon as the engine starts accelerating (at 2500 rpm), imperatively move the throttle back to idle so as to prevent starter turbine disintegration in case of cutout circuit failure.

Special case : MOTORING

After a false start, it may be necessary to perform a DRY MOTORING. This is performed as for normal starting, but :
- the ignition/ventilation selector is set to "VENT", which has the effect of cutting off the fuel supply to the starting fuel nozzles and the electrical supply to the plug
- the throttle is left at STOP

(The procedure is described in SECTION 4 - para. 4,25.1.3)

STARTING SAFETY SYSTEMS

Safety systems are provided in case the automatic starting sequence does not proceed normally :

A - If the starter fuel pressure does not reach a given value, a timer stops the starting sequence at the end of 12 seconds.

B - If starting and acceleration of the starter do not proceed normally, a timer stops the starting sequence 7 seconds after energization of the starter.

C - If the engine does not start normally, i.e. the engine does not reach 2150 rpm, the timer also stops the starting sequence 12 seconds after the start of the 2nd phase.
It is this 12-second safety system which normally stops the starting sequence when a ventilation is performed.

REMARK : The pilot cannot directly control stopping of the starting sequence (except by pulling out the "START" circuit-breaker).

2 - IN-FLIGHT RELIGHT

The in-flight relight control is normally off. When it is switched on, it is self-held in this position for 30 seconds. This has the effect of :
- opening the starting solenoid valve
- igniting the R/H and L/H plugs (provided the ignition/ventilation selector switch is on "IGN" "P" or "S").
In-flight relight procedures are dealt with in Section 4.

3 - MAIN REGULATION

The main function of the main regulation system is to provide for fuel supply to the combustion chamber.
The main FCU is mechanically controlled by the speed selector which receives pilot's commands through the throttle lever and acts on the RPM regulation system.
The main regulation system is composed of six components each having a special function but all being interdependent.

A - Fuel regulation system

The fuel regulation system essentially consists of the metering valve which meters the fuel flow.
The stop valve, controlled according to the throttle lever movement through the speed selector, allows the metered fuel to flow through the pressurizing and dump valve or to be by-passed to the return circuit.
The metering valve movement is controlled by the RPM regulation system within the limits determined by the stop regulation system.

B - RPM regulation system

The RPM regulation system controls the metering valve according to the engine rotational speed in order to ensure a fuel flow suited to the selected rotational speed.
In addition, it determines the following characteristic power settings :
- idle (RPM = 2900 or 34.5 %)
- full power dry or A/B (RPM = 8400 or 100 %)
- overspeed (RPM = 8900 or 106 %), controlled by a Mach number signal.

C - Stop regulation system

Two stops acting on the metering valve limit the fuel flow in order to increase the margin of surge due to throttle lever movements or certain flight conditions.
The control of this dual stop is slaved to :
- an RPM/P2 stop corrector } to regulate throttle lever movements
- a P2/P1 stop corrector }
- a stop limiter solenoid valve which operates according to H, IAS, i and engine rpm under the following conditions :

INCIDENCE	ALTITUDE	DRY	A/B
i > 14° whatever IAS	H > 29,000 ± 1500 ft	whatever RPM	RPM > 8100 or 96 %
	H < 29,000 ± 1500 ft	RPM < 8100 or 96 %	without
whatever i IAS ⩽ 242.5 kt	H > 29,000 ± 1500 ft	whatever RPM	RPM > 8100 or 96 %

REMARKS: Effect of this regulation for the pilot :

A) The first two correctors have no direct effect for the pilot, except for the engine which does not react rapidly.
B) On the other hand, the stop limiter, when energized, acts on the operation of the exhaust nozzle flaps through the temperature regulation system.
1. The RPM governing system maintains the engine rpm with a ± 80 (1 %) rpm hunting (2- to 4-second period).
2. The temperature regulation system opens the exhaust nozzle flaps, which may cause the JPT to drop down to 550°C under extreme conditions.

D - Temperature Regulation

The purpose of this regulation is to associate to each rotational speed an operating JPT which tends to optimize the engine consumption.
Schematically, the temperature regulator, subjected to the action of a ΔP, supplies the exhaust nozzle actuators with high pressure oil, thus controlling the exhaust nozzle area variation.
From full power, an electronic JPT regulation system, associated with a JPT conformation box, maintains the temperature constant irrespective of the flight conditions.
The JPT conformation box specially provides, for certain characteristic operating points, the same JPT reading in all aircraft though there are noticeable variations from an engine to another.

REMARKS:

1. In certain cases of failure, the pilot can cut out the electronic JPT regulator. In this case, for a same engine rpm, the JPT will be lower.
2. The exhaust nozzle flap hydraulic system has a solenoid valve actuated by :
   - the «emergency regulation» control
   - the «firing fuel dipper» control (missile firing)

   Energizing this solenoid valve controls immediate opening of the exhaust nozzle flaps.
3. To the pressure regulator itself is associated a mechanical valve the bleed flow of which is also controlled by the throttle. This valve is adjusted so as to vent the $\beta P2$ pressure at low engine rpm, thus causing the exhaust nozzle to immediately open in case of reduction (RPM < 6800 or 81 %).

E - Overspeed System

The overspeed system, controlled by a signal from the air data computer (Mach 1.4), acts on the RPM governing system through the speed selector (supplied with high pressure oil).
The engine rpm increases to 8900 (106 %), which improves the performance by increasing the air flow.
Simultaneously, the JPT regulation system causes a JPT drop so as to maintain a turbine inlet temperature identical to that existing during normal full power operation.

F - Bleed Valves

These valves divert part of the air compressed by the first four stages of the compressor. This air bleed prevents partial stalls or even flameouts and also reduces the stresses affecting the vanes of rotating wheel 1 (RW1) to acceptable values.
The valves are controlled by springs which hold them open up to about 4000 (47.5 %) rpm, and by an electronics box which opens or closes them according to the following logic :

- RPM < 6700 (80 %) : valves open
- RPM > 7000 (83.5 %) : valves closed
- stresses on RW1 : opening signal if RPM < 8100 (96 %)

To avoid directing very hot air into the engine compartment, the electronics box prevents opening of the bleed valves at engine speeds higher than 8100 (96 %) rpm.

The B.O.V. light comes on :

- in case of disagreement between the given signal and the position of the valve
- if the given signal does not correspond to the control logic
- when RW1 stresses are detected regardless of the engine rpm
- if the 15/28 V power supply of the TV 815 has failed

NOTE : Momentary illumination of the B.O.V light may occur due to interferences in the detection circuit. This untimely operation should occur only when the JPT emergency regulation switch is actuated or the inflight relight switch is on, and at 6500 < RPM < 7000 (77.5 % < RPM < 83.5 %).

Aircraft equipped with engine incorporating Mod. 303

REMARKS: Effect of this regulation for the pilot :

A) The first two correctors have no direct effect for the pilot, except for the engine which does not react rapidly.

B) On the other hand, the stop limiter, when energized, acts on the operation of the exhaust nozzle flaps through the temperature regulation system.

1. The RPM governing system maintains the engine rpm with a ± 80 (1 %) rpm hunting (2- to 4-second period).
2. The temperature regulation system opens the exhaust nozzle flaps, which may cause the JPT to drop down to 550°C under extreme conditions.

D - Temperature Regulation

The purpose of this regulation is to associate to each rotational speed an operating JPT which tends to optimize the engine consumption.
Schematically, the temperature regulator, subjected to the action of a ΔP, supplies the exhaust nozzle actuators with high pressure oil, thus controlling the exhaust nozzle area variation.
From full power, an electronic JPT regulation system, associated with a JPT conformation box, maintains the temperature constant irrespective of the flight conditions.
The JPT conformation box specially provides, for certain characteristic operating points, the same JPT reading in all aircraft though there are noticeable variations from an engine to another.

