PI 1T-MB339C-1

FLIGHT MANUAL

AERMACCHI
MB-339C aircraft

THIS PUBLICATION IS INCOMPLETE
WITHOUT PI 1T-MB339C-1-1
"PERFORMANCE DATA".

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3-1 thru 3-40	0
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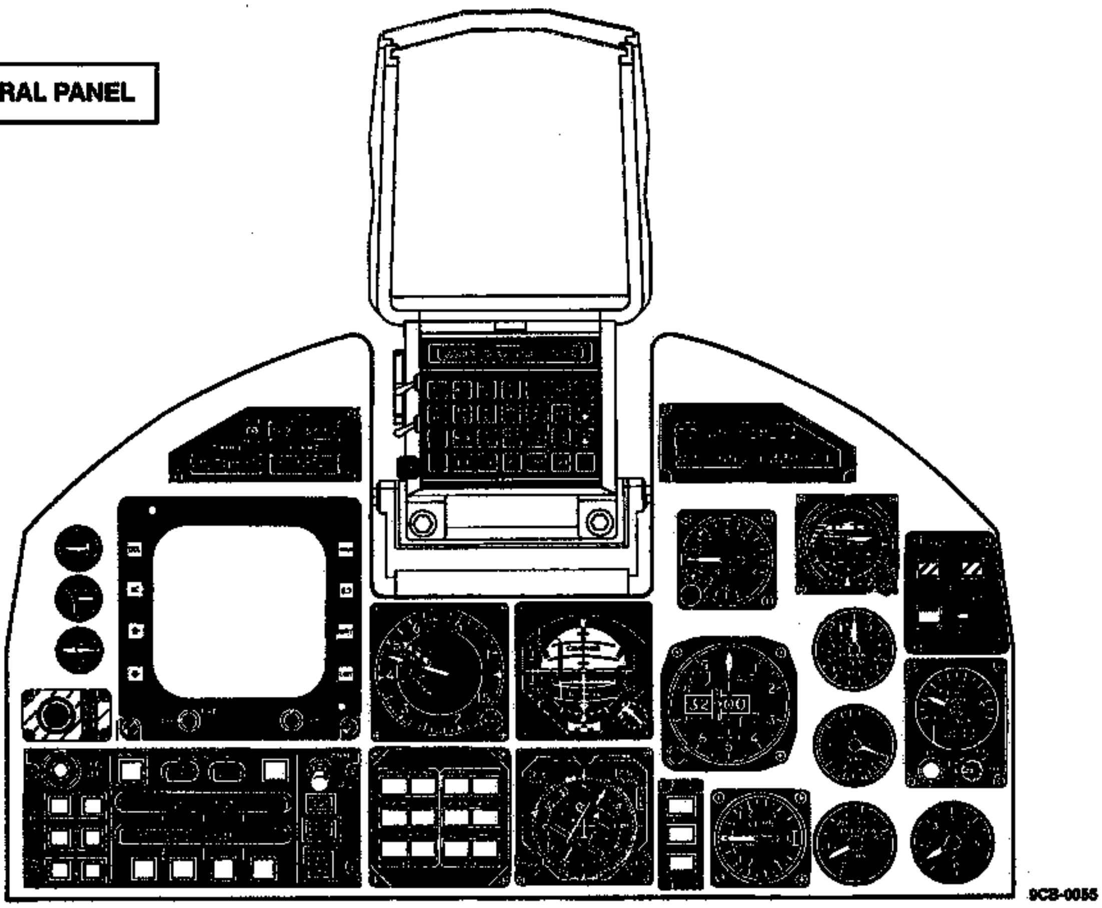
7-1 thru 7-6	0
Glossary 1 thru 10	0
Index 1 thru 21	0
Index 22 blank	0

FRONT INSTRUMENT PANEL

CENTRAL PANEL



1. COMMUNICATION / IDENTIFICATION DISPLAY (CID)
2. PILOT DISPLAY UNIT (PDU)
3. DATA ENTRY PANEL (DEP)
4. REMOTE DISPLAY UNIT (RDU)
5. STANDBY ATTITUDE INDICATOR
6. ANTI-ICE INDICATORS
7. OXYGEN INDICATORS
8. FUEL QUANTITY INDICATOR
9. ENGINE OIL PRESSURE
10. FUEL FLOW INDICATOR
11. JET PIPE TEMPERATURE INDICATOR
12. TACHOMETER
13. ACCELEROMETER
14. ENCODER ALTIMETER
15. VERTICAL VELOCITY INDICATOR
16. "BRG" CONTROL PANEL
17. HORIZONTAL SITUATION INDICATOR (HSI)
18. ATTITUDE DIRECTOR INDICATOR (ADI)
19. MACH-AIRSPEED INDICATOR
20. NAVIGATION AND FLIGHT DIRECTOR CONTROL PANEL
21. WEAPON CONTROL PANEL
22. MULTIFUNCTION DISPLAY (MFD)
23. EXTERNAL STORES RELEASE PUSHBUTTON
24. FLAP POSITION INDICATOR
25. SPEEDBRAKE POSITION INDICATOR
26. LONGITUDINAL TRIM INDICATOR

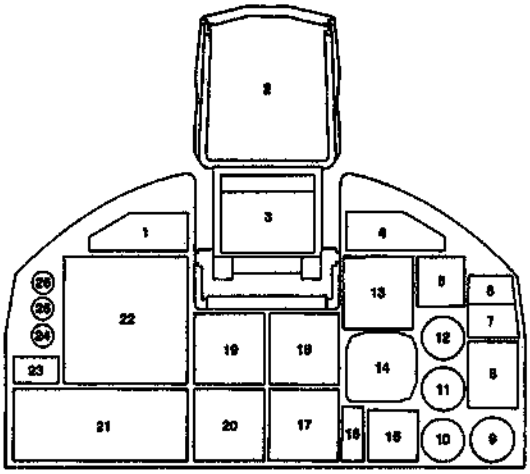
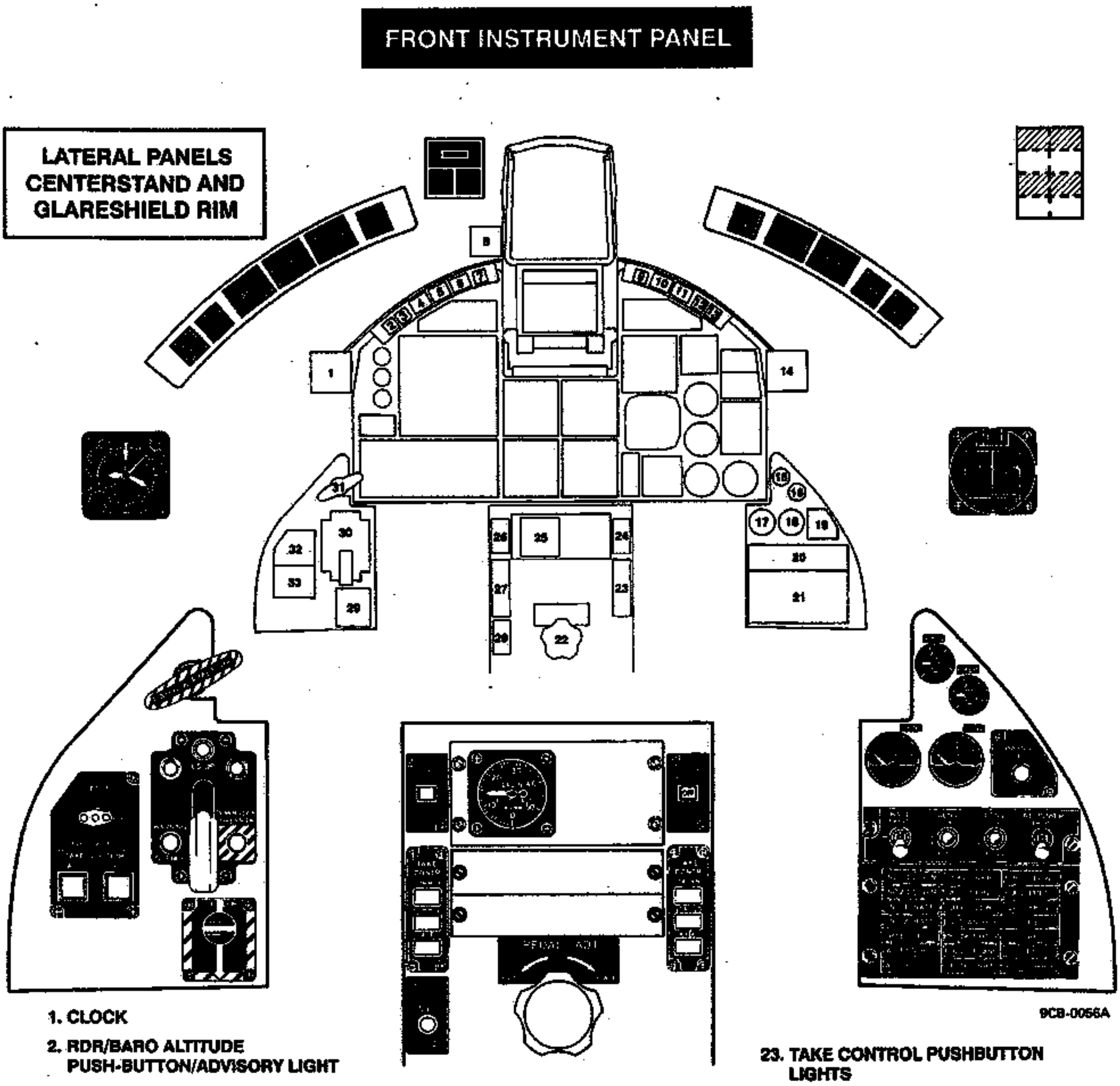


Figure 1-3 (Sheet 1 of 2)



1. CLOCK
2. RDR/BARO ALTITUDE PUSH-BUTTON/ADVISORY LIGHT
3. LASER ADVISORY LIGHT
4. CANOPY WARNING LIGHT
5. SEAT ADVISORY LIGHT
6. MASTER CAUTION LIGHT
7. NAV/ATTK MODE PUSHBUTTON/ /ADVISORY LIGHT
8. SMOKE GENERATION SYSTEM ADVISORY LIGHTS
9. STEER/A-SKID ADVISORY LIGHT
10. FIRE WARNING LIGHT
11. OHEAT CAUTION LIGHT
12. MKR ADVISORY LIGHT
13. LAND/SEA PUSHBUTTON/ /ADVISORY LIGHT
14. STANDBY COMPASS
15. MAIN HYDRAULIC SYSTEM PRESSURE GAUGE
16. EMERGENCY HYDRAULIC SYSTEM
17. GEN 1 LOADMETER
18. GEN 2 LOADMETER
19. WARNING LIGHTS TEST PUSHBUTTON
20. ELECTRICAL SUPPLY CONTROL PANEL
21. CAUTION LIGHTS PANEL
22. RUDDER PEDALS ADJUSTMENT
23. TAKE CONTROL PUSHBUTTON LIGHTS
24. RNAV RAD UPDATE ADVISORY LIGHT
25. CABIN ALTIMETER
26. IRU RDY ADVISORY LIGHT
27. TAKE CONTROL PUSHBUTTON LIGHTS
28. MISSION DATA LOADING JACK
29. TIP TANKS FUEL DUMP CONTROL
30. LANDING GEAR CONTROLS
31. PARK & EMER BK HANDLE
32. TAXI, NOSE AND LANDING LIGHTS SWITCH
33. TAKE OFF TRIM PANEL

Figure 1-3 (Sheet 2)

ENGINE OPERATING LIMITATIONS

ENGINE SPEED AND JPT

CONDITIONS	ENGINE SPEED % (100 % = 13760 rpm)	JPT °C	TIME LIMIT (per hour)
Maximum rpm	102 -0.5/+0.2 ▲	756*	20 minutes
Intermediate	98	715	30 minutes Plus any unused time at maximum thrust
Maximum Continuous	95	660	Unlimited
Ground Starting	-	756	-
Relighting	-	800	-
Ground Idling	42 to 43 • (ISA, SEA LEVEL)	-	Unlimited
Maximum Overspeed	105	-	20 seconds

▲ During flight at full throttle maximum rpm may be permitted to increase to 103.5% provided the JPT limitation is not exceeded.

* With the "JPT LMTR" switch in the ON position, this value can be exceeded by + 3 °C due to the tolerance allowed in the automatic temperature control system.

• ISA condition accessories, unloaded, and warm engine. For other than ISA conditions, refer to the chart in figure 5-3.

NOTE: Slam accelerations may be carried out when necessary however rapid opening of the throttle above 42 000 ft must be avoided.

Figure 5-2

CENTER-OF-GRAVITY LIMITATIONS

The CG limitations in relation to the different aircraft configurations are shown in the graph at figure 5-6.

NOTE

The CG position can be obtained from publication PI 1T-MB339C-5-2 "Loading Data".

MASS LIMITATIONS

The aircraft maximum mass at takeoff and landing is 6150 kg (13 550 lb). The maximum overload takeoff mass for special configurations is 6350 kg (14 000 lb). The maximum overload takeoff mass corresponds to special configurations exceeding the maximum mass which are specifically indicated in figure 5-12.

ENGINE IDLING SPEED

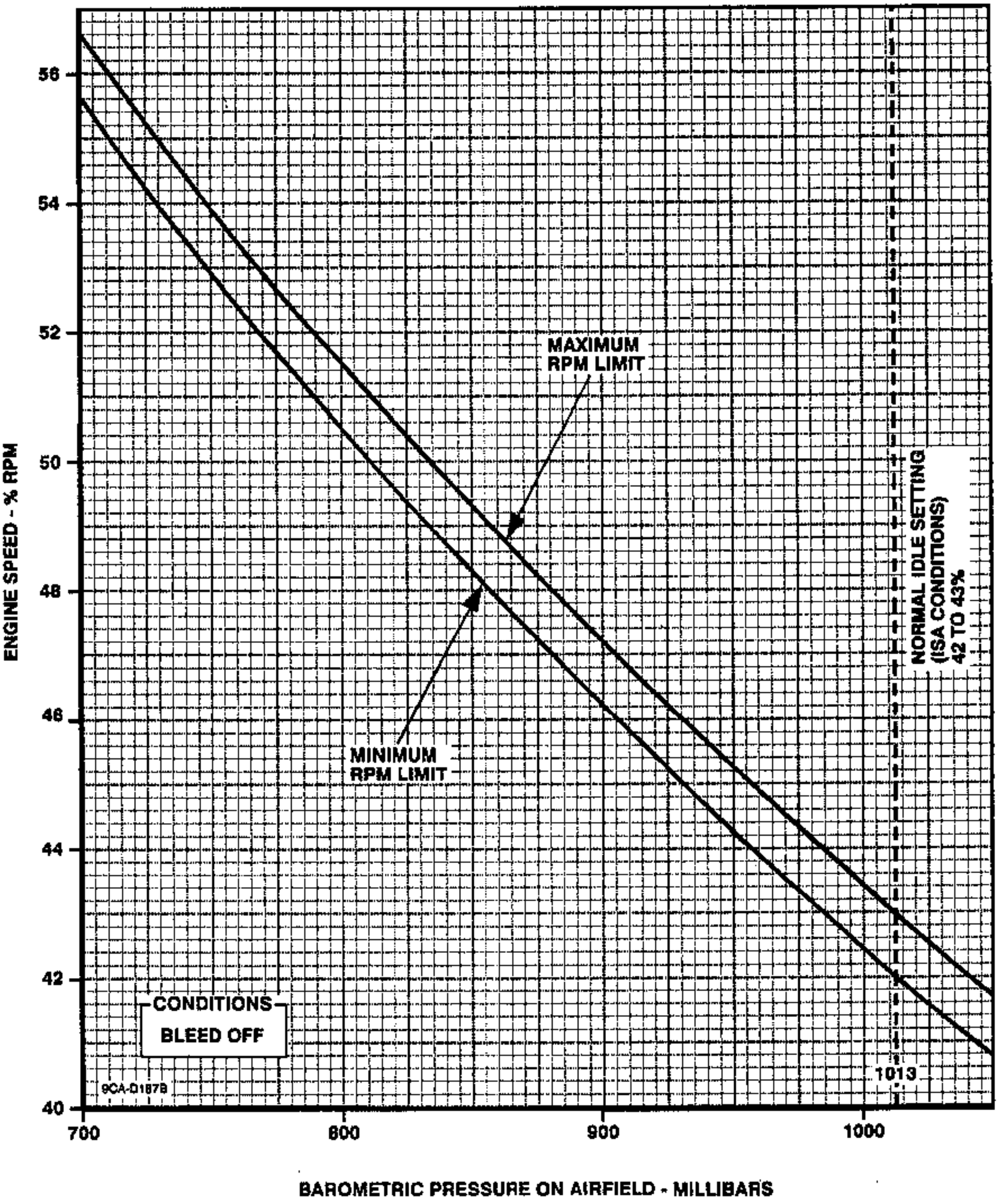


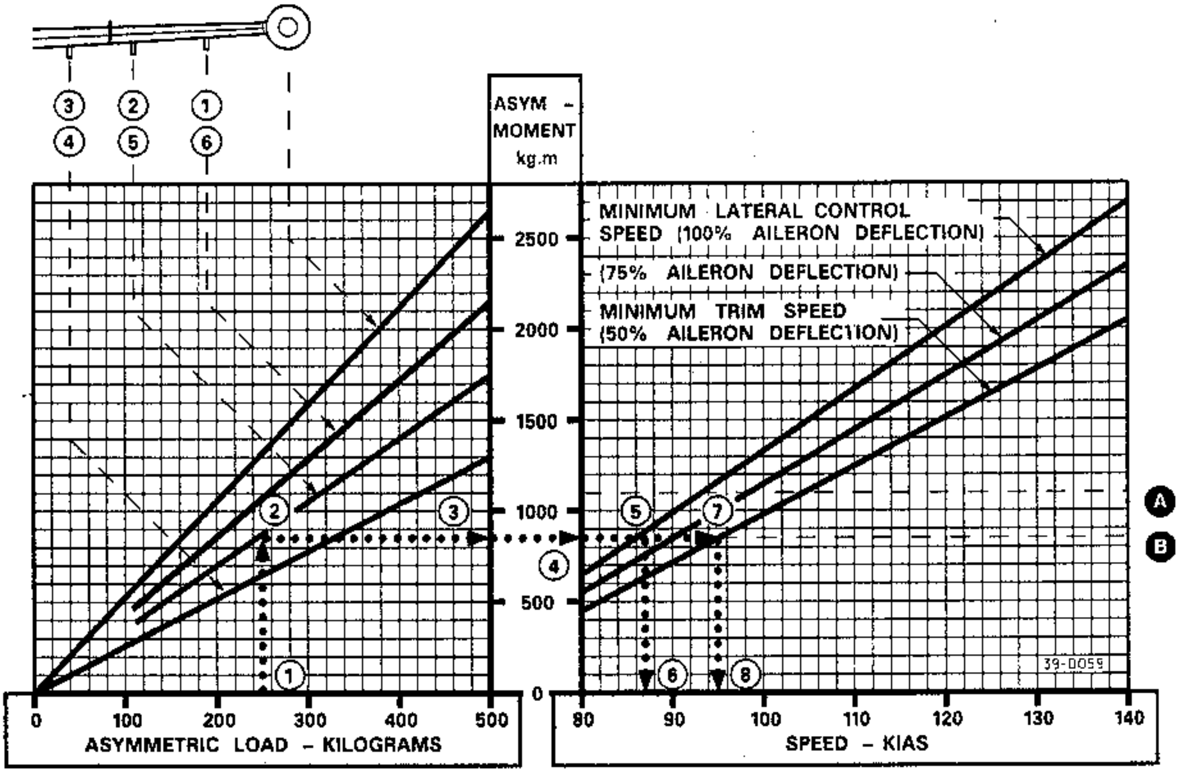
Figure 5-3

MINIMUM LATERAL CONTROL SPEED WITH ASYMMETRIC LOAD

- **SPEEDS MAKE NO ALLOWANCE FOR TURBULENCE, GUSTS OR CROSSWIND.**
- **FOR MULTIPLE STORES, ADD MOMENTS FOR ALL STORES BEFORE DETERMINING MINIMUM AILERON AND AILERON TRIM CONTROL SPEEDS.**

Ⓐ MAX. PERMITTED ASYMMETRY FOR EMERGENCY LANDING - 1100 kg.m.