REMARKS:

1. In certain cases of failure, the pilot can cut out the electronic JPT regulator. In this case, for a same engine rpm, the JPT will be lower.
2. The exhaust nozzle flap hydraulic system has a solenoid valve actuated by :
   - the «emergency regulation» control
   - the «firing fuel dipper» control (missile firing)

   Energizing this solenoid valve controls immediate opening of the exhaust nozzle flaps.
3. To the pressure regulator itself is associated a mechanical valve the bleed flow of which is also controlled by the throttle. This valve is adjusted so as to vent the β P2 pressure at low engine rpm, thus causing the exhaust nozzle to immediately open in case of reduction (RPM < 6800 or 81 %).

E - Overspeed System

The overspeed system, controlled by a signal from the air data computer (Mach 1.4), acts on the RPM governing system through the speed selector (supplied with high pressure oil).
The engine rpm increases to 8900 (106 %), which improves the performance by increasing the air flow.
Simultaneously, the JPT regulation system causes a JPT drop so as to maintain a turbine inlet temperature identical to that existing during normal full power operation.

F - Bleed Valves

These valves divert part of the air compressed by the first four stages of the compressor. This air bleed prevents partial stalls or even flameouts and also reduces the stresses affecting the vanes of rotating wheel 1 (RW1) to acceptable values.
The valves are controlled by springs which hold them open up to about 4000 (47.5 %) rpm, and by an electronics box which opens or closes them according to the following logic :

- RPM < 6700 (80 %) : valves open
- RPM > 7000 (83.5 %) : valves closed
- stresses on RW1 : opening signal if RPM < 8100 (96 %)

To avoid directing very hot air into the engine compartment, the electronics box prevents opening of the bleed valves at engine speeds higher than 8100 (96 %) rpm.
In case of disagreement between the signal from the electronics box and the position of the valves, the red B.O.V. light comes on.
It may be the case, for example, when RW1 stresses are detected above 8100 (96 %) rpm.

4 - EMERGENCY REGULATION SYSTEM

The emergency regulation system compensates for :
- most of the oil failures
- most of the rpm freezing cases.

It enables the engine rpm to be adjusted through direct action on the main FCU metering unit within a reduced envelope.
There is no more automatic regulation of the engine speed.

The emergency regulation switch, when turned on :

- energizes the control lever (illumination of the emergency regulation light)
- controls opening of the exhaust nozzle (solenoid valve)
- energizes the bearing 1 lubricating oil micropump.

NOTE : Opening of the exhaust nozzle, by means of the emergency regulation switch, causes an important thrust drop. For information, the maximum engine thrust, in the emergency regulation mode, is approximately equal to that obtained in the normal regulation mode around 7300 rpm at 1500 ft - 200 kt - ISA, i.e., about 43 % of the maximum thrust.

The control lever controls an electric actuator which directly acts on the fuel metering unit (in the fuel flow increasing direction), thus allowing the necessary engine rpm to be set. The fuel flow is reduced through an anti-overspeed spring as the actuator retracts.

REMARKS :

1. The pilot must act on the control lever in small steps (no rpm regulation ; the response is long).
2. The AB cannot be ignited in the emergency regulation mode.
3. A relay prohibits any energization of the starter during emergency regulation.
4. Turning the emergency regulation switch off automatically places the electric actuator in the full reduced position and extinguishes the emergency regulation light.
5. The emergency regulation system must not be switched on during overspeed system operation.

5 - AFTERBURNER

Injection of fuel into the gases from the turbine increases the temperature, which increases the exhaust jet velocity. This gives an important thrust gain.

- The AB regulation system acts as a function of two parameters :
  - selection of the degree of reheat (throttle)
  - P2 air pressure which represents the quantity of air available for the AB (variable with flight conditions).

- AB ignition and slam relight lighting (SRL) system

  The SRL system permits the throttle to be directly moved from any position of the dry quadrant to any position of the AB quadrant.
  The pilot slams the throttle and when N $>$ 8100 (96 %) rpm for more than 3 seconds (SRL), the AB regulation unit, through the TV 815, authorizes the following :
  - operation of the AB fuel pump
  - energization of the AB ignition fuel nozzle
  - illumination of the "INJ" light
  - arming of the 8-second interlock which will automatically cut off AB injection in case of ignition or detection failure.

  - the ionization probe detects AB ignition and controls the following :
    . cutoff of AB injection
    . extinction of the red "INJ" light
    . illumination of the "ON" light
    . closing of the SRL circuit (which will remain closed as long as the "ON" light is on) after a 1.7-second delay.

REMARKS :

1. The AB is designed to operate only when the engine is at its maximum power setting. The JPT does not change.
2. If the «ON» light is already or still on in the dry quadrant, AB ignition may be attempted if JPT $\geqslant 600^\circ$ C but must be effected at min. AB (non-indicated SRL system failure).
3. If the «SRL» warning light is on, attempt to ignite the AB in the same conditions as above.
4. The SRL system failure (solenoid valve which remains open during AB operation) is not indicated, whereas the «ON» light is on.
   This failure results in a thrust loss of about 20% of the total thrust, which corresponds to a thrust lower than min. AB thrust.
5. If the «INJ» light remains on for more than 10 seconds, shut off the AB.
6. The AB regulation system normally ensures automatic AB reignition in case of accidental flameout.
   In this case, it is imperative to move the throttle back to mid-travel in the AB quadrant (this flameout usually occurs at envelope limit).

- AB Overboost System
  This system is automatically engaged above 27,500 ft.
  The air data computer feeds the overboost solenoid valve with an opening signal ; this valve enriches the mixture, which results in a 40° C temperature increase not legible on the JPT indicator.

6- FIRING FUEL DIPPER

The gun/missile firing fuel dipper is an engine protection against the risks of compressor stall which may result from the following :

- ingestion of hot exhaust gases during firing (case of missiles), or
- sudden air rarefaction due to the pressure wave

The engine is momentarily leaned during firing, which has the effect of increasing the compressor surge margin. This leaning is obtained by bypassing a certain quantity of metered fuel.
The firing fuel dipper is energized when :

- the armament control panel «F DIP» switch is on
- the «ARM. M.» armament master switch is on

In addition, operation of the missile firing fuel dipper circuits is dependent on :

- actuation of at least one of the following armament control panel pushbuttons : LH or RH 550 missile or fuselage missile

A - Gun Firing

In short-duration firing, the gun firing solenoid valve is energized during 0.8 second from the «trigger» signal. In long-duration firing, the solenoid valve remains open throughout the trigger actuation duration.

B - Missile Firing

- Pressing the firing button causes :
  . opening of the exhaust nozzle
  . automatic shutoff of the AB if it is ignited or ignition prohibition if it is not

- Departure of a missile results in the following :
  . simultaneous opening of three solenoid valves
  . a time delay box then controls successive closing (0.8 s, 3 s, 5 s) of the latter valves, thus ensuring progressive reacceleration of the engine
  . at the end of 10 seconds, the exhaust nozzle closes and the AB is automatically reignited if the throttle is still in the AB quadrant
  After application of both modifications Nos. 909 and 910
  The exhaust nozzle opening duration is reduced from 10 seconds to 3 seconds, automatic AB reignition occurs 3 seconds after nozzle closing, and successive closing of the solenoid valves is reduced to 0.8, 1.5 and 2.8 seconds after their opening.

- A complementary dual sequence box causes the leaning sequence to restart when a second 550 missile is fired less than 10 seconds after the first one, provided that the armament control panel missile switch is on.

6.1 - FUEL DIPPER OPERATING CONDITIONS

During gun or missile firing (See instructions in Book 3)
The fuel dipper operates only when the initial engine rpm is higher than 7300 (87 %).