Ⓑ MAX. PERMITTED ASYMMETRY FOR TAKEOFF AND INTENTIONAL LANDING - 850 kg.m.



SAMPLE PROBLEM

DATA

No transfer from 1 x 330 l pylon tank of station 2

FIND:

- Asymmetric moment

- Minimum aileron trim speed

- Minimum lateral control speed

PROCEDURE:

1. **Enter the chart at the asymmetric load - 250 kg.**
2. **Intersect the guideline of underwing station 2.**
3. **Move horizontally and read the asymmetric moment -870 kg/m.**
4. **Reenter the chart at the asymmetric moment - 870 kg/m.**
5. **Intersect the minimum lateral control speed curve.**
6. **Move vertically down and read the value of 87 KIAS.**
7. **Intersect the minimum aileron trim speed curve.**
8. **Move vertically down and read the value of 95 KIAS.**

Figure 5-10

INDEX OF TABLES OF EXTERNAL STORE LIMITATIONS

STORES	MIXED STORE CONFIGURATIONS																																												
Sheet No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
12.7 mm MACHINE GUN POD	●	●	●						●																																				
330l FUEL TANK	●			●		●			●																																				
LUGGAGE CONTAINER						●	●																																						
DISPENSER BRD-4-2CRV7	●	●						●	●																																				
MK82 LOW DRAG BOMB				●	●																																								
LAU 5002 B/A ROCKET LAUNCHER			●	●																																									
SMOKE TANK							●																																						

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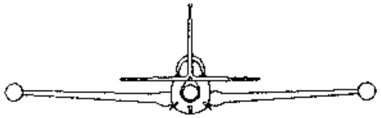
NOTE: TO FIND THE CONFIGURATIONS WHERE THE CONCERNED TYPE OF STORE IS PRESENT, LOCATE THE COLUMN (OR COLUMNS) CONTAINING THE BLACK DOT AND READ THE NUMBER OF THE APPLICABLE TABLE

Figure 5-11

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.



STORE	CONFIGURATION No.	UNDERWING STATIONS						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER-g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
12.7 mm MACHINE GUN POD	1			●	●			450 0.75	425 0.7 Gun pods 400 0.75 Rkt	NA	NA	From − 3 to +7	From − 1 to + 4 Gun pods From +0.5 to +1.5 Rkt	NA	NA	From 0°to − 45° Rkt BDU33 and BDU76 Bombs From 0°to − 15° BDU48 Bombs	30	150 Empty 228 Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ °2 . Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (3) -2xCRV7 rockets plus 4 x BDU33 or MK76 bombs ≃ 147 kg -2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg -2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
	2A			●													15	75 Empty 114 Full	
	2B				●														
12.7 mm MACHINE GUN POD AND BOMB/ROCKET DISPENSER BRD-4-2CRV7	3A			●	THROT SET 100 / 75 ◒					420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 (2)			From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 Fuel tanks and BRD (2)		60 Empty 55 Full	195 Empty 145 plus (3) Full	
	3B			THROT SET 100 / 75 ◒	●														
330 l FUEL TANK 12.7 mm MACHINE GUN POD AND	4		THROT SET 75 / 75 ○	●	●	THROT SET 75 / 75 ○				NA	From 130 0.17 to 300 0.7 (2)	From − 2 to +5,5		NA			80	278 Empty 876 Full	

9CB-01118

Figure 5-12 (Sheet 1 of 9)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

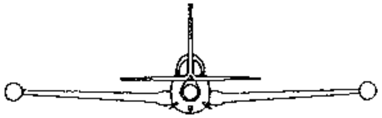
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS – kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
12.7 mm MACHINE GUN POD AND BOMB/ROCKET DISPENSER BRD-4-2CRV7	5A		THROT SET 100 /75 					450 0.75	425 0.7 Gun pods 400 0.75 Rkt	420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 (2)	From – 3 to +7	From – 1 to +4 Gun pods From +0.5 to +1.5 Rkt	From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 BRD (2)	From 0°to – 45° Rkt BDU33 and BDU76 Bombs From 0°to – 15° BDU48 Bombs	75 Empty 70 Full	270 Empty 259 plus (3) Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (3) –2xCRV7 rockets plus 4 x BDU33 or MK76 bombs = 147 kg –2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg –2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
	5B					THROT SET 100 /75 													

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Figure 5-12 (Sheet 2)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

STORE	CONFIGURATION No.	UNDERWING STATIONS						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS – kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
LAU 5002 B/A ROCKET LAUNCHER (WITH CRV7 ROCKETS)	6			THROT SET 100 /100 ●	THROT SET 100 /100 ●			430 0.75	400 0.75 Rkt 425 0.7 Gun pods	NA	From 130 0.17 to 250 0.7 Rkt (1)	From – 3 to +7	From +0.5 to +1.5 Rkt From – 1 to +4 Gun pods	NA	From +0.5 to +1.5 Rkt (1)	From 0° to – 45° Rkt	60 Empty 80 Full	120 Empty 250 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2° Level flight (max dive /climb 5°). Flaps, landing gear and speedbrake up. (2) Avoid abrupt maneuvers with full aileron deflection when stores are installed at stations 1 and 6. (3) Take off is authorized only with tip tanks full to 2/3 max.
	7		THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ●											120 Empty 160 Full	240 Empty 500 Full	
	8	THROT SET 100 /100 ● (2)	THROT SET 100 /100 ●	THROT SET 100 /100 ● (3)	THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ● (2)					From – 2 to +5,5					180 Empty 240 Full	360 Empty 750 Full	
12.7 mm MACHINE GUN POD AND LAU 5002 B/A ROCKET LAUNCHER (WITH CRV7 ROCKETS)	9	THROT SET 100 /100 ● (2)	THROT SET 100 /100 ●	⬮	⬮	THROT SET 100 /100 ●	THROT SET 100 /100 ● (2)										150 Empty 190 Full	390 Empty 728 Full	

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Figure 5-12 (Sheet 3)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

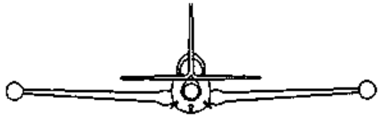
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS – kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
330 l FUEL TANK AND MK82 LOW DRAG BOMB	10	THROT SET 75 /75 ● (2)	THROT SET 75 /75 ○	THROT SET 75 /75 ●	THROT SET 75 /75 ● (3)	THROT SET 75 /75 ○	THROT SET 75 /75 ● (2)	430 0.75	400 0.75 Rkt	From 130 0.17 to 400 0.7 Bombs (4)	From 130 0.17 to 300 0.7 Fuel tanks (1) From 130 0.17 to 250 0.7 Rkt (1)	From -2 to +5.5	From +0.5 to +1.5 Rkt	From +0.5 to +3 Bombs (4)	From +0.5 to +1.5 Fuel tanks and Rkt (1) From +0.5 to +3 Bombs (1)	From 0° to – 45° Rkt From +30° to – 50° Bombs (4)	94 w/o bombs 118 with bombs	252 Empty 1672 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (2) Avoid abrupt maneuvers with full aileron deflection when stores are installed at stations 1 and 6. (3) Limit the fuel quantity on-board not to exceed a max take off mass of 6350 kg. (4) Max operational release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight. Flaps, landing gear and speedbrake up.
330 l FUEL TANK AND LAU 5002 B/A ROCKET LAUNCHER (WITH CRV7 ROCKETS)	11		THROT SET 75 /75 ○	THROT SET 100 /100 ⊛	THROT SET 100 /100 ⊛	THROT SET 75 /75 ○											110 Empty 130 Full	248 Empty 898 Full	
	12	THROT SET 100 /100 ⊛ (2)	THROT SET 75 /75 ○	THROT SET 100 /100 ⊛	THROT SET 100 /100 ⊛	THROT SET 75 /75 ○	THROT SET 100 /100 ⊛ (2)										170 Empty 210 Full	368 Empty 1148 Full	

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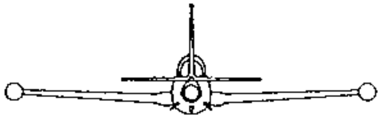
Figure 5-12 (Sheet 4)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER-g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
LUGGAGE CONTAINER	18C			THROT SET 100 /75 ◒	THROT SET 100 /75 ◒			450 0.75	NA	NA	From 130 0.17 to 250 0.7 (1)	From − 2 to +5,5	NA	NA	From +0.5 to +1.5 (1)	NA	52	138 Empty 438 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. - Do not place flammable material or explosives in the luggage container.
SMOKE TANK (NOT YET CLEARED)	19			⊖	⊖			500 0.8			(2)	From − 3 to +7			(2)		32	79 Empty 191 Full	(2) Tank jettisoning is not possible. In the event of an emergency gear up (or unlocked gear) landing with smoke liquid in the tanks. It is recommended that all smoke liquid be used up.

9CB-0274

Figure 5-12 (Sheet 7)

EXTERNAL STORE LIMITATIONS

NEW

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
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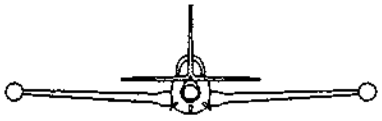
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
BOMB/ROCKET DISPENSER BRD–4–2CRV7	20			THROT SET 100 / 75	THROT SET 100 / 75			450 0.75	400 0.75 Rkt	420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 (2)	From - 3 to +7	From +0.5 to +1.5 Rkt	From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 BRD (2)	From 0°to - 45° Rkt BDU33 and BDU76 Bombs From 0°to - 15° BDU48 Bombs	90 Empty 80 Full	240 Empty 62 plus (3) for each BRD Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ °2 . Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (3) –2xCRV7 rockets plus 4 x BDU33 or MK76 bombs = 147 kg –2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg –2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
	21		THROT SET 100 / 75			THROT SET 100 / 75													
	22A			THROT SET 100 / 75													45 Empty 40 Full	120 Empty 31 plus (3) Full	
	22B				THROT SET 100 / 75														

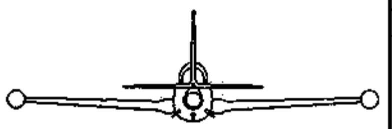
9CB-1427

Figure 5-12 (Sheet 8)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

NEW

STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
12.7 mm MACHINE GUN POD AND BOMBROCKET DISPENSER BRD-4-2CRV7	23		THROT SET 100 /75 ●	⬮	⬮	THROT SET 100 /75 ●		450 0.75	425 0.7 Gun pods 400 0.75 Rkt	420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 BRD (2) From 130 0.17 to 300 0.7 Fuel tanks (2)	From – 2 to + 5,5	From - 1 to + 4 Gun pods From +0.5 to +1.5 Rkt	From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 BRD and Fuel tanks (2)	From 0° to – 45° Rkt BDU33 and BDU76 Bombs From 0° to – 15° BDU48 Bombs	120 Empty 110 Full	390 Empty 290 plus (3) for each BRD Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ °2 . Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (3) –2xCRV7 rockets plus 4 x BDU33 or MK76 bombs = 147 kg –2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg –2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
330 l FUEL TANK AND BOMBROCKET DISPENSER BRD-4-2CRV7	24		THROT SET 75 / 75 ○	THROT SET 100 / 75 ●	THROT SET 100 / 75 ●	THROT SET 75 / 75 ○											140 Empty 130 Full	368 Empty 699 plus (3) for each BRD Full	
330 l FUEL TANK, 12.7 mm MACHINE GUN POD AND BOMBROCKET DISPENSER BRD-4-2CRV7	25A		THROT SET 75 / 75 ○	⬮	THROT SET 100 / 75 ●	THROT SET 75 / 75 ○											110 Empty 105 Full	323 Empty 782 plus (3) Full	
	25B		THROT SET 75 / 75 ○	THROT SET 100 / 75 ●	⬮	THROT SET 75 / 75 ○													

9CB-1428

Figure 5-12 (Sheet 9)

PI 1T-MB339C-1

FLIGHT MANUAL

AERMACCHI MB-339C aircraft

This publication replaces
PI 1T-MB339C-1
dated 1 March 1989.

THIS PUBLICATION IS INCOMPLETE
WITHOUT PI 1T-MB339C-1-1
"PERFORMANCE DATA".

30 MAY 1992
CHANGE 1 - 20 FEBRUARY 1993

Prepared by:
AERMACCHI
Technical Publications Department

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of page affected by the change is indicated by the change method described in para "Change symbol" of the manual introductory pages.

CAUTION: Upon receipt of the second and subsequent changes to this manual, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete.

Dates of issue for original and changed pages are:

Original	0	30 May 92
Change	1	20 Feb 93

Total number of pages in this publication is 406, consisting of the following:

Page No.	Change No.	Page No.	Change No.	Page No.	Change No.
Title	1				
A	1				
i thru iv	0				
v blank	0				
vi	0				
1-1 thru 1-235	0				
1-236 blank	0				
2-1 thru 2-43	0				
2-44 blank	0				
3-1 thru 3-40	0				
4-1	0				
4-2 blank	0				
5-1 thru 5-18	0				
5-19 thru 5-23	1				
5-24 thru 5-25	0				
5-26 blank	0				
6-1 thru 6-2	0				
6-3	1				
6-4 thru 6-11	0				
6-12 blank	0				
7-1 thru 7-6	0				
Glossary 1 thru 10	0				
Index 1 thru 21	0				
Index 22 blank	0				

<B1>

STATUS OF SAFETY AND OPERATIONAL SUPPLEMENTS

This page is published with each Safety and Operational Supplement. It provides the current status of the supplements at the date of issue of the last supplement (indicated in the list by two continuous lines). This page is:

- Replaced by the issue of a subsequent supplement
- Deleted by the issue of a change or a new issue incorporating all supplements.

SAFETY AND OPERATIONAL SUPPLEMENTS

Number	Date	Short Title
S-1	10 Mar 93	Amend the engine starting procedure, and the altitude and airspeed conditions for immediate relight and cold relight in flight.

PI 1T-MB339C-1S-1

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

AERMACCHI MB-339C
AIRCRAFT

NOTE

This supplement amends publication PI 1T-MB339C-1 dated 30 May 1992, Change 1 - 20 February 1993, and should be inserted immediately after the title page. A suitable reference to this supplement will be made on the title page and each affected page of the basic publication.

10 MARCH 1993

1. PURPOSE

To amend the engine starting procedure, and the altitude and airspeed conditions for immediate relight and cold relight in flight.

2. INSTRUCTIONS

* At page 1-17, amend the "Ground Starting" in paragraph "ENGINE OPERATION" as follows:

Ground starting can only be carried out from the front cockpit. The "ENG MSTR" switch, when selected to ON, connects power to the engine circuits and the booster pump, creating a pressure at the engine-driven pump inlet (the "FUEL PRESS" caution light goes out). When the "ENG START" pushbutton is pressed, the automatic sequence begins: the starter rotates the engine, the high pressure pump (driven by the engine) delivers fuel, and the starting fuel solenoid valve is energized. Moving the engine throttle from STOP to IDLE opens the high pressure fuel cock incorporated in the BFCU, the fuel is delivered to the engine fuel system (previously described in this section), the starting fuel solenoid valve supplies fuel to the combustion chamber, and approx 15 seconds after the beginning of the starting cycle, the engine achieves self-sustaining speed. If the engine fails to start, the automatic starting cycle is terminated after 25 seconds i.e. the starting valve closes, and the high energy units and the starter are de-energized. When the engine reaches self-sustaining speed, the starting cycle ends, power supply to the starter ceases, and the starter becomes a generator. At completion of the starting cycle the engine stabilizes at idle (43-46% rpm in ISA conditions). This speed varies as a function of the barometric pressure and the amount of air bled from the compressor for operation of the aircraft systems. No engine warm up period is required, and the throttle can be moved as soon as the engine indications are within limits.