6.2 - PRACTICAL REACTION FOR PILOT

At 30,000 ft, with the throttle lever in the full power dry position or within the A/B quadrant, the missile firing fuel dipper causes :

- engine rpm drop down to 7200 (85.5 %), then progressive increase up to maximum rpm which is reached at the end of 7 to 8 seconds (rpm variations are all the more sudden as the Mach number is greater).
- JPT drop below 600°C, then start of increase at the end of 13 to 18 seconds.

REMARKS :

1. The missile firing fuel dipper operates only when the concerned missiles are present. On the other hand, the 550 training missiles allow complete operation of the sequence.
2. The fuel dipper does not operate during emergency regulation.
3. The complementary unit prohibits gun firing leaning during a missile firing leaning sequence.

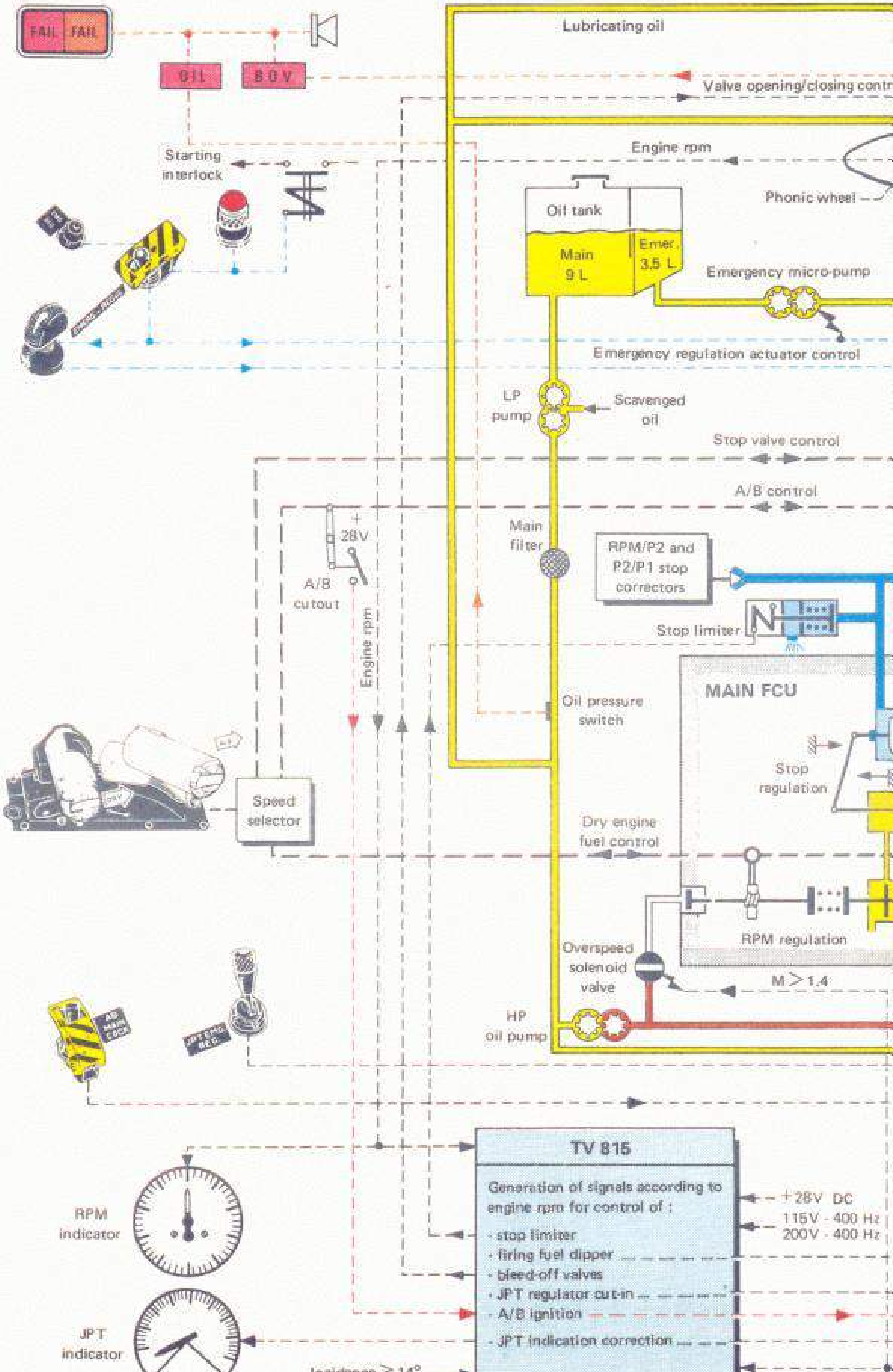
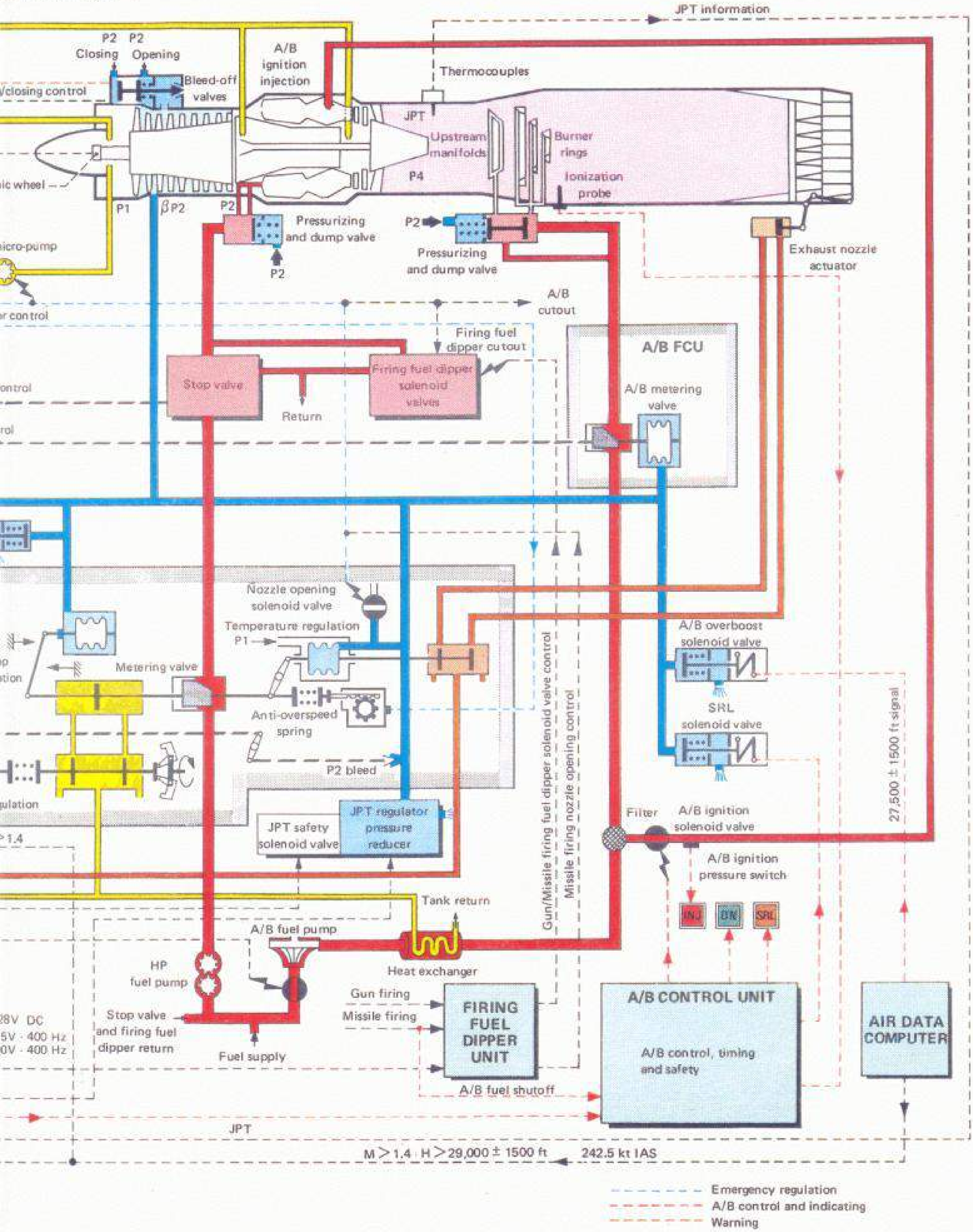