* At page 2-13, amend the paragraph "STARTING ENGINE" as follows:

1. Throttle - Ensure that is at STOP.
2. "START" button and clock - Press for 2 seconds and release.

NOTE

The engine normally lights up within 4 to 12 seconds from pressing the "START" button.

3. At 10% rpm, throttle - Advance to IDLE.

CAUTION

- If the jet pipe temperature rises too quickly and approaches the maximum limit, immediately move the throttle to STOP.
  Allow the engine to stop and cool, then investigate the cause.
- If the temperature exceeds the specified limits, report the overtemperature condition since flight safety and engine life are affected.
- If after 20 seconds from pressing the "START" button the engine does not light up (by reference to jet pipe temperature and the engine speed), move the throttle lever to STOP and the "ENG MSTR" switch to OFF.
- Move the aircraft if the ground beneath the tail becames soaked with fuel.
- Prior to attempting a new start, allow at least 5 minutes for the starter to cool and the engine to drain; than carry out a dry motoring cycle.
- If the engine does not start after the second attempt, investigate the cause.

4. Oil pressure - Check for normal indication.
5. Engine speed - Check for normal rpm increase.
6. Flowmeter - Positive indication (4 to 5 kg/min).
7. JPT - Check for normal increase.
8. "FIRE" and "OHEAT" warning lights - off.
9. Lights on caution lights panel - off.

NOTE

The "AIL SERVO" caution light goes off with some delay, viz. when hydraulic pressure exceeds 85 to 90 bar.

CAUTION

If the "BATT HOT" caution light comes on after engine starting, immediately disconnect the batteries and abort the mission.

10. Have the external power source disconnected (if plugged in).

* At page 3-10, amend the note in paragraph "IMMEDIATE HOT RELIGHT" to read:

NOTE

An immediate hot relight can be attempted at any altitude and airspeed. The most favourable conditions are however found: at altitudes below 20 000 ft and above 16 000 ft and airspeeds between 130 and 200 KIAS; at altitudes below 16 000 ft and airspeeds between 120 and 200 KIAS.

* At page 3-11, amend the note in paragraph "COLD RELIGHT" to read:

NOTE

The most favourable conditions for a cold relight are: at altitudes below 20 000 ft and above 16 000 ft and airspeeds between 130 and 200 KIAS; at altitudes below 16 000 ft and airspeeds between 120 and 200 KIAS (minimum windmilling rate: 8 to 10% rpm depending upon altitude).

THE END

TABLE OF CONTENTS

THIS INFORMATION IS IMPORTANT!

SCOPE

This manual contains the necessary information for a safe and efficient operation of the MB-339C aircraft. These instructions provide the pilot with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures.

SOUND JUDGEMENT

Although this manual provides instructions and procedures for the best possible operation of the aircraft, it cannot give proper indications for all circumstances and conditions that may be encountered in service. Multiple emergencies or adverse weather may require modification of the procedures contained herein.

PERMISSIBLE OPERATIONS

This flight manual states authorized operations only. Unusual operations or configurations other than those covered herein, are prohibited. Clearance from the concerned authority must be obtained prior to flight if operations not specifically indicated herein are attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to the publication "List of Applicable Publications" PI 1T-MB339C-01 for checking the current status of the Flight Manual. In addition, refer to page "Flight Manual Supplements, Check List and Safety and Operational Supplements Status" which is included in the manual along with each supplement immediately after page "A".

ARRANGEMENT

The manual has been divided into seven independent sections and comprises an alphabetical index to permit ready reference to the subjects treated herein. Performance data is contained in publication PI 1T-MB339C-1-1.

SAFETY SUPPLEMENTS

Information involving safety will be promptly provided by the way of "Safety Supplements". The cover page of the flight manual and the title block of each safety supplement should be checked to determine the effect they may have on existing supplements. It is important that the status of all supplements be constantly known.

OPERATIONAL SUPPLEMENTS

Information involving changes to operating procedures will be provided by the way of "Operational Supplements". The procedure for handling "Operational Supplements" is the same as for the "Safety Supplements". Operational Supplements are issued as an expeditious means of changing information in the manual when a deficiency in the publication may result in a reduction of the aircraft operational capability, although safety of flight is not affected.

NUMBERING OF SUPPLEMENTS

Safety and operational supplements to the Flight Manual will be numbered in sequence regardless of the type of supplement issued. For example, the first supplement issued will be numbered SS-1 or OS-1 dependent upon whether it is safety or operational, and the second supplement issued will be numbered -2 regardless of whether it is safety or operational.

CHECK LIST

The Check List, issued as a separate publication, contains simplified normal and emergency procedures and some of the most important charts taken from the PI 1T-MB339C-1-1 "Performance Data" manuals. See the Supplement Status page contained in the flight manual for the number and date of the latest check list. Line items in the flight manual and check list are identical with respect to arrangement and number of items. Whenever a safety supplement or operational supplement affects the check list, write in the applicable change on the affected check list page. As soon as possible a new check list page incorporating the supplement will be issued. This will keep handwritten entries of safety supplement information in your check list to a minimum. In all cases, the information contained in the flight manual and its supplements takes precedence over that contained in the check list.

CHANGE SYMBOL

The change symbol, consisting of a black vertical line, indicates text and tabular illustration changes made to the current issue. Changes to illustrations (except tabular and plotted illustrations), are indicated by a changed area box located in the upper part of the illustration. The box is divided into eight equal parts which represent eight proportional areas of the illustration. The shaded area of the box represents the area of the illustration which contains a change. The word "NEW" will appear in the box for new illustrations.

WARNINGS, CAUTIONS AND NOTES

The following definitions apply to warnings, cautions and notes found throughout the manual.

WARNING	Operating procedures, techniques, etc. which could result in personal injury or loss of life if not carefully followed.
CAUTION	Operating procedures, techniques, etc. which could result in damage to equipment if not care fully followed
NOTE	An operating procedure, technique, etc. which it is considered essential to emphasize.

COMMENTS AND RECOMMENDED CHANGES

Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. For the Flight Manual to be usefully amended, comments corrections and change proposals from all users are however invited. These should be forwarded on Form 22 "Publication Deficiency Report" to AERMACCHI S.p.A. Technical Publications Department - Via S. Sanvito, 80 - 21100 Varese (ITALY).

PUBLICATION DATE

The date appearing on the title page of this manual represents the currency of material in the manual. (The publication date is not the printing or distributor date). When referring to the manual, use the publication date plus the date of the latest change.

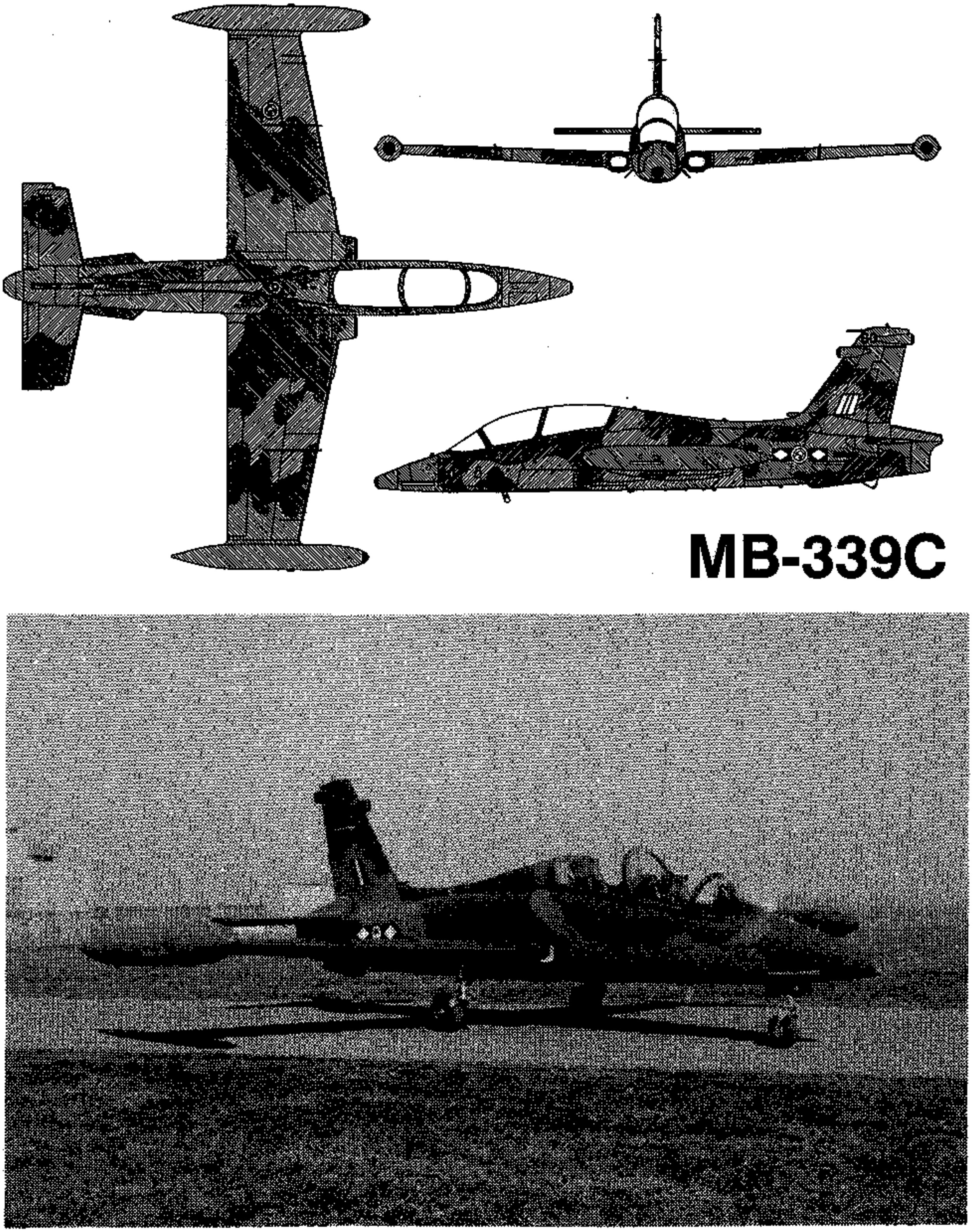


Figure 1-0

SECTION I

DESCRIPTION

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AIRCRAFT

The MB-339C is a single-engined, two-seat, subsonic aircraft manufactured by Aermacchi S.p.A., Varese. The aircraft primary role is basic and advanced training. With external armament stores the aircraft fulfills the secondary roles of operational training, air-to-ground and air-to-air attack. The aircraft is powered by a 19.05 kN (4280 lbf) thrust turbo-jet engine and can take off and land with a mass up to 6150 kg (13560 lb).

AIRCRAFT DIMENSIONS

The maximum dimensions of the aircraft, under normal conditions of mass, shock-absorber compression and tire inflation, are as follows:

• wing span	11.220 m
• fuselage length	11.242 m
• height to top of vertical stabilizer	3.994 m

Refer to Section II for minimum turning radius and ground clearance.

AIRCRAFT GROSS MASS

The aircraft basic mass is approx 3430 kg (including unusable fuel (17 kg), and oil (5 kg)). The aircraft gross mass in some typical configurations is as follows:

• Pilot training mission (crew of two, plus 1446 l internal fuel)	4722 kg
• Weapons training mission (crew of two, plus 1780 l internal fuel, two 12.7 mm gun pods with 350 rounds each and one pylon carrying one AEREA BRD-4-2CRV7 dispenser with four BDU-33C/B bombs and two 2.75 in rocket	5405 kg
• Low altitude attack mission with external armament (crew of one, 1780 l internal fuel, plus four MK-82 LD bombs)	6000 kg
• Ferry mission (crew of two, plus internal and external fuel)	5618 kg

The above mass data is based on average masses and is, therefore, given for guidance only. For the gross mass of each individual aircraft, refer to the "Sample Basic Weight Checklist" manual, PI 1T-MB339C-5-1, and "Loading Data" manual, PI 1T-MB339C-5-2, specifically prepared for each aircraft. For further information, refer to para "Mass Limitations" in Section V of this manual and to figure A1-2 of the "Performance Data" manual, PI 1T-MB339C-1-1.

GENERAL ARRANGEMENT (Figure 1-1)

The fuselage is built in two sections to permit engine removal. The forward section contains the nose landing gear and part of the electronic equipment, the two cockpits, the two-cell fuel tank, a dorsal electronic equipment compartment, the speedbrake and the engine bay. The cockpits are enclosed by a canopy hinged to the fuselage right side, and are fitted with ejection seats which are staggered in height to ensure maximum visibility from the rear cockpit. Each cockpit is equipped with an instrument panel and side consoles, (Figures 1-2 thru 1-7), a throttle lever (Figure 1-8) and a control stick (Figure 1-9). The central equipment compartment contains the cabin air-conditioning heat-exchanger unit and is located under the rear cockpit. The aft section, to which the horizontal and vertical stabilizers are attached, contains the jet pipe. Bays for the retracted main landing gear and the oxygen cylinders are provided in the wings, and underwing stations are fitted for the attachment of six pylons designed to carry armament stores or jettisonable fuel tanks. Non-droppable fuel tanks of 500 l capacity are mounted at the wing tips.

ENGINE

The Rolls-Royce Viper MK680-43 engine (fig 1-10) has an uninstalled, minimum thrust of 19.05 kN (4280 lbf) under ISA conditions at sea-level. During engine operation air flows into two air intakes, one on either side of the fuselage on the wing leading edge, and is directed to an axial-flow compressor where it is compressed progressively through 8 stages. The compressed air then passes into an annular combustion chamber, where it is mixed with fuel and combustion occurs. From the combustion chamber the hot exhaust gases pass through a two- stage turbine coupled directly to the compressor. It is finally discharged to the atmosphere through the exhaust cone and the jet pipe, thus producing the high-velocity jet and the reaction thrust. To promote optimum acceleration in the lower speed range, air is bled from the compressor fifth stage (No 4) through a piston type blow-off valve (BOV) mounted on the compressor casing. Operation of the valve is governed pneumatically by a control valve functioning in conjunction with a pressure ratio switch mounted on the compressor casing. The engine controls provided in bothcockpits permit the engine fuel supply to be controlled to suit the selected ratings. A compressor bleed from the 8th stage supplies high temperature pressurized air for engine anti-icing, and to the following aircraft services: cabin air conditioning and pressuriwation, anti-icing and demisting of the

GENERAL ARRANGEMENT

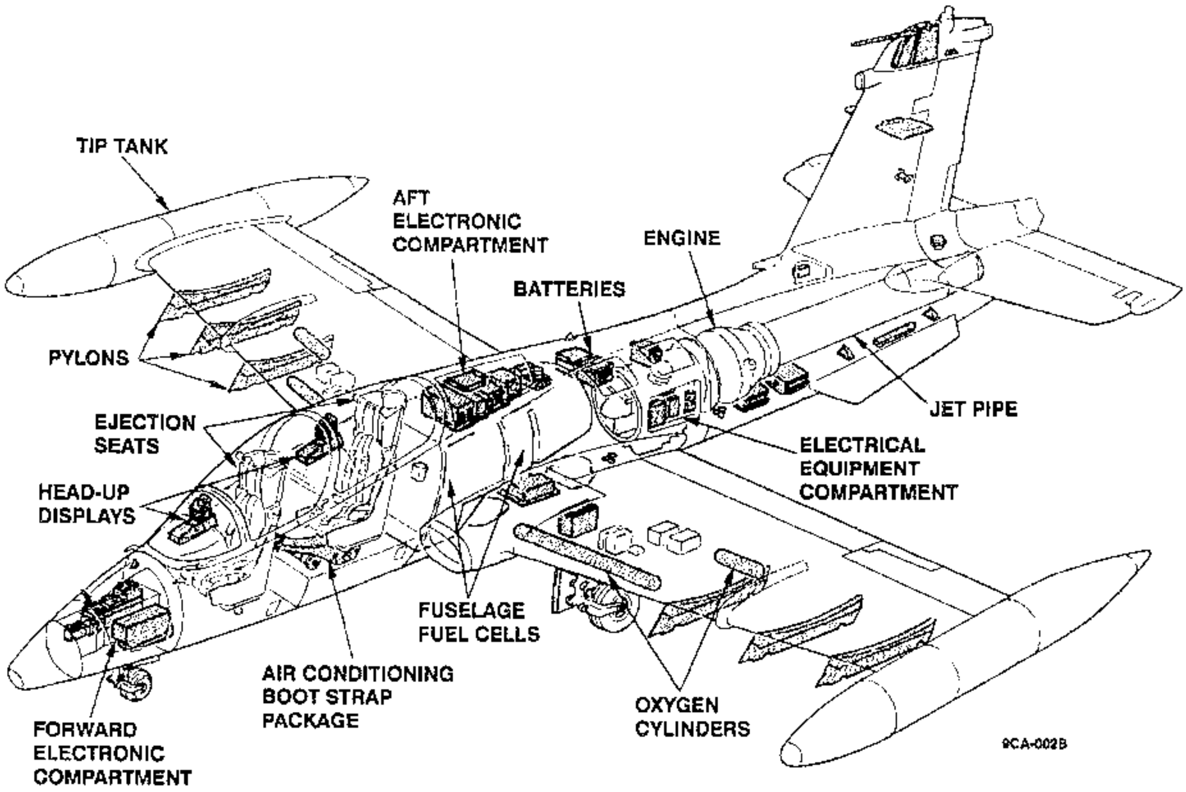


Figure 1-1

windshield and canopy, anti-g suits, fuel transfer from the external tanks and pressurization of the hydraulic system reservoir.

ENGINE OIL SYSTEM

The engine oil system is self-contained and has an engine-mounted tank. The oil system includes a pressure and scavenge system for the front bearing. A micro pump supplies the center and rear bearings with metered oil which is then discharged to atmosphere via the exhaust gas stream. The operation of the oil system is fully automatic: no action is required from the pilot except checking the oil pressure on the indicator. An "OIL PRESS" light on the caution lights panel illuminates when oil pressure drops below 0.4 bar. During zero or negative "g" flight, the "OIL PRESS" caution light comes on, and the engine oil pressure indicator reads 0 bar. The oil system contains 6.3 l (11 pints) of oil, 5.2 l (9 pints) of which are contained in a 7.3 l (13 pints) tank. The usable oil quantity is 3.4 l (6 pints), the unusable oil quantity is 1.7 l (3 pints). The maximum permissible oil consumption is 0.71 liters/hour (1.25 pints/hour) and the minimum permissible rate is 0.51 liters/hour (0.9 pints/hour).

FRONT CREW STATION

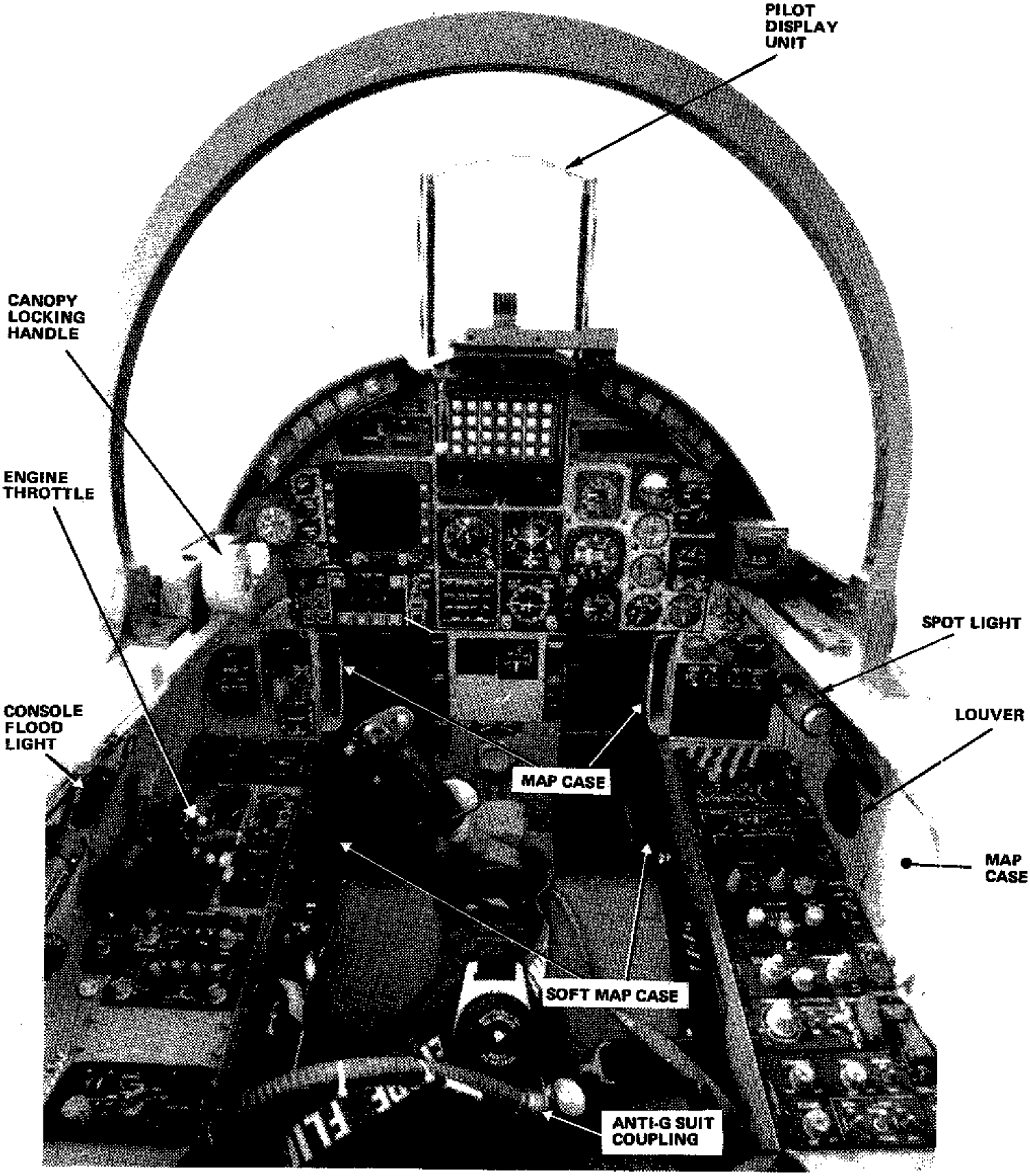
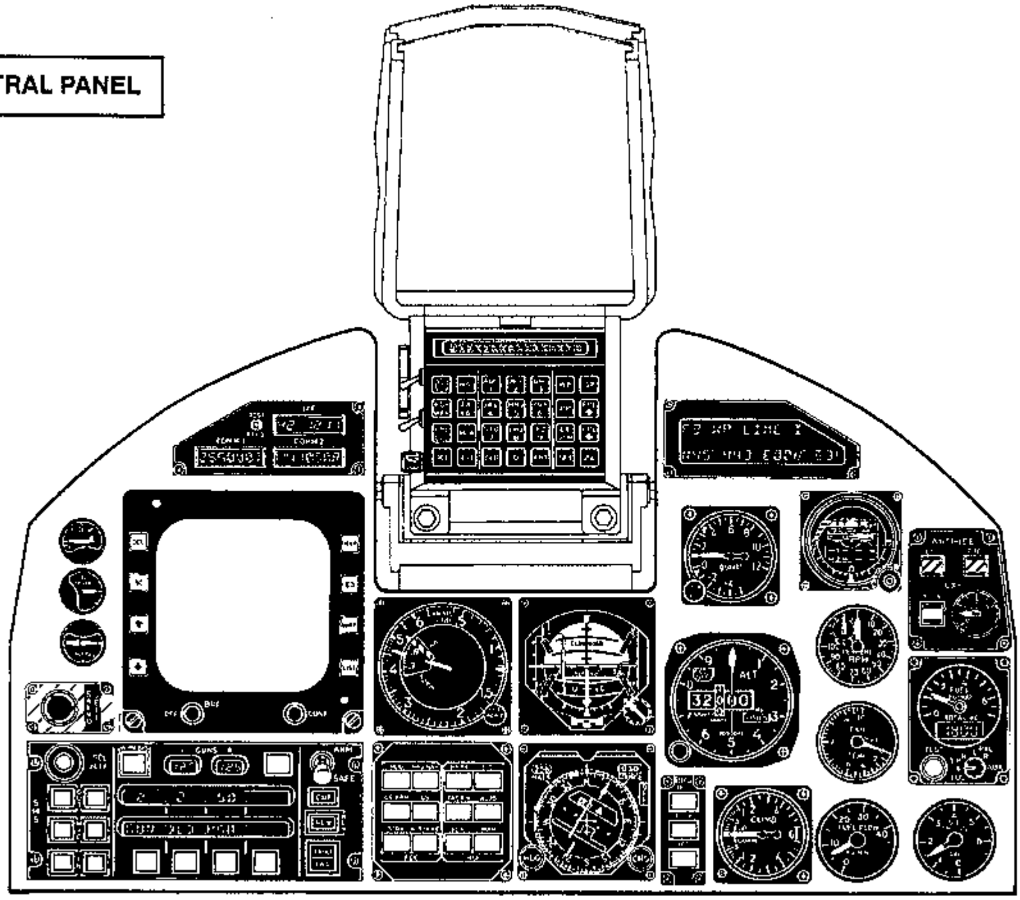


Figure 1-2

FRONT INSTRUMENT PANEL

CENTRAL PANEL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1. COMMUNICATION/IDENTIFICATION DISPLAY (CID)
2. PILOT DISPLAY UNIT (PDU)
3. DATA ENTRY PANEL (DEP)
4. REMOTE DISPLAY UNIT (RDU)
5. STANDBY ATTITUDE INDICATOR
6. ANTI-ICE INDICATORS
7. OXYGEN INDICATORS
8. FUEL QUANTITY INDICATOR
9. ENGINE OIL PRESSURE
10. FUEL FLOW INDICATOR
11. JET PIPE TEMPERATURE INDICATOR
12. TACHOMETER
13. ACCELEROMETER
14. ENCODER ALTIMETER
15. VERTICAL VELOCITY INDICATOR
16. "BRG" CONTROL PANEL
17. HORIZONTAL SITUATION INDICATOR (HSI)
18. ATTITUDE DIRECTOR INDICATOR (ADI)
19. MACH-AIRSPEED INDICATOR
20. NAVIGATION AND FLIGHT DIRECTOR CONTROL PANEL
21. WEAPON CONTROL PANEL
22. MULTIFUNCTION DISPLAY (MFD)
23. EXTERNAL STORES RELEASE PUSHBUTTON
24. FLAP POSITION INDICATOR
25. SPEEDBRAKE POSITION INDICATOR
26. LONGITUDINAL TRIM INDICATOR

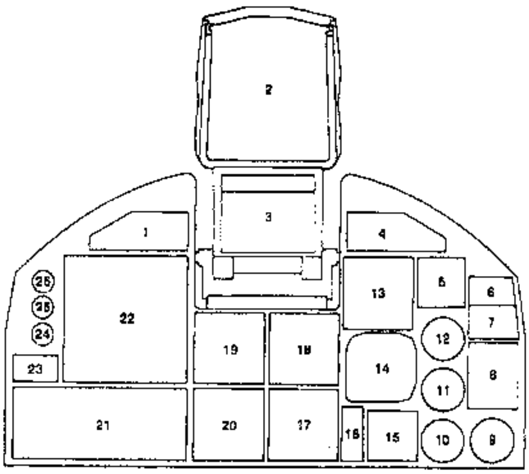
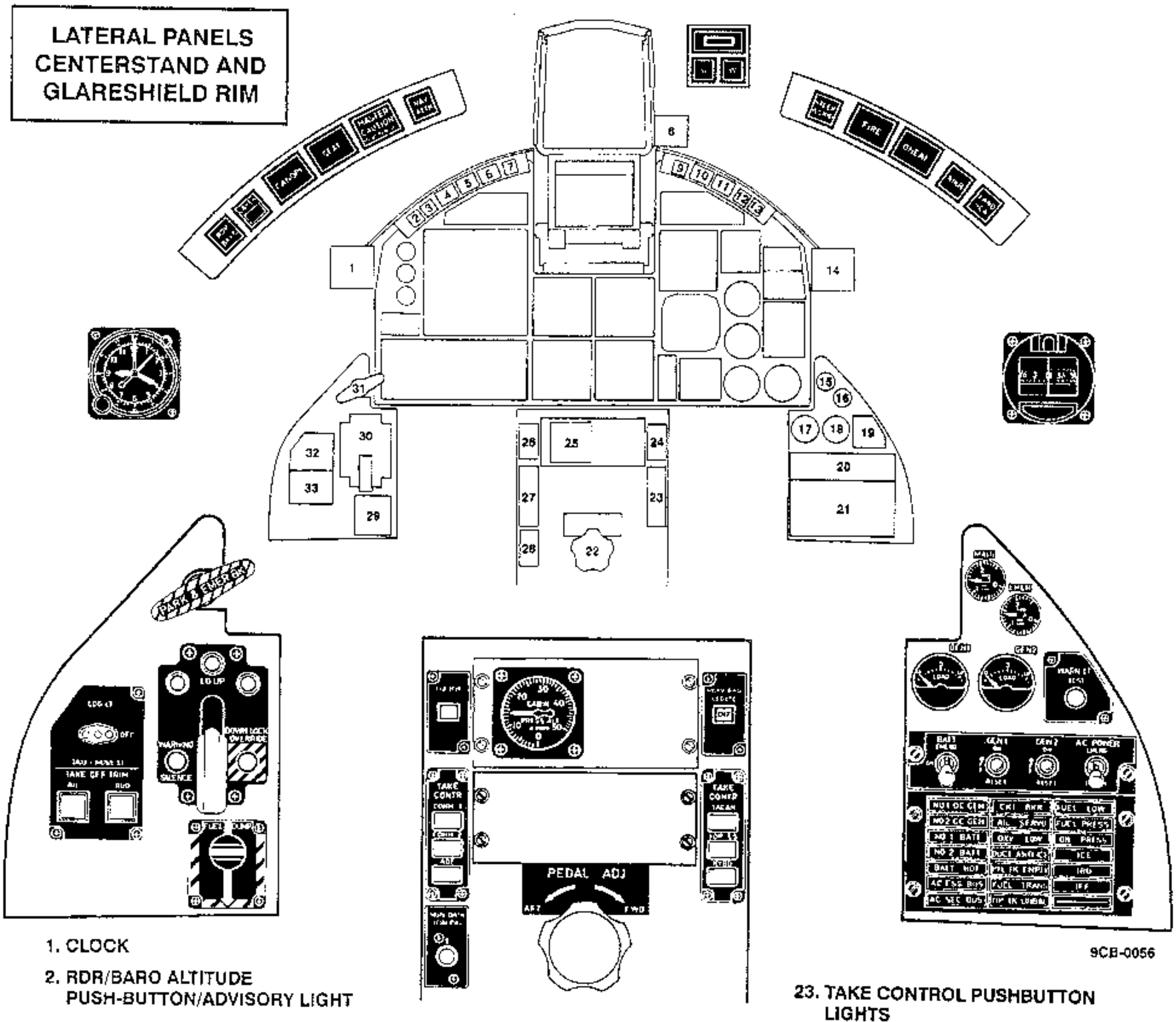


Figure 1-3 (Sheet 1 of 2)

FRONT INSTRUMENT PANEL



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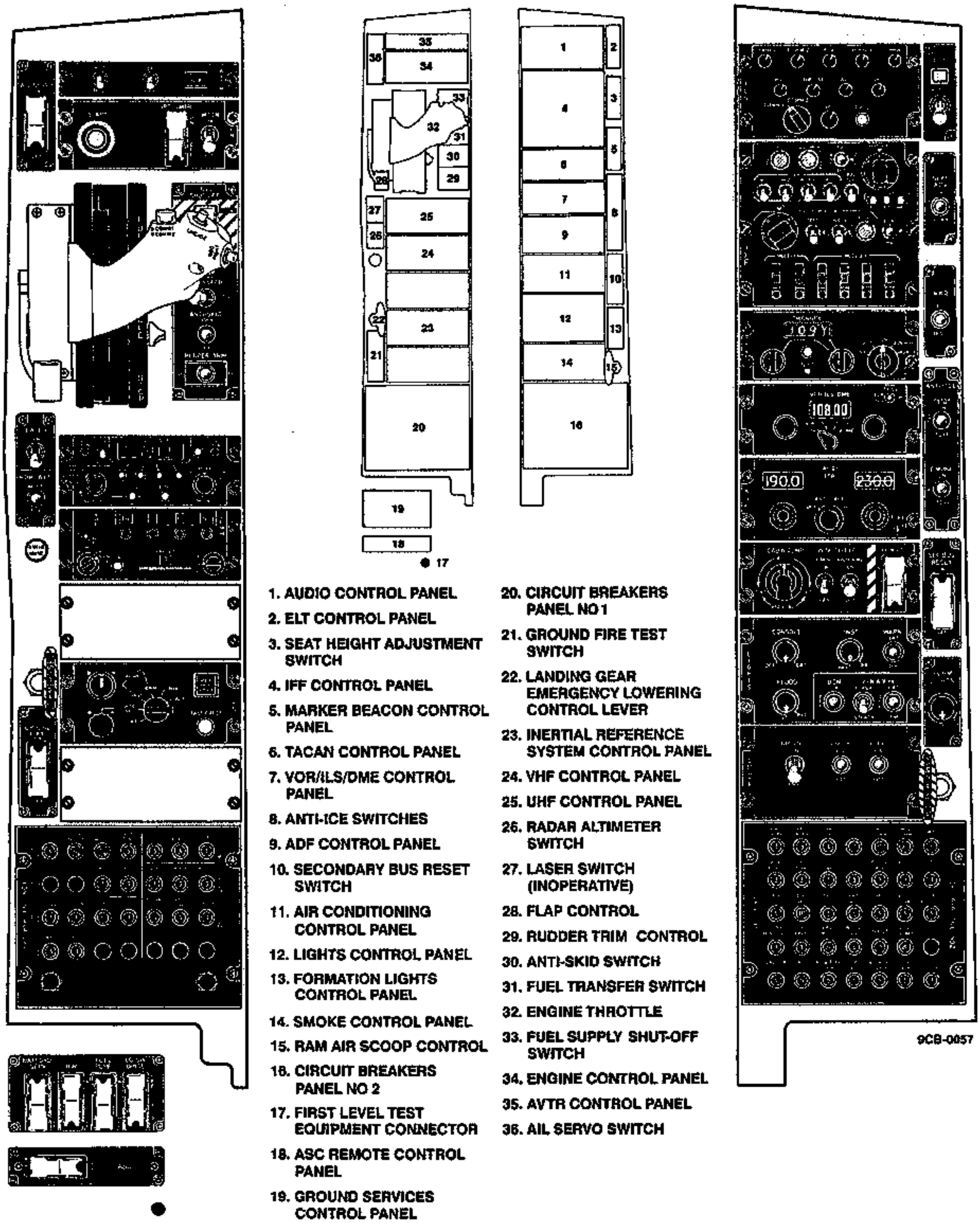
1. CLOCK
2. RDR/BARO ALTITUDE PUSH-BUTTON/ADVISORY LIGHT
3. LASER ADVISORY LIGHT
4. CANOPY WARNING LIGHT
5. SEAT ADVISORY LIGHT
6. MASTER CAUTION LIGHT
7. NAV/ATTK MODE PUSHBUTTON/ /ADVISORY LIGHT
8. SMOKE GENERATION SYSTEM ADVISORY LIGHTS
9. STEER/A-SKID ADVISORY LIGHT
10. FIRE WARNING LIGHT
11. OHEAT CAUTION LIGHT
12. MKR ADVISORY LIGHT
13. LAND/SEA PUSHBUTTON/ /ADVISORY LIGHT
14. STANDBY COMPASS
15. MAIN HYDRAULIC SYSTEM PRESSURE GAUGE
16. EMERGENCY HYDRAULIC SYSTEM
17. GEN 1 LOADMETER
18. GEN 2 LOADMETER
19. WARNING LIGHTS TEST PUSHBUTTON
20. ELECTRICAL SUPPLY CONTROL PANEL
21. CAUTION LIGHTS PANEL
22. RUDDER PEDALS ADJUSTMENT
23. TAKE CONTROL PUSHBUTTON LIGHTS
24. RNAV RAD UPDATE ADVISORY LIGHT
25. CABIN ALTIMETER
26. IRU RDY ADVISORY LIGHT
27. TAKE CONTROL PUSHBUTTON LIGHTS
28. MISSION DATA LOADING JACK
29. TIP TANKS FUEL DUMP CONTROL
30. LANDING GEAR CONTROLS
31. PARK & EMER BK HANDLE
32. TAXI, NOSE AND LANDING LIGHTS SWITCH
33. TAKE OFF TRIM PANEL