FIGURE 1 – DRY ENGINE AND A/B FUEL REGULATION


JPT information
P2 Closing
P2 Opening
Bleed-off valves
/closing control
A/B ignition injection
Thermocouples
JPT
Upstream manifolds
Burner rings
P4
Ionization probe
ic wheel
P1
βP2
P2
Pressurizing and dump valve
P2
Pressurizing and dump valve
Exhaust nozzle actuator
icro-pump
r control
A/B cutout
Firing fuel dipper cutout
A/B FCU
A/B metering valve
ontrol
Stop valve
Firing fuel dipper solenoid valves
Return
rol
Nozzle opening solenoid valve
Temperature regulation
P1
Metering valve
Anti-overspeed spring
P2 bleed
A/B overboost solenoid valve
SRL solenoid valve
Gun/Missile firing fuel dipper solenoid valve control
Missile firing nozzle opening control
27,500 ± 1500 ft signal
ulation
JPT safety solenoid valve
JPT regulator pressure reducer
Filter
A/B ignition solenoid valve
A/B ignition pressure switch
Tank return
A/B fuel pump
INJ
DN
SRL
Heat exchanger
HP fuel pump
Gun firing
Missile firing
FIRING FUEL DIPPER UNIT
A/B CONTROL UNIT
A/B control, timing and safety
AIR DATA COMPUTER
28V DC
5V - 400 Hz
0V - 400 Hz
Stop valve and firing fuel dipper return
Fuel supply
A/B fuel shutoff
JPT
M > 1.4 H > 29,000 ± 1500 ft
242.5 kt IAS
Emergency regulation
A/B control and indicating
Warning

1,25.4 - FAILURES

OIL light on + warning horn

Pressure at the pump outlet is < 0.75 bar (11 psi).
The loss of oil pressure is a serious failure ; it leads to erratic operation of the main FCU (risk of overspeed) and can also cause engine seizure due to lack of bearing 1 lubrication.

OIL light on + warning horn + RPM indicator near 0

This is a failure of the engine accessory support gearing which affects all engine regulation and leads to oil pump drive failure.

OIL light out upon starting, before engine rpm = 2000 (23.8%)

This is a failure due to faulty operation of the oil pressure switch.

FUEL REGULATION FAILURES

In addition to the case of failure of the oil system, operation of the fuel control system may be affected either by an internal failure of the FCU, or by a failure of the throttle control. The pilot notices stabilization of the rpm at any value and the ineffectiveness of the throttle.

OVERSPEED SYSTEM

If the overspeed system cuts in or remains in operation below Mach 1.4, the failure may arise from a defect in the air data computer. There is a risk of compressor stall at low flying speeds.

PERMANENT OPERATION OF FIRING FUEL DIPPER

This may be caused by a relay of the timer box being permanently energized ; in this case, the incident results in :
maximum rpm being less than normal, or
low JPT, or
both of these abnormalities.

THRUST SURGES

This failure is evidenced by rough thrust surges and engine rpm variations.
If the thrust surges are rapid, the JPT does not vary ; the oil warning light remains out.
The failure may lead to jamming of the nozzle flaps in the full open position.
The JPT then decreases and the thrust decreases.

THRUST DROP AT TAKEOFF

If the pilot notices a thrust drop, confirmed by a JPT drop, without a decrease in rpm, this is caused by an accidental opening of the nozzle flaps.

ASYMMETRICAL THRUST

An asymmetry in nozzle flap displacement or position produces a jet deflection resulting in pitch or yaw moments, particularly during AB operation.

ENGINE OR AB FIRE WARNING LIGHT ON

If a «FIRE» warning light comes on and then goes out, this may indicate a violent fire : destruction of the fire warning light power supply circuit.

«SRL» FAILURE WARNING LIGHT

Failure of the slam relight lighting system.

CAUTION

THIS WARNING LIGHT DOES NOT INDICATE ALL FAILURES OF THE SRL SYSTEM.

In case of malfunction of the SRL system, engine protection is no longer assured and there is a risk of compressor stall on AB ignition with a high degree of reheat. Electrical failure of the SRL system is indicated by the illumination, in dry engine operation, of the «SRL» light.

AB «INJ» (INJECTION) LIGHT

When the AB is ignited, engine hunting often occurs.
If this light does not go out, there is a risk of serious damage to the turbine.

AB «ON» (OPERATION) LIGHT

This light often goes out only several seconds after the AB is actually shut off, specially at altitude ; however, if the light does not go out, or goes out only after the throttle is set to idle, there may be abnormalities in the AB detection system or a defect in the AB fuel supply.

B.O.V. light on

Illumination of this light indicates a position in disagreement with the bleed-off valve opening control signals.

SHOCK-CONE FAILURE

The compressor may stall and engine flameout occur.

JPT ABNORMALITIES

These may be due to the JPT regulator, the indicating system, the electronic regulation system or the basic regulation system.

STARTING INCIDENTS - See SECTION 4

«LIM» WARNING LIGHT COMES ON IN EMERGENCY REGULATION

This may be encountered during go-around, with full power during emergency regulation, on high-elevation fields and under hot weather conditions.