Figure 1-3 (Sheet 2)

FRONT CONSOLES



1. AUDIO CONTROL PANEL
2. ELT CONTROL PANEL
3. SEAT HEIGHT ADJUSTMENT SWITCH
4. IFF CONTROL PANEL
5. MARKER BEACON CONTROL PANEL
6. TACAN CONTROL PANEL
7. VOR/ILS/DME CONTROL PANEL
8. ANTI-ICE SWITCHES
9. ADF CONTROL PANEL
10. SECONDARY BUS RESET SWITCH
11. AIR CONDITIONING CONTROL PANEL
12. LIGHTS CONTROL PANEL
13. FORMATION LIGHTS CONTROL PANEL
14. SMOKE CONTROL PANEL
15. RAM AIR SCOOP CONTROL
16. CIRCUIT BREAKERS PANEL NO 2
17. FIRST LEVEL TEST EQUIPMENT CONNECTOR
18. ASC REMOTE CONTROL PANEL
19. GROUND SERVICES CONTROL PANEL
20. CIRCUIT BREAKERS PANEL NO 1
21. GROUND FIRE TEST SWITCH
22. LANDING GEAR EMERGENCY LOWERING CONTROL LEVER
23. INERTIAL REFERENCE SYSTEM CONTROL PANEL
24. VHF CONTROL PANEL
25. UHF CONTROL PANEL
26. RADAR ALTIMETER SWITCH
27. LASER SWITCH (INOPERATIVE)
28. FLAP CONTROL
29. RUDDER TRIM CONTROL
30. ANTI-SKID SWITCH
31. FUEL TRANSFER SWITCH
32. ENGINE THROTTLE
33. FUEL SUPPLY SHUT-OFF SWITCH
34. ENGINE CONTROL PANEL
35. AVTR CONTROL PANEL
36. AIL SERVO SWITCH

Figure 1-4

REAR CREW STATION

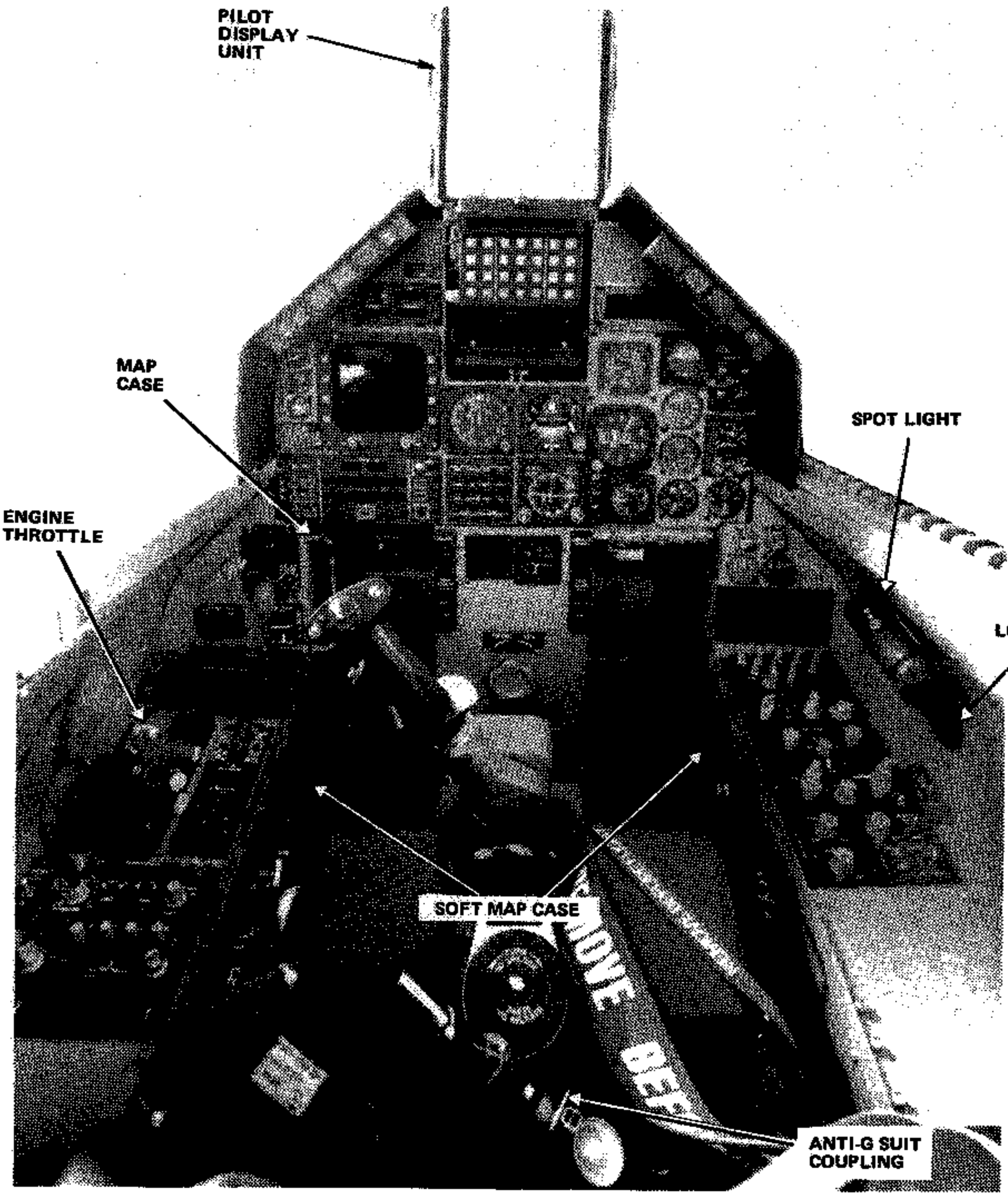
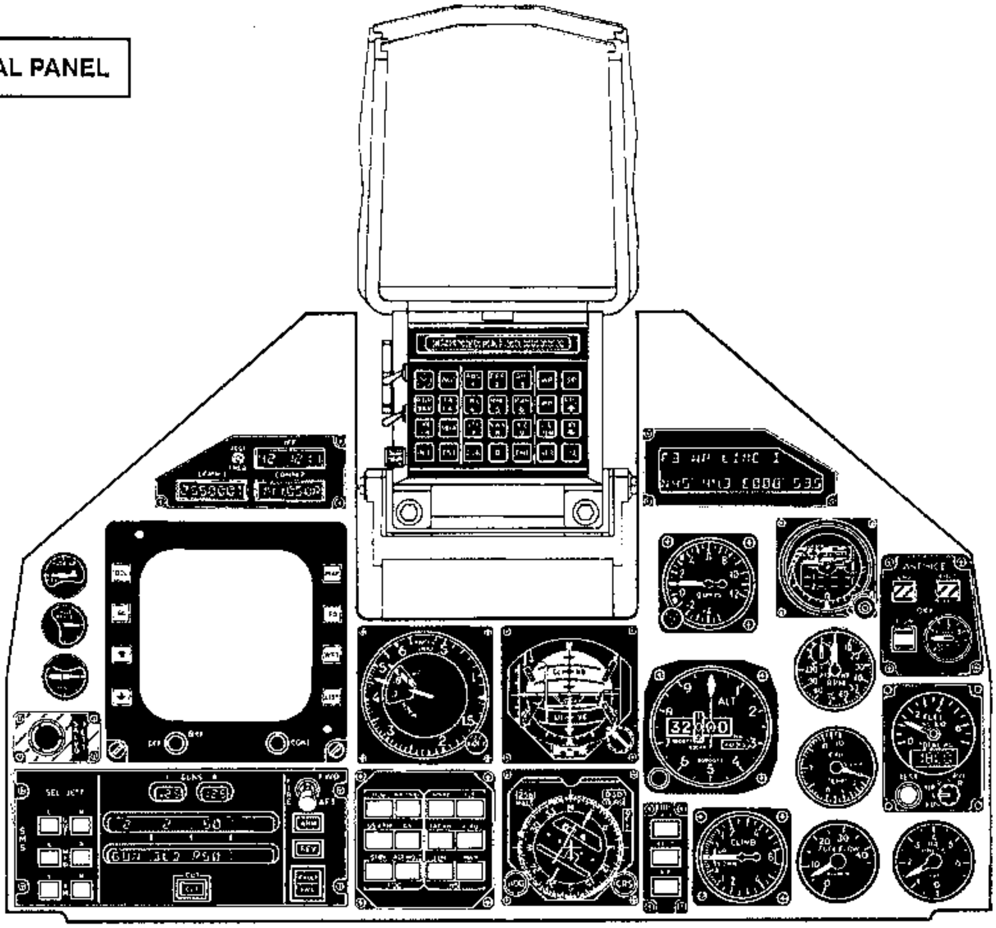
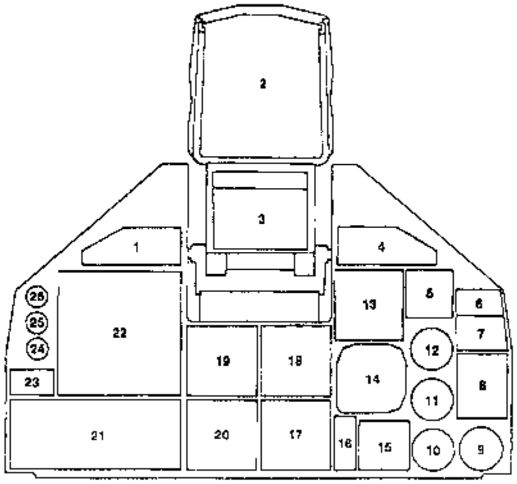


Figure 1-5

REAR INSTRUMENT PANEL

CENTRAL PANEL





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12. TACHOMETER
13. ACCELEROMETER
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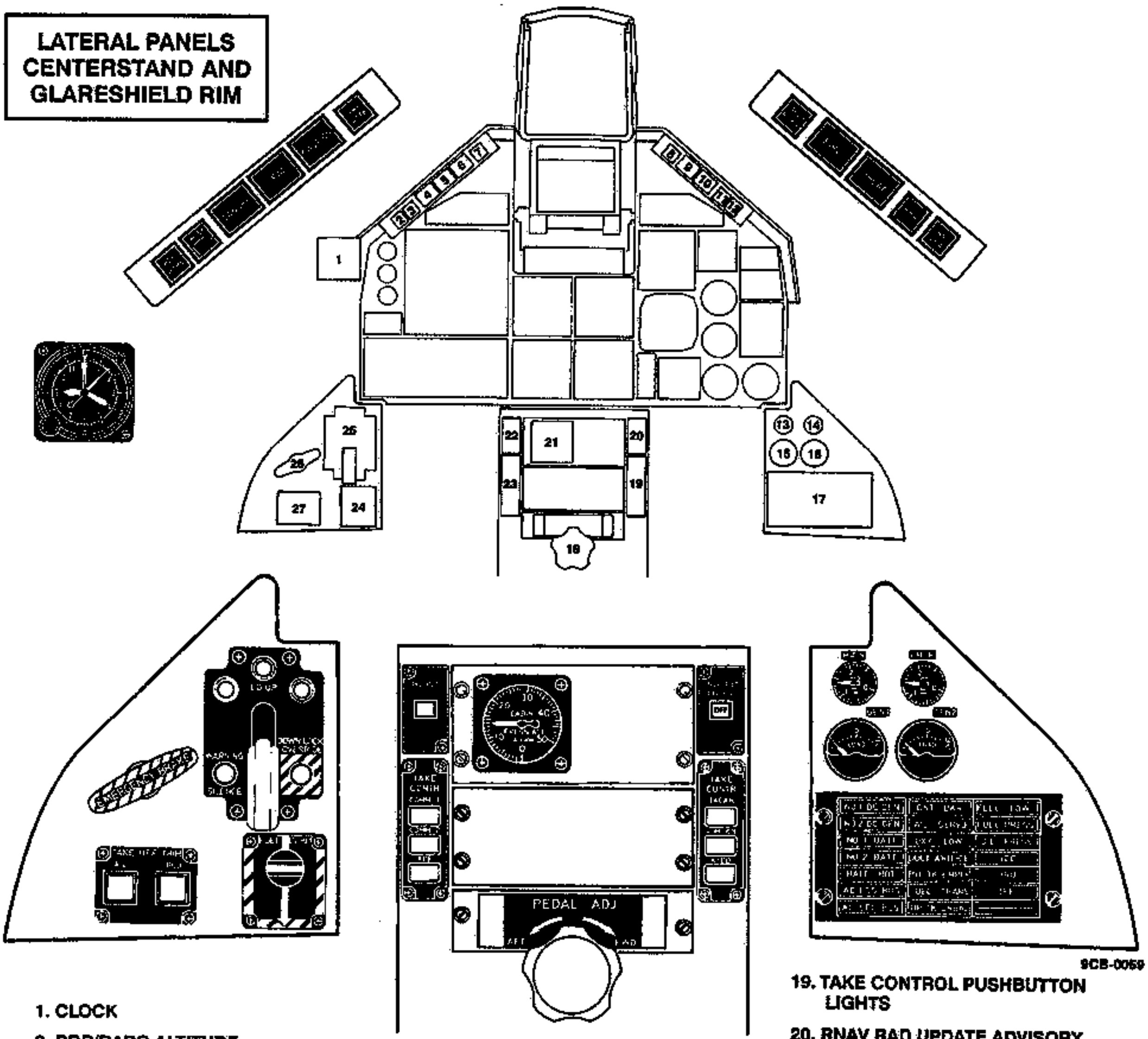
24. FLAP POSITION INDICATOR
25. SPEEDBRAKE POSITION INDICATOR
26. LONGITUDINAL TRIM INDICATOR

Figure 1-6 (Sheet 1 of 2)

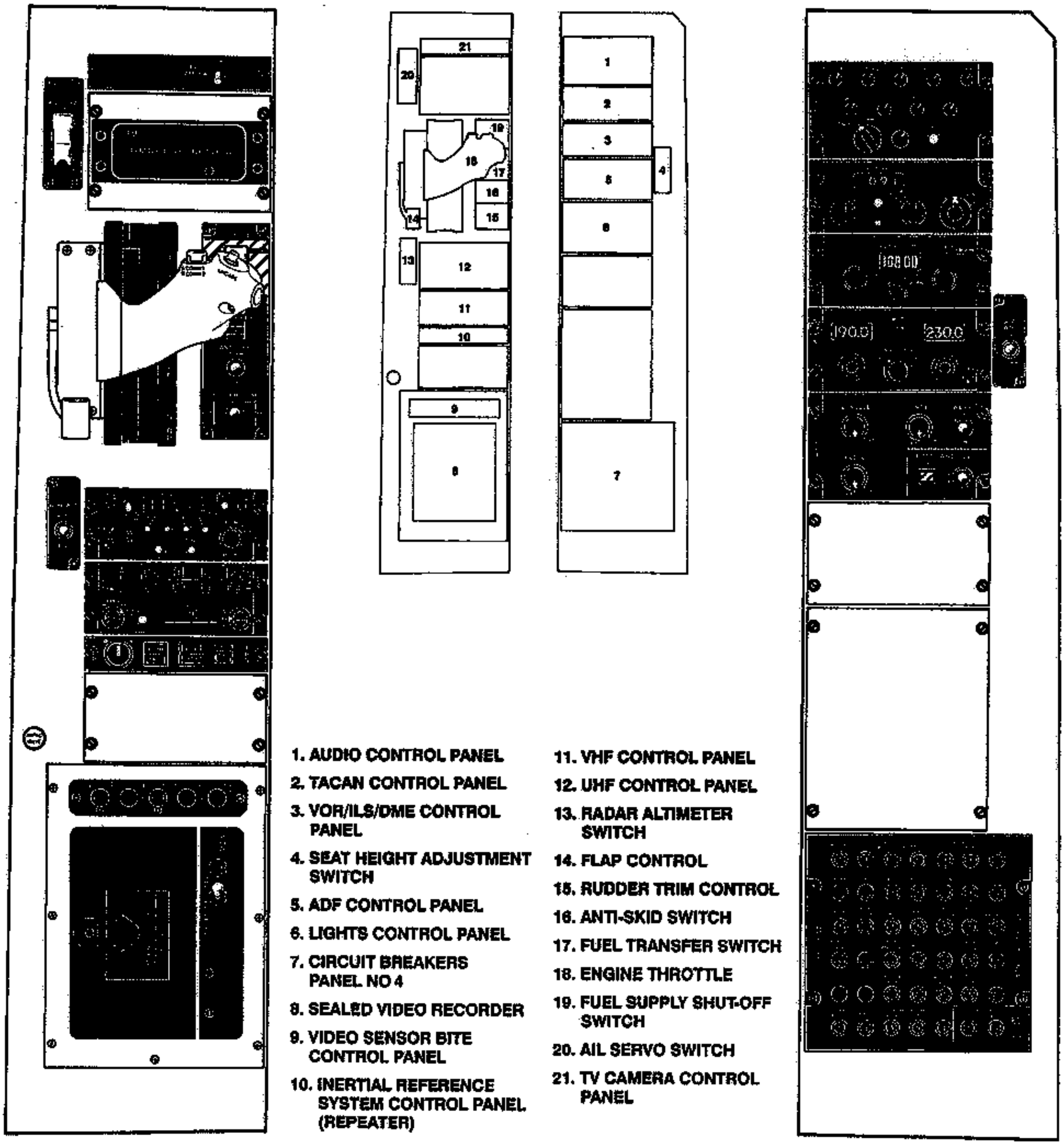
REAR INSTRUMENT PANEL



1. CLOCK
2. RDR/BARO ALTITUDE PUSHBUTTON/ADVISORY LIGHT
3. LASER ADVISORY LIGHT
4. CANOPY WARNING LIGHT
5. SEAT ADVISORY LIGHT
6. MASTER CAUTION LIGHT
7. NAV/ATTK MODE PUSHBUTTON/ /ADVISORY LIGHT
8. STEER/A-SKID ADVISORY LIGHT
9. FIRE WARNING LIGHT
10. OHEAT CAUTION LIGHT
11. MKR ADVISORY LIGHT
12. LAND/SEA PUSHBUTTON/ /ADVISORY LIGHT
13. MAIN HYDRAULIC SYSTEM PRESSURE GAUGE
14. EMERGENCY HYDRAULIC SYSTEM
15. GEN 1 LOADMETER
16. GEN 2 LOADMETER
17. CAUTION LIGHTS PANEL
18. RUDDER PEDALS ADJUSTMENT CONTROL
19. TAKE CONTROL PUSHBUTTON LIGHTS
20. RNAV RAD UPDATE ADVISORY LIGHT
21. CABIN ALTIMETER
22. IRU RDY ADVISORY LIGHT
23. TAKE CONTROL PUSHBUTTON LIGHTS
24. TIP TANKS FUEL DUMP CONTROL
25. LANDING GEAR CONTROLS
26. EMERGENCY BRAKE HANDLE
27. TABS NEUTRAL POSITION INDICATORS

Figure 1-6 (Sheet 2)

REAR CONSOLES



1. AUDIO CONTROL PANEL
2. TACAN CONTROL PANEL
3. VOR/ILS/DME CONTROL PANEL
4. SEAT HEIGHT ADJUSTMENT SWITCH
5. ADF CONTROL PANEL
6. LIGHTS CONTROL PANEL
7. CIRCUIT BREAKERS PANEL NO 4
8. SEALED VIDEO RECORDER
9. VIDEO SENSOR BITE CONTROL PANEL
10. INERTIAL REFERENCE SYSTEM CONTROL PANEL (REPEATER)
11. VHF CONTROL PANEL
12. UHF CONTROL PANEL
13. RADAR ALTIMETER SWITCH
14. FLAP CONTROL
15. RUDDER TRIM CONTROL
16. ANTI-SKID SWITCH
17. FUEL TRANSFER SWITCH
18. ENGINE THROTTLE
19. FUEL SUPPLY SHUT-OFF SWITCH
20. AIL SERVO SWITCH
21. TV CAMERA CONTROL PANEL

9CB-0060

Figure 1-7

ENGINE THROTTLE

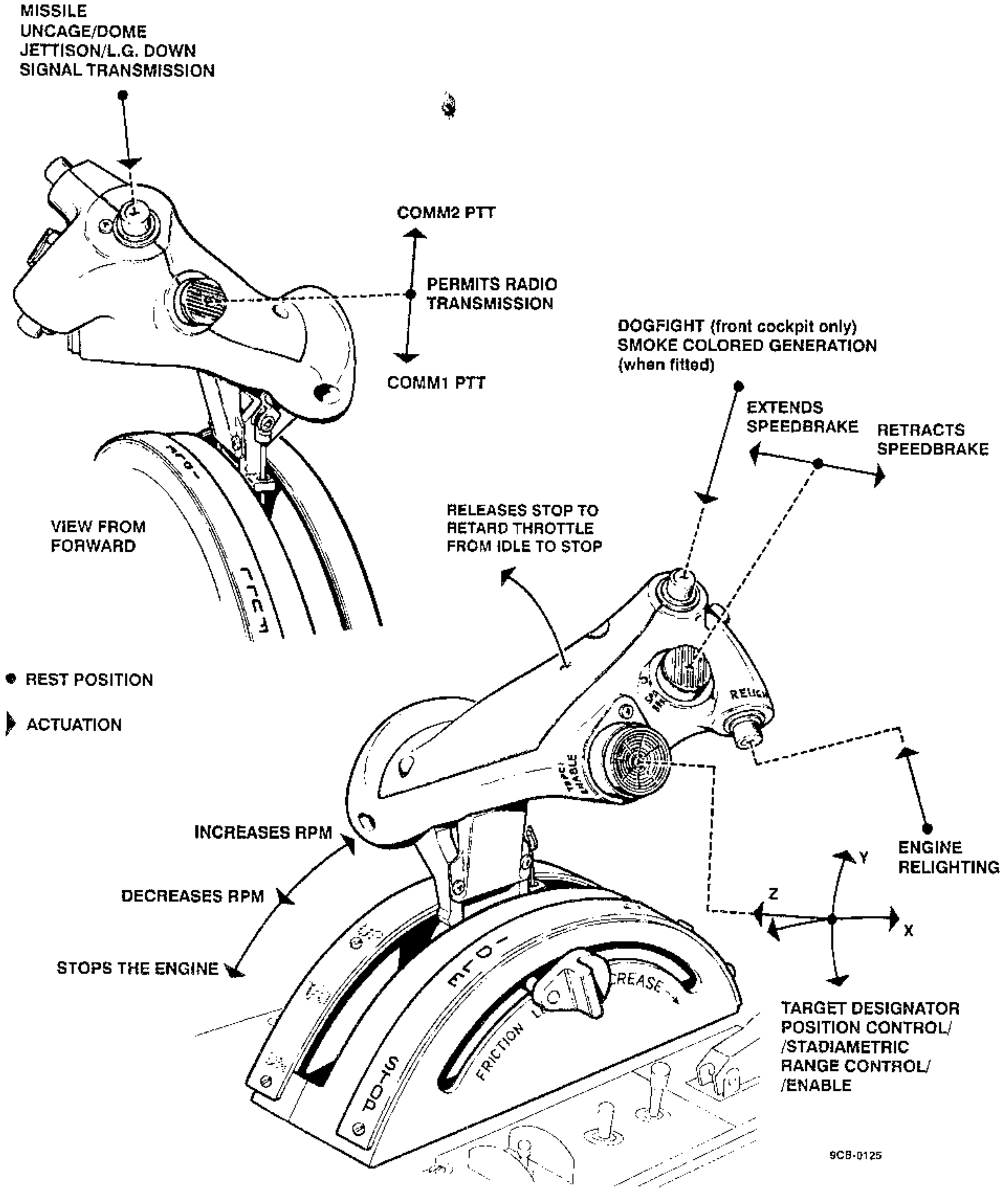


Figure 1-8

CONTROL STICK

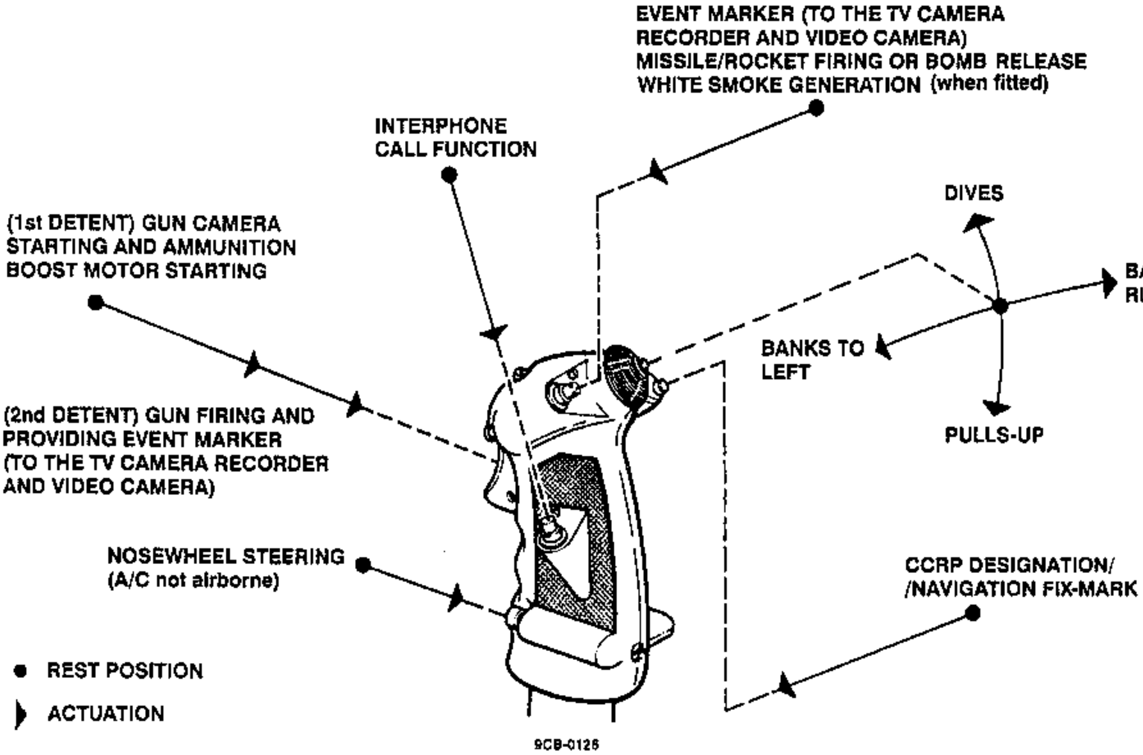


Figure 1-9

ENGINE FUEL SYSTEM

Pressurized engine fuel (Figure 1-11) from the booster pump (Figure 1-14) flows through a low pressure filter and into the engine driven hp pump. A hydro- mechanical governor, within the hp pump, limits the maximum rpm. A Rate Reset Valve (RRV) in the feed line from the fuel pump to the governor prevents any fuel pressure variation, due to altitude, from affecting the governed rpm during flight. The pump feeds fuel under pressure to the Barometric Flow Control Unit (BFCU) which incorporates a throttle controlled shut-off cock which provides the means of stopping the engine by shutting off the flow of fuel to the combustion chamber. The metered fuel from the BFCU flows into the Air/Fuel Ratio Control (AFRC), which controls the fuel flow to the engine during acceleration, thus preventing compressor stall. Fuel from the AFRC passes through a fuel flow meter (giving cockpit indications of fuel flow) and a Pressure Increasing Valve (PIV) to the fuel feed pipe units (burners) in the combustion chamber. A starting solenoid is energized by the engine starting circuits during engine start, or during engine relight, and allows metered fuel to be delivered through six starting atomizers in the combustion chamber, where it is ignited by two igniters.

VIPER MK 680-43 ENGINE

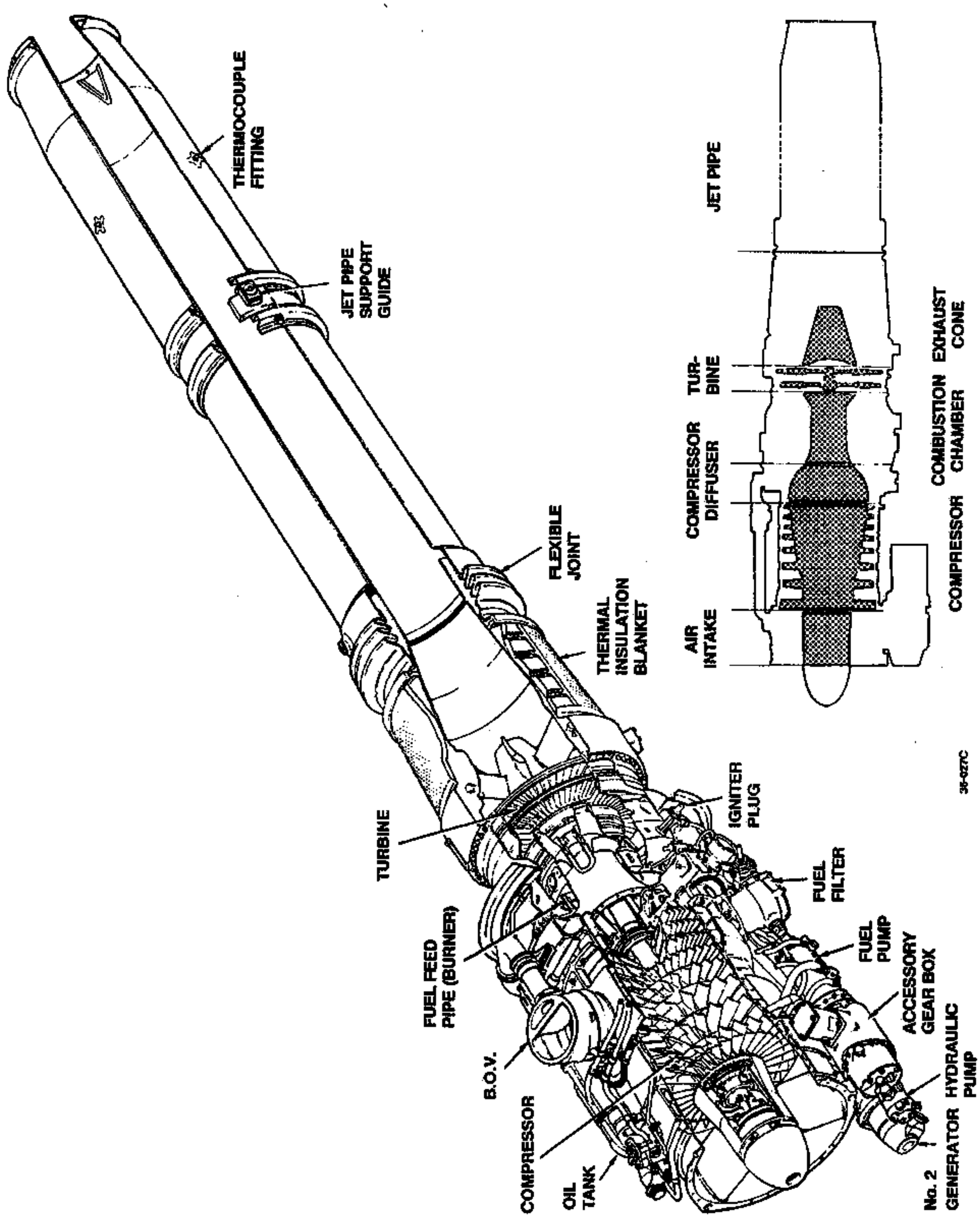


Figure 1-10

ENGINE FUEL SYSTEM

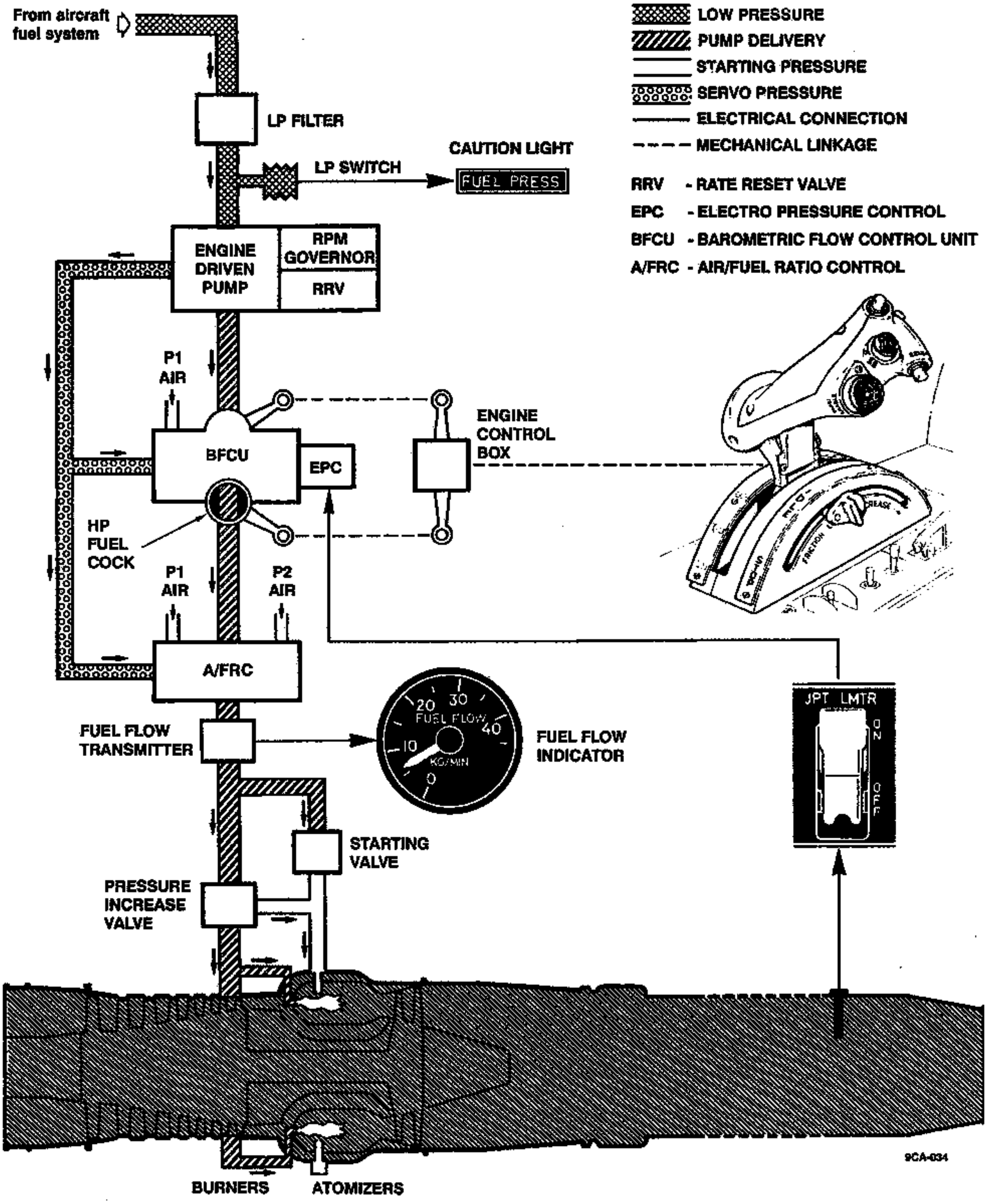


Figure 1-11

Jet Pipe Temperature Limiter

The JPT limiter system consists of four twin-element thermocouples which serve the JPT indicator, and the JPT limiter amplifier. When the electro-motive force generated by the thermocouples exceeds the limiting value, an error signal is passed through the amplifier to energize the electro-pressure control unit (EPC). This lowers the pump servo pressure and limits the fuel flow from the pump. The "ENG JPT LMTR" switch enables the system to be isolated when a malfunction is suspected. The system operates when JPT reaches 756 °C.