FIGURE 1 – ATAR 9K 50 JET ENGINE

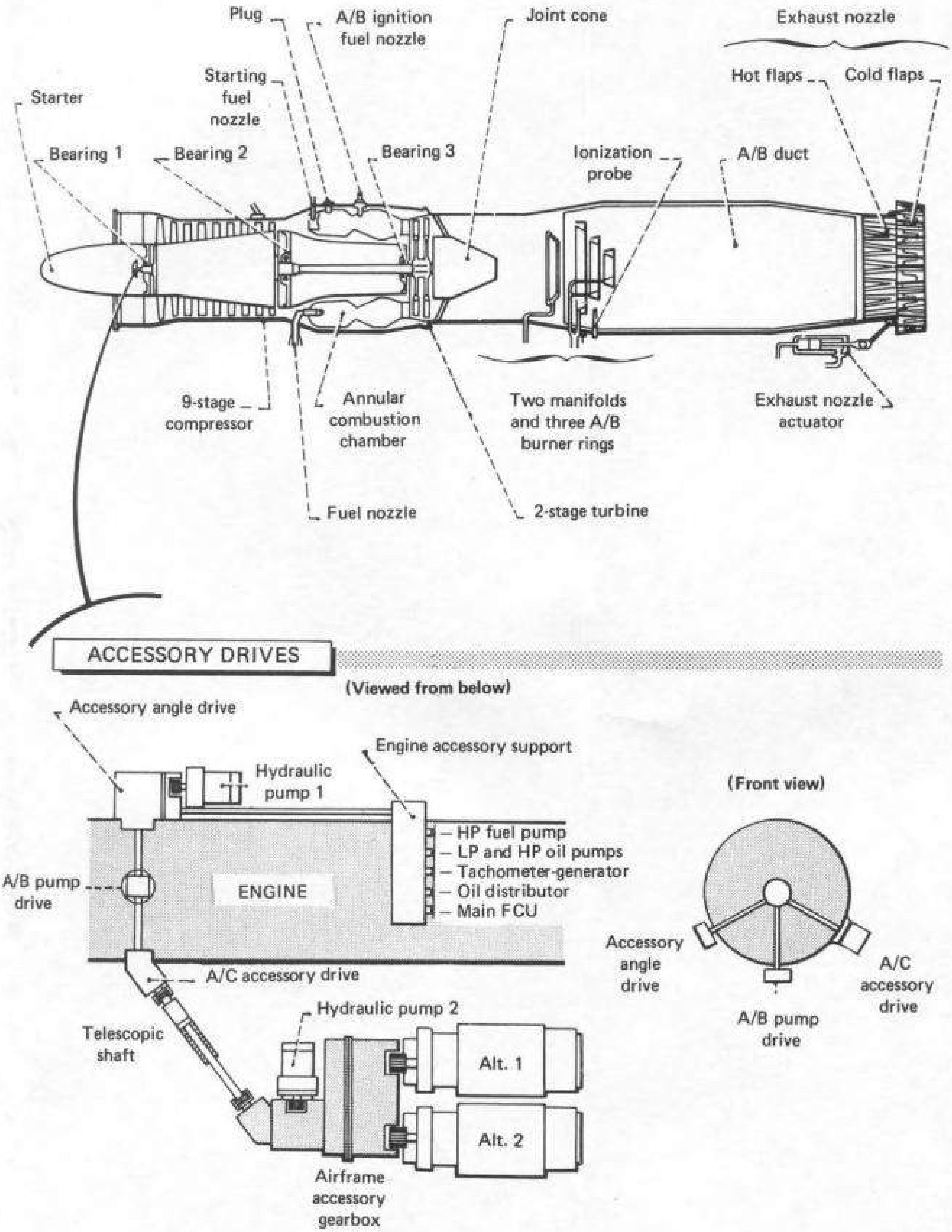


FIGURE 1 – ATAR 9K 50 JET ENGINE

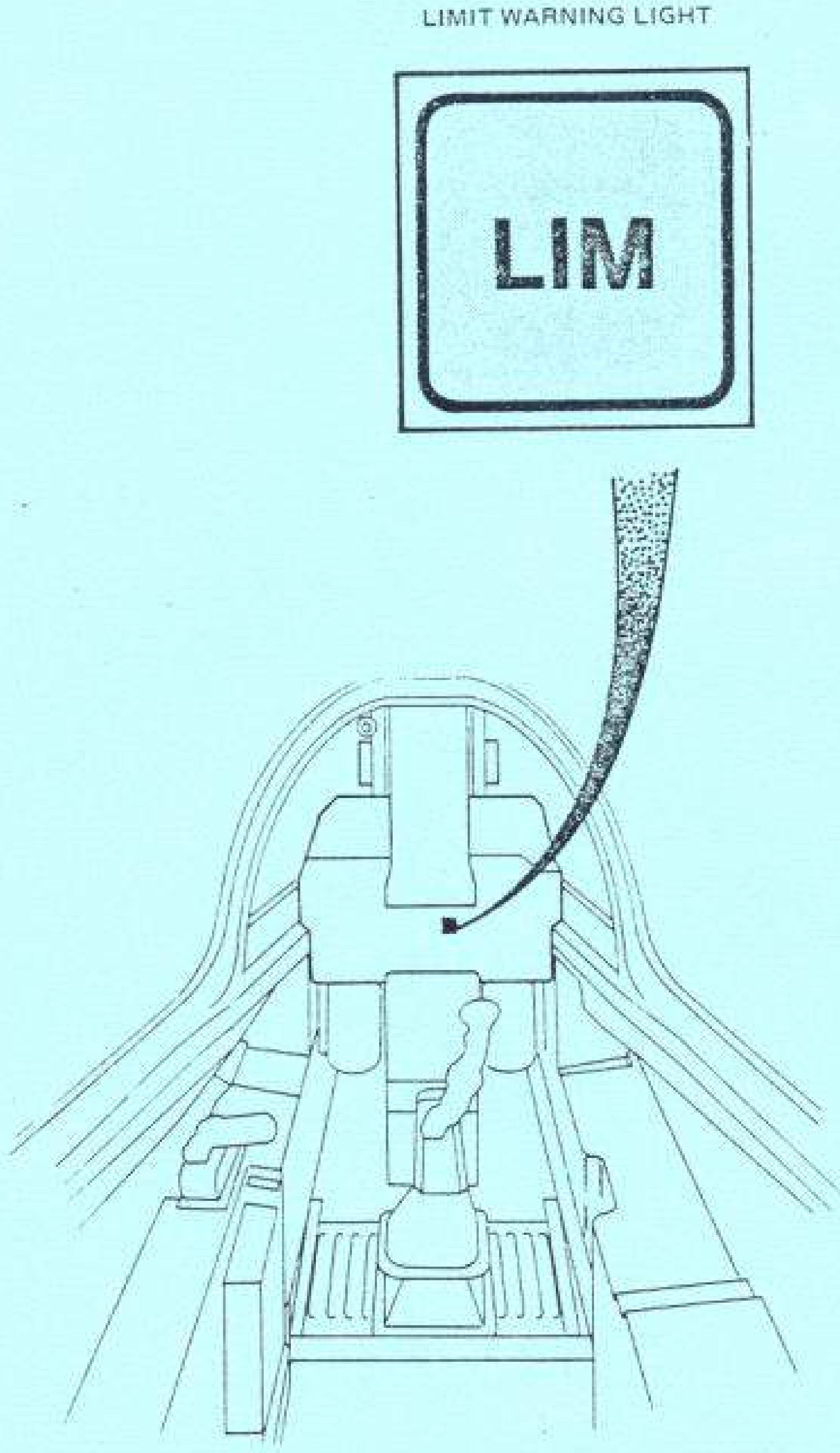


FIGURE 3A - ENGINE CONTROLS AND INDICATORS
(POST/SAAF/MOD/MIRAGE/187)