ENGINE ANTI-ICE SYSTEM

The engine anti-ice system is confined to the compressor air inlet and is an integral part of the engine. It consists of a system blowing hot air on the engine front face to prevent ice formation on the compressor zero stage. The engine anti-ice system is powered from the 28 V dc anti-ice bus and enabled from the 28 V dc primary bus. It is operated by a toggle switch labeled "ANTI- ICE/ENGINE" on the right console in the front cockpit (Figure 1-39). When set to ON, the switch operates an anti-ice valve which controls the hot air system protecting the compressor, and energizes both the heaters of the air intake lips and ducts (inoperative on the ground). In the event of electrical supply failure, the anti-ice valve will fail to the open position. A ground test of the engine anti-ice system is possible by temporarily moving the switch to the TEST position, provided the engine is running at 60% rpm or more and both generators are on. The engine anti-ice controls and indicators are described and illustrated in figure 1-39.

IGNITION SYSTEM

Ignition is provided by two high energy igniter plugs for normal starting on the ground and relighting in flight. During starting or relighting, the ignition units convert the 28 V dc essential bus current into high-voltage alternating current and feed it to the igniter plugs. During relighting, the ignition system is energized by pressing the "RELIGHT" button mounted on the engine throttle in either cockpit.

STARTING SYSTEM

The engine is started by a starter-generator (generator No 1) operating as a starter until the engine speed reaches 23% rpm. When this rpm is reached, the starter is automatically de-energized and the unit becomes a dc generator. To start the engine, the starter-generator can be energized either from an external power source or from the aircraft batteries. When using an external power source, the starter is directly energized from the external power source and the aircraft batteries energize the starter control circuit. When the engine is started using the aircraft batteries, the starting bus is connected to the essential bus, which is supplied from the two batteries. The starting bus supplies the starter-generator, while the essential bus supplies the starter control circuit. The starting system is controlled by the "ENG MSTR" switch and the "ENG START" push-button. When the "ENG START" button is pressed, the starting cycle is initiated and continues automatically until the engine has reached self-sustaining speed. If the engine does not light up within 20 seconds, the throttle lever should be moved to STOP (see para "Starting Engine", section II). However if the engine does not reach the self-sustaining speed within 25 seconds, the system is designed to stop the starting cycle automatically. The starting sequence can be terminated at any time by turning the "ENG MSTR" switch to OFF. The starting system is powered from the 28 V dc essential bus via the "ENG START" circuit breaker.

ENGINE THROTTLE

The engine throttle consists of a lever which adjusts the engine rpm and, in the first range of travel (up to IDLE), operates the high pressure fuel cock. Upward rotation of the throttle grip overrides the stop dividing the two ranges of travel and closes the hp cock. A pawl, sliding in a slot, provides adjustment of the throttle friction. The controls on the engine throttle are illustrated in figure 1-8.

ENGINE CONTROLS AND INSTRUMENTS

The engine controls and instruments are described and illustrated in figure 1-12. The throttle is shown in figure 1-8.

ENGINE OPERATION

Ground Starting

Ground starting can only be carried out from the front cockpit. The "ENG MSTR" switch, when selected to ON, connects power to the engine circuits and the booster pump, creating a pressure at the engine-driven pump inlet (the "FUEL PRESS" caution light goes out). Moving the engine throttle from STOP to IDLE opens the high pressure fuel cock incorporated in the BFCU. When the "ENG START" push-button is pressed, the automatic sequence begins: the starter rotates the engine, the high pressure pump (driven by the engine) delivers fuel to the engine fuel system (previously described in this section), the starting fuel solenoid valve supplies fuel to the combustion chamber, the high energy units provide ignition, and approx 15 seconds after the beginning of the cycle, the engine achieves self-sustaining speed. If the engine fails to start, the automatic starting cycle is terminated after 25 seconds i.e. the starting valve closes, and the high energy units and the starter are de- energized. When the engine reaches self-sustaining speed, the starting cycle ends, power supply to the starter ceases, and the starter becomes a generator. At completion of the starting cycle the engine stabilizes at idle (40-41% rpm in ISA conditions). This speed varies as a function of the barometric pressure and the amount of air bled from the compressor for operation of the aircraft systems. No engine warm up period is required, and the throttle can be moved as soon as the engine indications are within the limits.

In-Flight Relighting

With the engine throttle at IDLE and the engine windmilling (minimum windmilling rpm required is 8-10% rpm, but this value is normally 13% rpm), pressing the "RELIGHT" push-button opens the starting fuel solenoid valve which directs fuel to the combustion chamber through the atomizers. At the same time, the high energy units are energized for as long as the "RELIGHT" push-button is pressed. Any increase in JPT and rpm will indicate that the engine has relit. The "RELIGHT" push-button can be released when 40% rpm is reached or the JPT has peaked and begins to decrease.

FIRE AND OVERHEAT DETECTION SYSTEM

The fire and overheat detection system consists of two detector systems, one for fire and the other for fire and overheat. The fire detector circuit is installed in the forward section of the engine compartment (zone I) and is connected to the red "FIRE" warning light. The fire and overheat detector circuit is installed in the aft section of the engine compartment (zone II) and is connected to the yellow "OHEAT" caution light. Each system consists of a fire detector unit routed through the relevant zone, and of a warning/caution light located just below the right glareshield in each cockpit. Zone I includes all engine systems, the aircraft fuel and hydraulic system pipes, and is close to the aircraft fuel tanks. A fire in this section could result in catastrophic damage. Zone II is separated from zone I by a stainless steel firewall installed just aft the engine compressor. This zone houses the combustion chamber and jet pipe, and does not contain any fuel or hydraulic fluid. Illumination of the yellow "OHEAT" caution light may be caused by the escape of hot gases from the jet pipe, burning of residual fuel, and rupture or disconnection of the jet pipe. In the latter case, severe damage to flight controls and structure could result.

NOTE

The aircraft is not equipped with a fire extinguishing system.

ENGINE CONTROLS AND INDICATORS

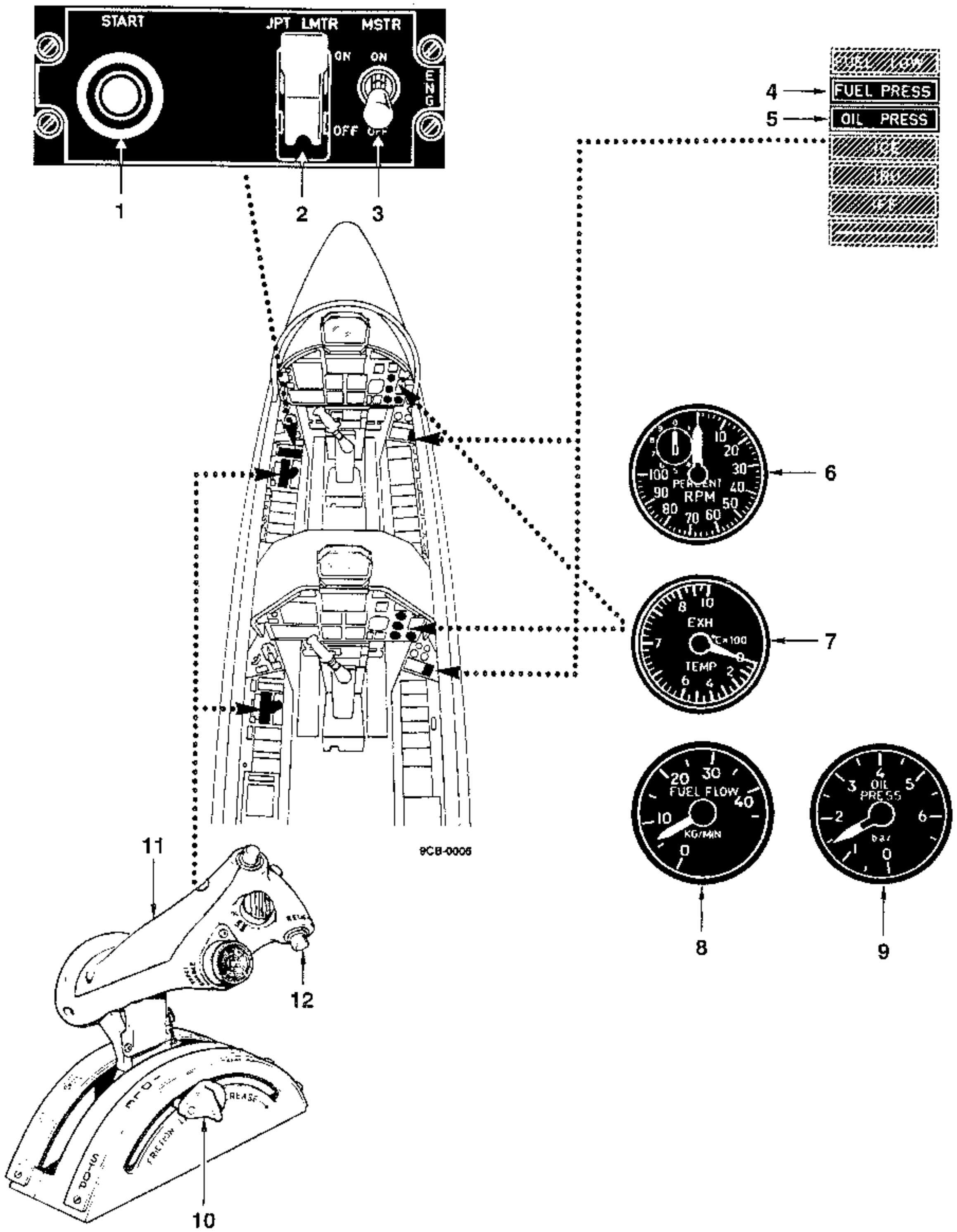


Figure 1-12 (Sheet 1 of 3)

ENGINE CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "ENG START" push-button	Pressed - Commences the engine starting cycle.
2. "ENG JPT LMTR" switch	ON (guard down) - Prevents max JPT (756 °C) from being exceeded by energizing the JPT limiter amplifier. OFF (guard up) - Disconnects the Electro Pressure Control (EPC) unit. The jet pipe temperature could exceed the maximum value if not controlled by the pilot.
3. "ENG MSTR" switch	ON - Energizes the ignition/starting circuits and the booster pump. OFF - De-energized position.
4. "FUEL PRESS" caution light	Illuminated - Indicates that the fuel pressure at the engine pump inlet has dropped below the minimum permissible value (0.2 bar).
5. OIL PRESS" caution light	Illuminated - Indicates that pressure at the engine oil pump outlet has dropped below the minimum permissible value (0.4 bar).
6. Tachometer ("PERCENT RPM")	Indicates engine rpm in percentage of the maximum nominal speed.
7. Jet pipe temperature indicator ("EXH TEMP")	Indicates the exhaust gas temperature in degrees Celsius.
8. Fuel flow indicator ("FUEL FLOW")	Indicates the rate of flow in kilograms/minute.
9. Engine oil pressure indicator ("OIL PRESS")	Indicates the oil pressure (in bars) at the pump outlet
10. Friction lever (front throttle only)	Moved forward - Increases the friction of both engine throttle levers.

Figure 1-12 (Sheet 2)

ENGINE CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
11. Engine throttle	STOP - Closes the HP fuel cock thus preventing fuel supply to the engine. IDLE - Selects the engine idle rpm. **NOTE** The upward rotation of throttle grip permits the engine throttle to be retarded from IDLE to STOP. FULL - Selects the engine maximum rpm.
12. "RELIGHT" push-button	Pressed - Activates the in-flight relighting system for as long as it is depressed.

Figure 1-12 (Sheet 3)

The fire and overheat detection system is powered from the essential bus, and is set into operation when the "BATT" switch is moved to ON. The fire and overheat warning system indicators are described and illustrated in figure 1-13.

ENGINE LIFE RECORDER (ELR)

The aircraft is equipped with a recording unit that records the expended engine life to monitor the engine operability with respect to the scheduled maintenance requirements. The ELR records the expended creep life of the turbine blades, the rotating parts low cycle fatigue arising from engine speed changes, the engine hours, JPT peaks and rpm peaks. The unit is connected to the jet pipe temperature probe and engine tachometer.

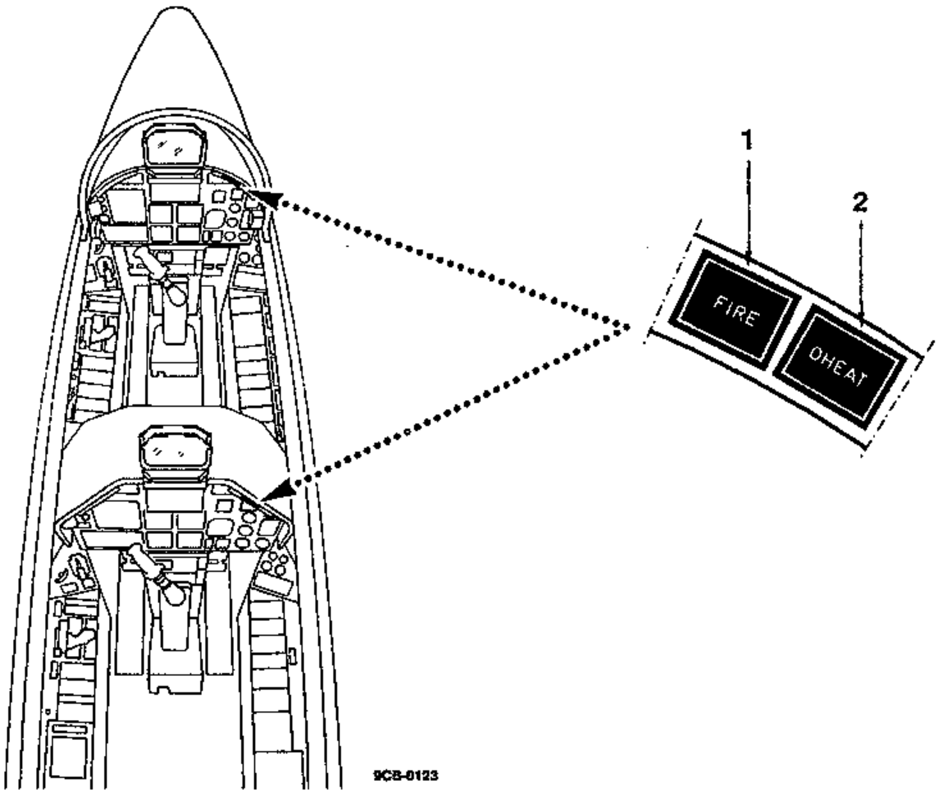
FUEL SYSTEM

Fuel is contained (Figures 1-14 and 1-15) in the two cells of the main fuselage tank and in the two tip tanks. Two jettisonable 325 l underwing pylon tanks can be fitted at pylons 2 and 5. Fuel tank capacities and locations are shown in figure 1-15. The types of fuel and the refueling points are specified in figure 1-87 (Sheet 1). All fuel tanks in the aircraft, except the underwing pylon tanks, can be filled by single-point pressure refueling. Each tank can however be refueled by gravity through its filler neck.

FUEL SUPPLY SYSTEM

Fuel under pressure is supplied from the fuselage tank to the engine. An inverted flight sump, containing the booster pump, is located at the bottom of the fuselage tank and contains sufficient fuel for the aircraft to fly under negative "g" conditions for approx 20 to 23 seconds (engine at max rating). Fuel flows from the inverted flight sump to the booster pump chamber and is forced by the pump into the supply line to the engine driven pump. A fuel shut-off valve is positioned in the supply line and is electrical controled by the "FUEL SHUT OFF" switch. The switch is powered from the 28 V dc essential bus via the "DUMP SHUT OFF" circuit breaker.

FIRE AND OVERHEAT DETECTION AND WARNING SYSTEM INDICATORS



NOMENCLATURE	FUNCTION
1. 'FIRE" warning light	Illuminated - Indicates fire in the forward section of the engine compartment (zone I).
2. "OHEAT" caution light	Illuminated - Indicates an overheat condition or fire in the aft section of the engine compartment (zone II).