FIGURE 3 – ENGINE CONTROLS AND INDICATORS

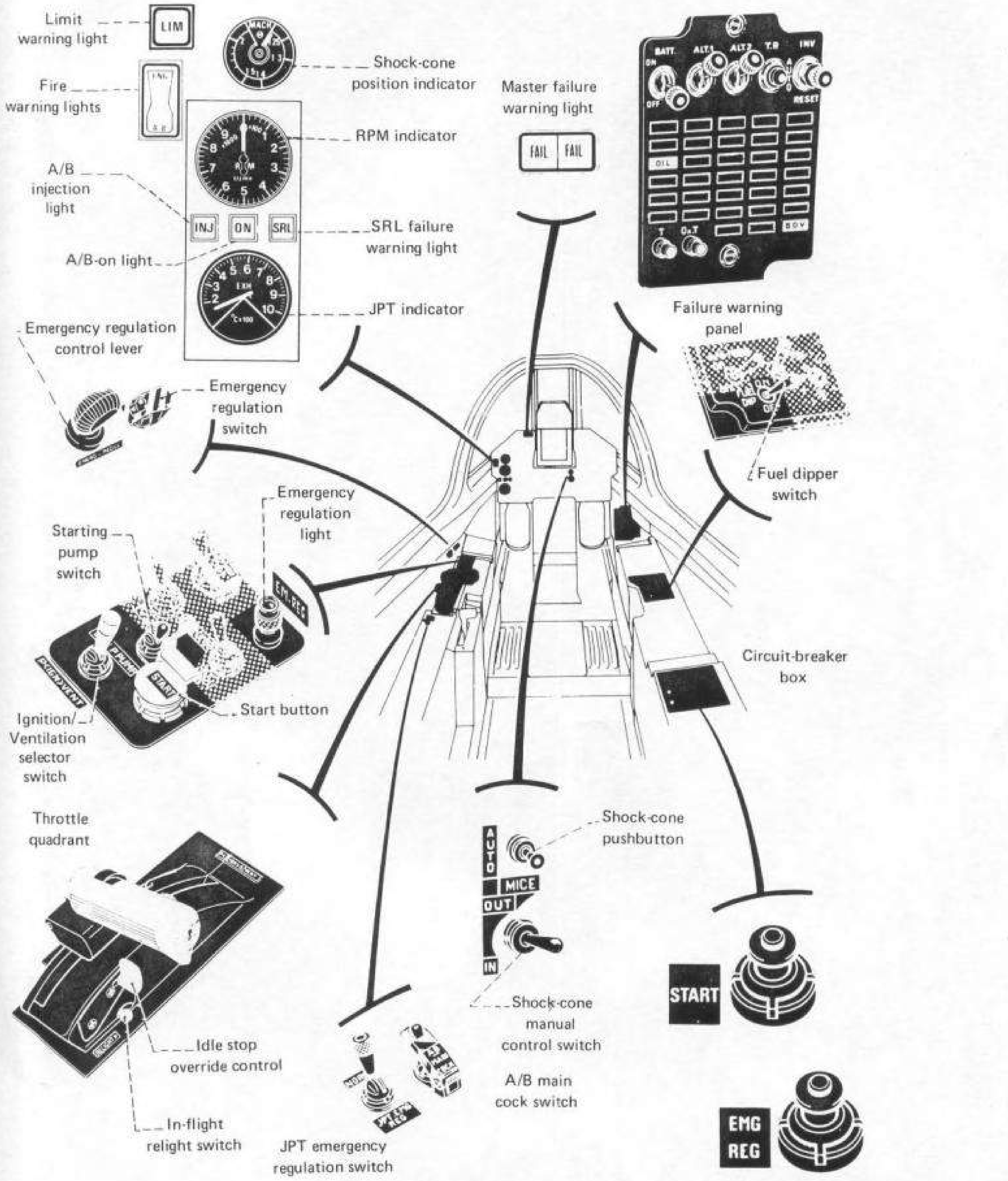


FIGURE 3 – ENGINE CONTROLS AND INDICATORS

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

1,30.4 - HYDRAULIC FAILURES

"ANC" PRESSURE = 0

Pressure readings ancillaries = 0
servo 1 = 210 bar (3046 psi)
with or without illumination of the HYD.1 light

The ancillary shut-off valve is closed (more or less serious leak).
2.6 litres (0.6 Imp. gal - 0.7 U.S. gal) remain in hydraulic reservoir 1. Valve shut-off preserves this fluid if the leak is in the ancillary sub-system.
Slats, flaps, airbrakes, shock-cones, normal U/C control system and normal refuelling probe extension are lost.

HYD.1 light steady on

Pressure readings 140 bar (2031 psi) ⩽ servo 1 ⩽ 174 bar (2524 psi)
0 ⩽ ancillaries ⩽ 145 bar (2103 psi)

Failure of pump 1 regulation.
The electro-pump supplies the pressure to the servo-control sub-system.
Use of the ancillaries may or may not be possible depending on the "ANC" pressure.
In the negative case : slats, flaps, shock-cones, airbrakes, normal U/C control system and normal refuelling probe extension are lost.

HYD.2 light on

Pressure reading 0 ⩽ servo 2 < 145 bar (2103 psi)
Failure of pump 2 regulation.
If the pressure is 0 : barrel 2 of the servo-controls, emergency U/C extension and nose wheel steering are lost.

EMG.HYD light on + warning horn

Pressure readings : normal
The pressure in the emergency system is below 115 bar (1668 psi) or the pressure switch is defective.
The electro-pump is off or defective. The emergency system is inoperative.

E.P. light on + warning horn

The electro-pump has been operating for more than 8 seconds.

HYD.1 + EMG.HYD lights on warning horn + E.P. light on after 8 seconds

Pressure readings 0 ≤ servo 1 ≤ 115 bar (1668 psi)
utility = 0

Leak in the emergency system or the servocontrol subsystem.
The utility shutoff valve has operated. Hydraulic reservoir 1 continues to empty.
The following are lost : - complete hydraulic system 1 and emergency hydraulic system
- flying aids.

HYD.1 + HYD.2 lights on

Pressure readings	140 bar (2031 psi)	≤ servo 1 ≤ 174 bar (2524 psi)
	0	≤ utility ≤ 145 bar (2103 psi)
	0	≤ servo 2 ≤ 145 bar (2103 psi)

Failure of both hydraulic pumps.
The flight controls are supplied by the emergency hydraulic system.

The following are lost : - if utility = 0 : hydraulic utility systems and normal U/C control system
- if servo 2 = 0 : emergency U/C extension and nose wheel steering.

There is a risk of losing the flying aids.

CAUTION

THIS DUAL FAILURE MAY BE DUE TO ENGINE SEIZURE.
THE ELECTRIC PUMP IS SUPPLIED BY THE BATTERY WHOSE ENDURANCE IS, IN THIS CASE, ONLY 3 MINUTES.

E.P. then EMG.HYD lights on + warning horn

Normal pressures : there is a heavy leak in the emergency system.

HYD.1 + HYD.2 + EMG.HYD lights on + warning horn

Complete hydraulic failure : jamming of flight controls imminent.

FIGURE 1 – HYDRAULIC SYSTEM

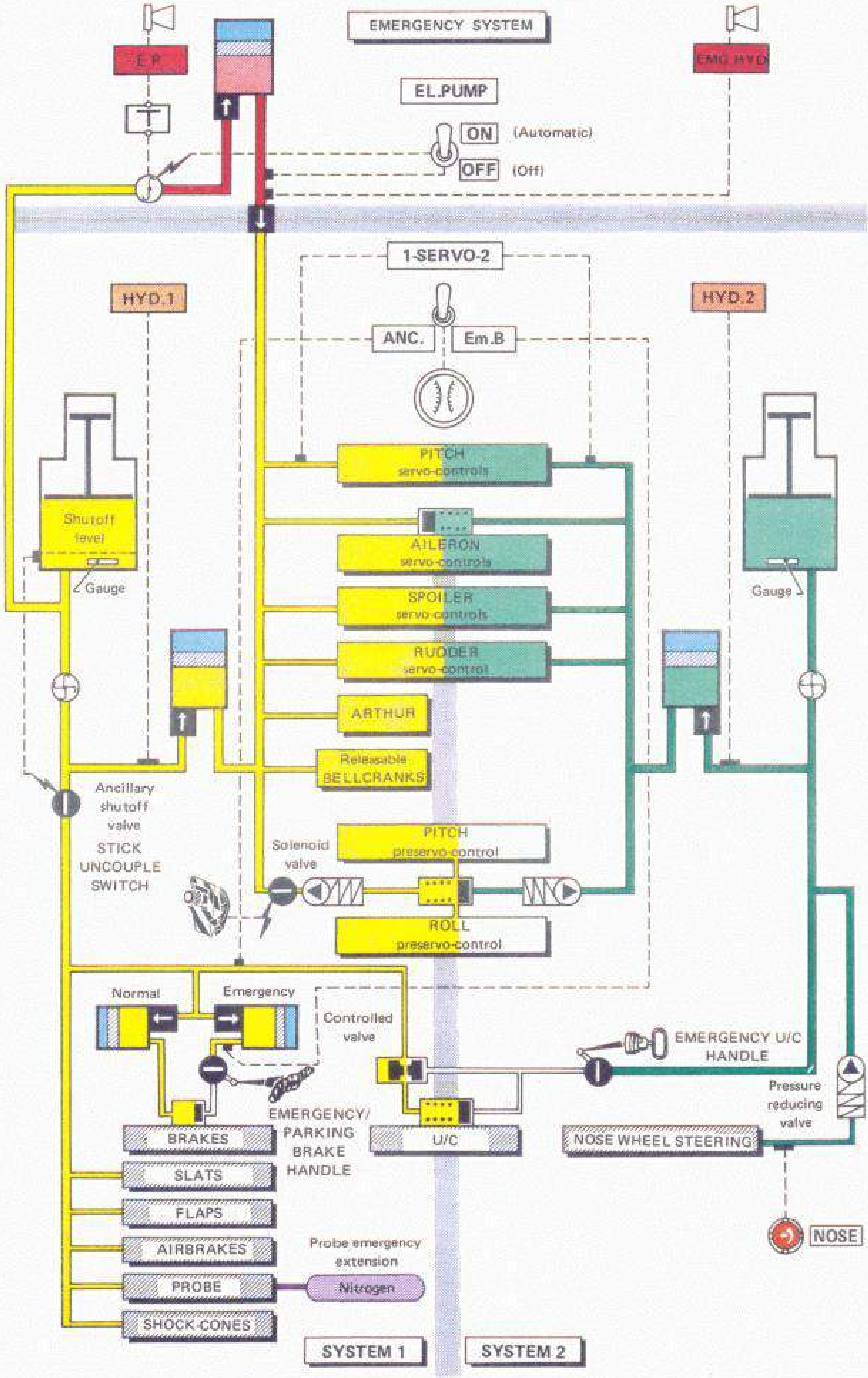


FIGURE 1 – HYDRAULIC SYSTEM

FIGURE 2 – HYDRAULIC SYSTEM
CONTROLS AND INDICATORS

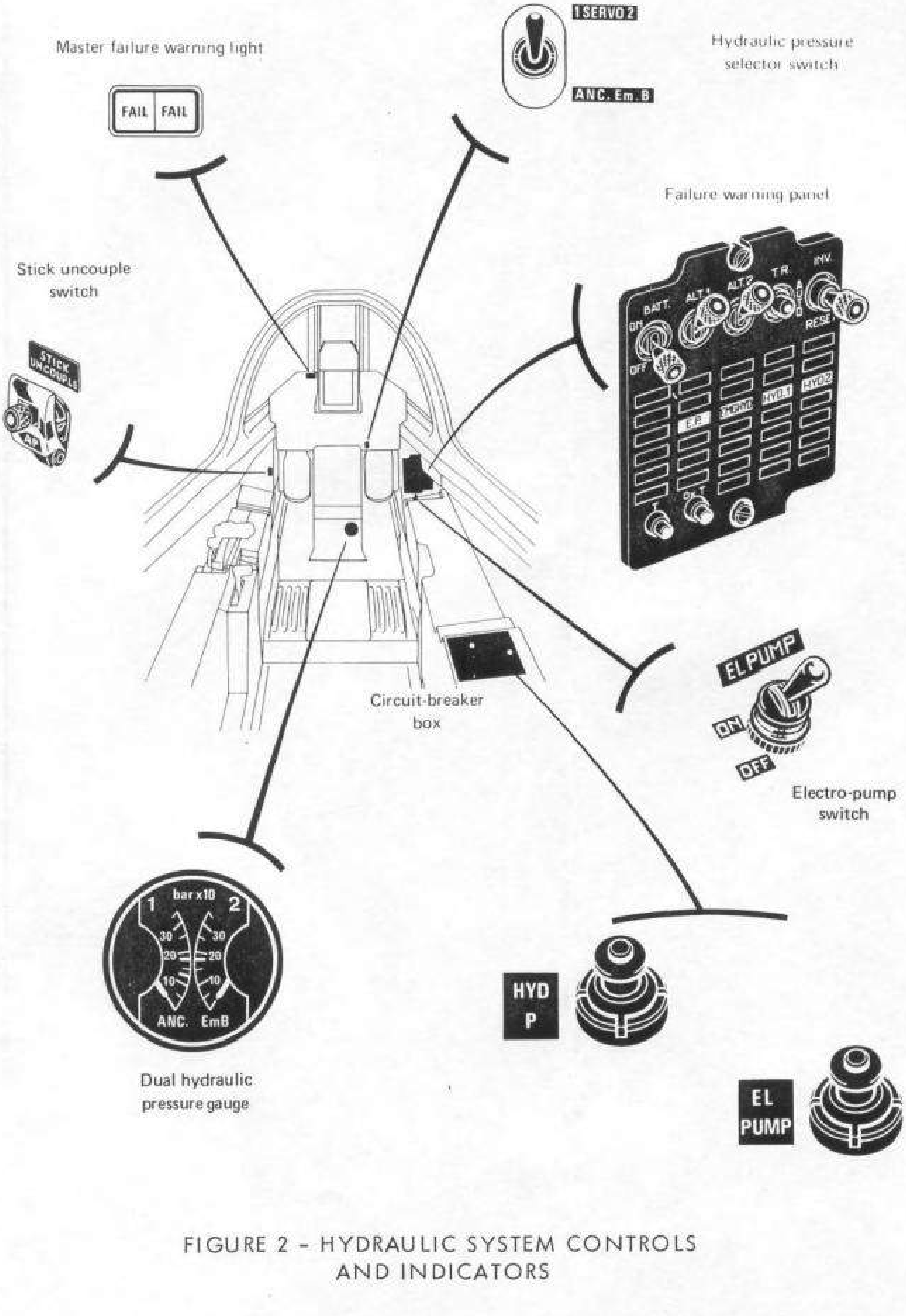


FIGURE 2 - HYDRAULIC SYSTEM CONTROLS AND INDICATORS

1,35 – FLIGHT CONTROLS AND FLYING AIDS

1,35 - FLIGHT CONTROLS AND FLYING AIDS

1,35.1 - PITCH - ROLL - RUDDER

1,35.1.1 - CONTROLS AND INDICATORS

ITEM	NAME	DESCRIPTION	REMARKS
PITCH	Control stick		
	Trim control switch	On control stick handgrip	Vertical movement
	Trim indicator	Horizontal bar "P"	
	Pitch switch	"PITCH" 2 positions	
	ARTHUR selector switch	3 positions "AUTO-HIGH-LOW"	
	Servo reset button		Common with rudder
	Stick uncouple switch	"STICK UNCOUPLE"	Guarded Common with roll
	Probe heating switch		Controls dash-pot heating
	PITCH ROLL. ELEV TRIM lights	Amber	
	Circuit-breaker	"PITCH TRIM"	
ROLL	Control stick		
	Trim control switch	On control stick handgrip	Lateral movement
	Trim indicator	Horizontal bar "R"	
	Stick uncouple switch	"STICK UNCOUPLE"	Guarded Common with pitch
	TRIM light	Amber	
RUDDER	Rudder pedals		
	Rudder trim control switch	3 positions with spring-loaded neutral position	
	Trim indicator	Vertical bar "Y"	
	Yaw/Anti-slip switch	3 positions "ANTI-SLIP" "YAW" "OFF"	
	Servo reset button		Common with pitch
	YAW RUD lights	Amber	

1, 35. 1. 1 - CONTROLS AND INDICATORS (Cont'd)

ITEM	NAME	DESCRIPTION	REMARKS
FLIGHT CONTROL TEST	Test switch	2 positions Guarded	
	Counter	2-figure window	00 to 35 : flight controls 40 to 57 : autopilot
	Restart button		

Preservo-control

Double barrel servo-control. Barrel 1 is normally supplied by hydraulic system 1 (SERVO line) ; it is controlled mechanically in normal flying mode and electrically (torque motor) in autopilot mode. In this case, the input bellcrank is locked to the preservo-control ; the linkage is therefore driven by the latter and the control stick follows. However, two safety microswitches on the preservo-control body permit autopilot overpowering in case of excessive force applied to the control stick by the pilot. Barrel 2 is supplied by hydraulic system 2, but only in case of hydraulic system 1 and emergency hydraulic system failure, or on pilot's action (stick uncouple switch).
This is performed by a solenoid valve actuating a dual feed valve, and permits a possible jamming of barrel 1 to be corrected. In this case, the autopilot is no longer usable.

AMEDEE variable reduction ratio bellcrank

This bellcrank is used to render the control less sensitive near the neutral position (low altitude high speed flight). For example, a 35 mm control stick movement is necessary for a 1° stabilator deflection around the neutral position, but only 5 mm is required in the full up position.

Releasable bellcranks

Purpose : to override the linkage during electro-hydraulic operation of the servo-control (normal mode) by authorizing a limited deviation between the control stick position and the control surface position ; this deviation is necessary to superimpose the damping command signals.
If an erratic electrical command signal leads to overriding the bellcrank, limit switches instantaneously cause locking without noticeable jerk.
The bellcrank is provided with three arms hinged about the same bolt attached to the structure :
- A : arm connected to the pilot's linkage
- B : arm connected to the servo-control selector valves
- C : arm connected to the servo-control body and actuating the dual position pickoff.

Arm B can be hydraulically locked to or unlocked from arm A (locking pin).
Safety microswitches mounted on arm A and actuated by arm B define two deflection range of ± 3° and ± 1°30'.
The unlocking control and the deflection limit are controlled by a dual solenoid-operated selector valve. The releasable bellcrank is fitted with a dual differential position pickoff, with its body integral with arm A, and its lever connected to arm C. This pickoff is used to slave the stabilator servo-control.

Dual solenoid-operated selector valve

This selector valve permits hydraulic power supply of the releasable bellcranks and is used only during operation of the servo-controls in electrical control mode.
Inside the body of the unit are two solenoid valves, an accumulator, a pressure relief valve and a pressure switch.
When energized, solenoid valve 1 permits passage of the pressure fluid to the lock of arm A, thereby unlocking the latter from arm B.
Solenoid valve 2 is slaved to the aircraft speed (air data computer).
When energized, it permits the moving stops to be overriden ; thus, the large deflection configuration is obtained.
When solenoid valve 2 is not energized, the hydraulic pressure is applied to the two moving stops, then authorizing only a small deflection of arm B relative to arm A.
The nitrogen charged accumulator constitutes a power reserve permitting operation of the bellcrank in case of system 1 and emergency system failure (three to five actuations approximately), with the solenoid valve energized.
The pressure switch permits operation of the servo-controls in electrical control mode. If the system pressure and the accumulator pressure drop, the pressure switch cuts off the electro-hydraulic operation of the servo-controls which then operate in mechanical control mode.

Stabilator servo-control

This is an electro-hydraulic double barrel servo-control of 5000 daN x 2 power which is supplied by the two hydraulic systems.
Each barrel is controlled by a slide-valve, the two slide-valves being interconnected. They can be controlled mechanically by the linkage or electrically through servo valves actuated by two torque motors (one per barrel).

B - OPERATION

- Electro-hydraulic manual mode

This operating mode is selected by the pilot by means of the "PITCH" switch and the "SERVO" reset button if necessary.
The pilot's control acts up to the releasable bellcranks through the preservo-control.
The releasable bellcranks are unlocked and allow a difference of ± 3° or ± 1°30', according to the flight conditions, between the position controlled by the pilot and the actual position of the stabilators ; the damping signals are generated (by the flying aid rack) so as to remain within these limits. The bellcrank potentiometer pickoffs detect the pilot's command. This command is sent in electrical form to the power servo-control torque motors after addition of the damping signals. This forms an electrical control circuit. Two electrical circuits, one of which only is active at a time, supply the torque motor of barrel 1 and the torque motor of barrel 2, respectively. During normal operation, only torque motor 1 is hydraulically activated on barrel 1, barrel 2 being mechanically controlled by its slide-valve linked with slide-valve 1. In case of electrical failure of circuit 1, the servo-control has a maximum error equal to the actual authority of the releasable bellcrank, and the safety microswitch of one of the bellcrank stops causes automatic operation of the circuit on barrel 2, barrel 1 being then controlled mechanically.
This partial failure is indicated by the ELEV amber light.

High authority (± 3°) or
Low authority (± 1°30') if $M > 0.4$ and $H < 10,000$ ft.

In case of failure of both electrical circuits, the releasable bellcranks are locked ; the flying mode is mechanical and the ELEV ROLL. PITCH amber lights come on.

Dampers

Each damper operates according to the same principle :
A rate gyro detects an angular velocity and sends the corresponding signal to the flying aid rack in which two separate channels generate damping signals and match them to the flight conditions (M, Hp). These two signals are compared and, if they are not identical, the damper is considered unserviceable ; the releasable bellcranks are locked and the flying mode becomes purely mechanical
(illumination of the ELEV ROLL. PITCH lights).

Remark : Since roll damping (autopilot mode) is obtained by differential deflection of the stabilators, it is no longer possible in this case. This is the reason for illumination of the ROLL. light.

Resetting

When an electrical control circuit has been switched off by the safety devices, the pilot can restore the memories concerned by depressing the "SERVO" button. This action results in resetting the faulty circuit into operation in case of short-lasting failure.

- Hydraulic manual mode

The pilot's control drives the power servo-controls through the preservo-control and the linkage. The preservo-control is supplied through barrel 1 by hydraulic system 1 or the emergency hydraulic system. In case of pressure drop in these systems, the dual feed valve causes automatic supply of barrel 2 by hydraulic system 2.
The releasable bellcranks are locked.
The power servo-controls are permanently supplied by the two systems through both barrels, respectively. The operation of the artificial feel system (ARTHUR, AFU, dash-pot, trim) is the same as in electrical mode ; thus, in this operating mode, the pilot feels nothing differing from the normal electrical mode, except that the dampers are not available.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

3,20 - LIMITATIONS WITH STORES

The approved configuration limitations are summarized in the tables of the Performance Manual (Book 3).

CAUTION 1

STRICTLY OBSERVE THE LIMITATIONS SPECIFIED IN THE PERFORMANCE MANUAL. ONLY THE CONFIGURATIONS INDICATED IN THE PERFORMANCE MANUAL ARE PERMISSIBLE.

CAUTION 2

WHEN THE AIRCRAFT CONFIGURATION INCLUDES A ROCKET LAUNCHER AT THE OUTBOARD STATION (STATION 2) WITH A STORE AT THE INBOARD STATION (STATION 1) (UNDER THE SAME WING), THE PROCEDURE TO BE APPLIED WILL BE AS FOLLOWS :

- BEFORE TAKEOFF, CHECK THAT THE JETTISON SELECTOR IS IN THE CENTER POSITION (INBOARD WING STATION)
- IF JETTISON IS NECESSARY, DEPRESS THE FOLLOWING IN SEQUENCE :
  - . SELECTIVE JETTISON BUTTON
  - . EMERGENCY JETTISON BUTTON

THIS PROCEDURE IS APPLICABLE ONLY TO AIRCRAFT NOT INCORPORATING MODIFICATION FX 139.

CAUTION 3

AT ALTITUDES BELOW 15,000 ft WITH THE ENGINE RUNNING AT MILITARY THRUST, DO NOT STABILIZE FLIGHT CONDITIONS CLOSE TO 600 kt OR M = 0.95 FOR MORE THAN 1 MINUTE IN THE FOLLOWING CONFIGURATIONS :

- TWO WING PYLON TANKS WITH OR WITHOUT BELLY STORE
- ANY CONFIGURATION IN WHICH THE DRAG INDEX IS CLOSE TO THAT IN THE PRECEDING CONFIGURATION.

Configurations with fuselage pylon tank

In the case of flight at high angle of attack, refer to the specific instructions in Chapter 5,10 (High angles of attack - Spins), paragraph 5,10.3.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.