Figure 1-13

AIRCRAFT FUEL SYSTEM

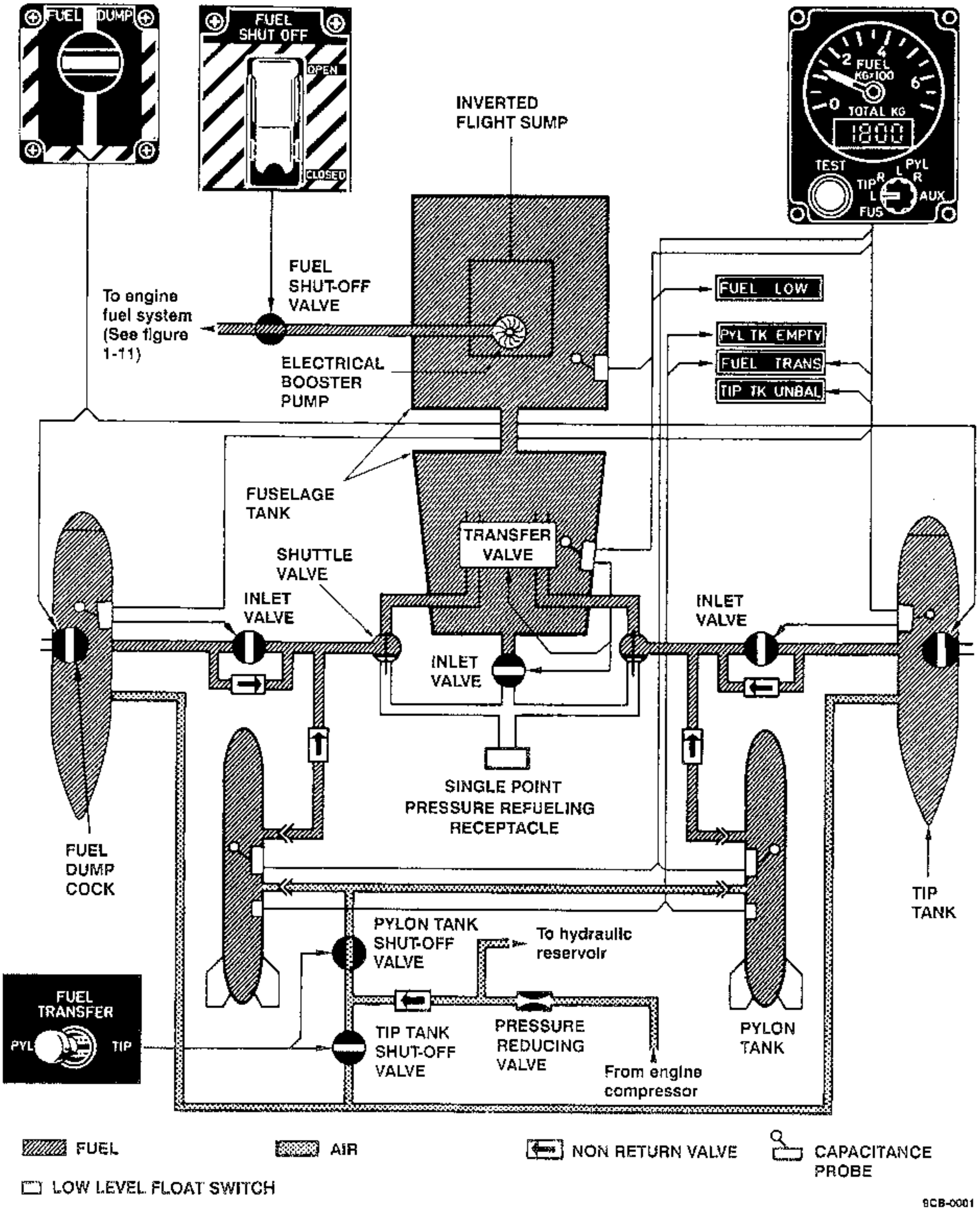
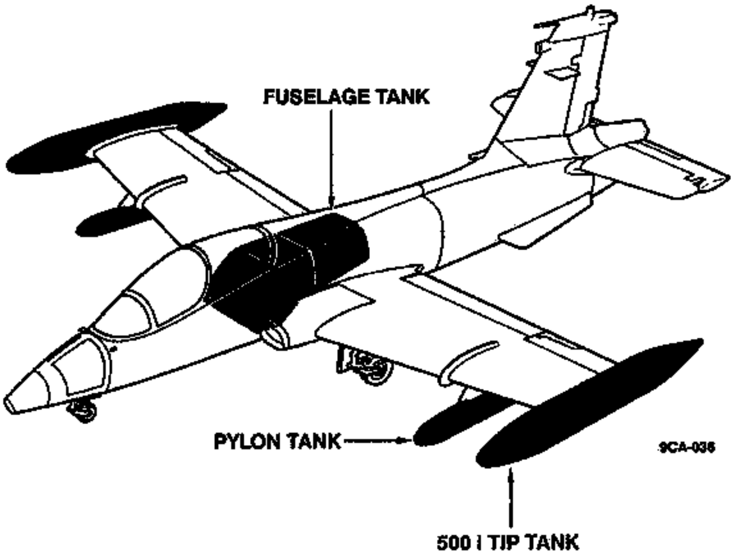


Figure 1-14

FUEL TANKS LOCATION AND USABLE FUEL

NOTE

- These figure are estimates only. The mass of the fuel is based on a fuel density of 0.7835 kg/dm^3.
- Density of F-34 fuel can change from 0.775 to 0.840 kg/dm^3.
- See para "Correct Interpretation of Fuel Quantity Indicator Readings".



TANKS	VOLUME IN LITERS	ACTUAL QUANTITY	
		kg	lb
FUSELAGE TANK	781	612	1356
500 l TIP TANK (2)	1000	783	1728
TOTAL	1781	1395	3077
325 l PYLON TANK (2)	650	509	1122
TOTAL WITH 325 l PYLON TANKS	2431	1905	1493

Figure 1-15

TRANSFER SYSTEM

This system (Figure 1-14) transfers fuel from the tip tanks and the underwing pylon tanks into the main fuselage tank. The compressed air required for operation of the transfer system is bled from the engine compressor 8th stage. Fuel transfer is selected by the pilot through the "FUEL TRANSFER" switch.

TIP TANK QUICK-DUMPING SYSTEM

This system enables the fuel contained in the tip tanks to be dumped under emergency conditions, through a dump cock provided in each tank and controlled by the "FUEL DUMP" knob. Dumping of 3/4 of total fuel tank capacity takes approx 2 minutes and dumping of full tanks takes approx 8 minutes. The electrical power required for operation of the system is supplied from the 28 V dc essential bus via the "FUEL DUMP" circuit breaker.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system measures the total quantity of fuel on board by means of capacitance-type level transmitters provided in each tank. The "FUEL" indicator provides indications of the quantity of fuel contained in the fuselage tanks, in each tip tank according to the selection made through the selector switch mounted on the indicator, as follows:

TIP L - Fuel remaining in left tip tank.

TIP R - Fuel remaining in right tip tank.

FUS - Fuel remaining in fuselage tank.

The total fuel quantity contained in the fuselage and the tip tanks is displayed continuously on the "TOTAL" indicator. A "FUEL TRANS" caution light illuminates to warn the pilot that transfer from the selected tanks into the fuselage tank takes place at a flow rate lower than normal or is interrupted The illumination of the "FUEL TRANS" caution light indicates less than approximately 540 ± 20 kg of fuel (NATO F-34) remaining in the fuselage tank. The light illuminates only if the above conditions are met and the selected tanks still contain fuel. The "TIP TK UNBAL" caution light comes on in the case of an asymmetrical fuel transfer from the tip tanks, when the difference reaches approx 60 kg (132 lb) and stays at this value for longer than 12 seconds. A "FUEL LOW" caution light indicates a fuel low level condition in the fuselage tank through a circuit separate from the fuel quantity indicator circuit. This light illuminates when the quantity of fuel, irrespective of the system indication, drops below 210 ± 15 kg (NATO F-34) as a function of fuel temperature. A "PYL TK EMPTY" caution light comes on when one or both pylon tanks are empty or when the "FUEL TRANSFER" switch is moved to PYL and no pylon tanks are carried.

Correct Interpretation of Fuel Quantity Indicator Readings

The system measures the quantity of fuel contained in the tanks, and the total quantity of fuel, expressed as a mass (kg) and not as a volume. The system indications can however change from time to time as a consequence of the fuel used or the variations of the fuel temperature. JP-8 (NATO F-34) fuel density at 15 °C can vary from 0.775 to 0.840 kg/dm^3 (in accordance with the production specifications). The density of fuel JP-4 (NATO F-40) can vary from 0.751 to 0.802 kg/dm^3. Further variations of density can result from variations of fuel temperature with respect to the reference temperature (15 °C). The fuel density varies at a rate equal to 0.008 kg/dm3 every 10 °C and is inversely proportional to the temperature variations. The system is set to provide indications as a function of a sample fuel with 0.7835 kg/dm3 density. In case of fuel having a density equal to the datum density, the system will provide indications corresponding to the real value of fuel mass contained in the tanks. Conversely, in case of fuel with higher density, the system will provide indications higher than the real values, and viceversa. The tables in figure 1-15 list the system indications for fuel JP-8 (NATO F-34) at datum density. It is necessary to consider that the system indications are also affected by an accidental error of ± 15 kg and 2% of the indication, and that the fuel volume contained in the tanks can vary from the nominal value due to the operating tolerance of the reed switches which control refueling, and the manufacturing tolerances of the tanks.

PRESSURE REFUELING SYSTEM

The fuel system comprises a pressure refueling circuit which enables all tanks, except the underwing pylon tanks, to be filled by single point refueling. The underwing pylon tanks can only be manually refuelled. The pressure refueling receptacle is located on the left side of the fuselage, as is the refueling control panel which indicates when a tank is full through the extinguishment of the associated indicator light. A three-position switch on the panel permits the tip tanks to be filled, half filled or to be cut out from refueling. The refueling points are shown in figure 1-87 (Sheet 1).

FUEL SYSTEM CONTROLS

The fuel system controls and indicators are described and illustrated in figure 1-16.

FUEL SYSTEM OPERATION

When the "ENGINE/MASTER" switch is moved to ON, the booster pump in the fuselage tank forward cell starts operating, and supplies fuel to the engine. After the engine has started, the air bled from the 8th stage of the compressor is directed at regulated pressure into the underwing or tip tanks, depending upon the position of the "FUEL TRANSFER" switch. When the switch is set to PYL the air builds up a pressure in the underwing pylon tanks thus forcing fuel to transfer into the fuselage tank as soon as the level of fuel in this tank decreases below a given level due to engine consumption (590 kg for fuel NATO F-34). A constant reading on the "FUEL QTY" indicator indicates that fuel transfer is taking place normally. When the "PYL TK EMPTY" caution light comes on and the "FUEL QTY" indicator starts reading with decreasing indications, the "FUEL TRANSFER" switch should be moved to TIP. The fuel transfer air then starts pressurizing the tip tanks until all fuel has transferred into the fuselage tank; at this point the air flows from the tip tanks to the fuselage tank to maintain tank pressurization. When the quantity of usable fuel has dropped below 210 kg (for NATO F-34 fuel), the "FUEL LOW" caution light comes on to warn the pilot of the reduced quantity of fuel. The "FUEL LOW" caution light power supply circuit is separate from that of the fuel quantity indicator.

ELECTRICAL POWER SYSTEM

Aircraft electrical power is supplied from a 28 V dc system through two engine-driven generators and two batteries. Alternating current at 115 V and 26 V is furnished by two static inverters. An external power receptacle used to supply the aircraft systems when the engine is not operating, is located on the right side of the fuselage, at the wing trailing edge. The electrical circuits are protected by circuit breakers grouped on six panels, three of which are located in the cockpit (Figure 1-17).

DC GENERATION SYSTEM

The dc generation system (Figure 1-18) consists of a 9 kW generator (which also functions as a starter), connected in parallel to a second 6 kW generator and to two 20 cell, 24 V, 24 Ah nickel cadmium batteries in turn connected in parallel. The second generator starts operating only when the engine speed is above 43% rpm, and furnishes the max power at rated voltage when the engine speed reaches 60% rpm. The dc generation system is controlled by three switches: "BATT", "GEN 1" and "GEN 2". Two loadmeters permit the current flow from the generators to the busses to be checked. When a generator failure occurs, the relevant caution light illuminates ("NO 1 DC GEN" or "NO 2 DC GEN"). Dc power distribution to the various aircraft systems is effected through six busses: the essential bus, the primary bus, the secondary bus, the anti-ice bus, the gun arm bus and the battery bus. With the engine anti-ice system on, the anti-ice bus sustains the high load of the resistors heating the air intake lips. With the engine shut-down (hence with the two generators inoperative) and the aircraft weight on wheels, power to both the essential and primary busses is supplied from the aircraft batteries when the "BATT" switch is at ON. The secondary bus can be connected by moving the "SEC BUS RESET" switch to ON, butthis is not required when an external power source is used. When both generators are disconnected, the "BATT"

FUEL SYSTEM CONTROLS AND INDICATORS

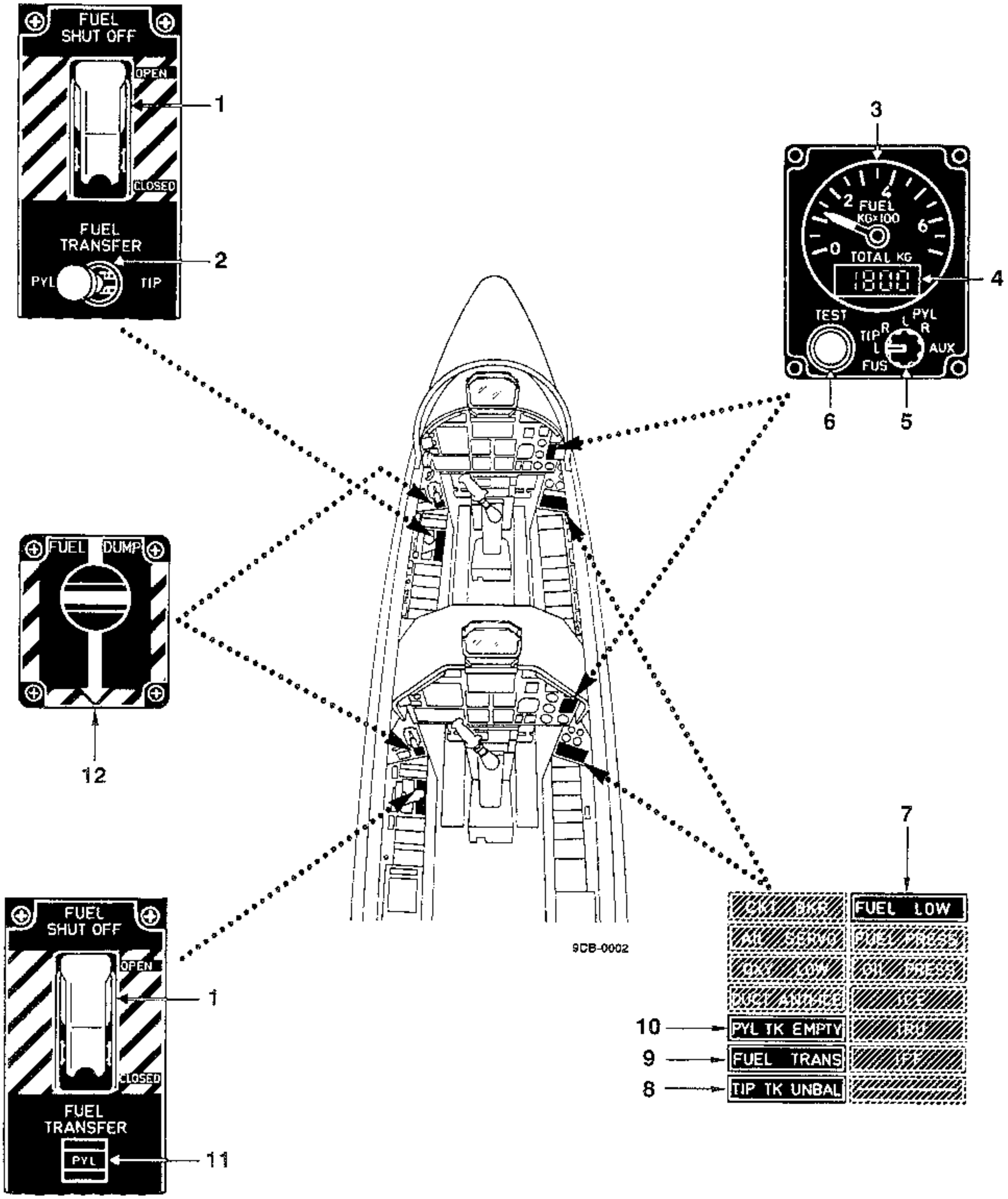


Figure 1-16 (Sheet 1 of 3)

FUEL SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "FUEL SHUT-OFF" switch	OPEN (guard down) - The low pressure fuel shut-off valve is open. CLOSED (guard up) - In an emergency, closes the shut-off valve on the supply line to the engine at the fuselage tank outlet.
2. "FUEL TRANSFER" switch	PYL - Allows fuel transfer from the underwing pylon tanks to the fuselage tank. TIP - Allows fuel transfer from the tip tanks to the fuselage tank. To pass from the PYL to the TIP position, the switch toggle must first be pulled and then moved to the new position.
3. "FUEL QTY" indicator	Provides indication in kg of the fuel contained in the tanks according to the position of the fuel quantity indicator selector.
4. "TOTAL" indicator	Indicates the total quantity of fuel on board.
5. Fuel quantity indicator selector	FUS - The indicator indicates the quantity of fuel contained in the fuselage tank. TIP L - The indicator indicates the quantity of fuel contained in the left tip tank. TIP R - Inoperative. PYL L - Inoperative. PYL R - The indicator indicates the quantity of fuel contained in the right pylon tank. AUX - Inoperative.
6. "TEST" push-button	Pressed - The indicator pointer moves to zero to indicate that the fuel quantity indicating system is serviceable; in this case, the digital indicator must read zero.
7. "FUEL LOW" caution light	On - Indicates that the quantity of fuel in the fuselage tank is less than 210 15 kg (NATO F-34 fuel).

Figure 1-16 (Sheet 2)

FUEL SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "TIP TANK UNBAL" caution light	On - Indicates that fuel transfer has taken place lightirregularly, and a fuel quantity imbalance of more than 60 kg is present in the tip tanks.
9. "FUEL TRANS" caution light	On - Indicates that fuel transfer from the selected tanks to the fuselage tank is below the normal rate or interrupted. The indication corresponds to a quantity of fuel in the fuselage tank of less than 540 ± 20 kg (NATO F-34).
10. "PYL TK EMPTY" caution light	On - Indicates that one or both underwing pylon tanks are empty.
11. "FUEL TRANSFER" magnetic indicator	PYL - Indicates that the "FUEL TRANSFER" switch in the front cockpit is at PYL. TIP - Indicates that the "FUEL TRANSFER" switch in the front cockpit is at TIP.
12. "FUEL DUMP" knob	Rotated 90° clockwise (white line vertical) - Permits quick dumping of the fuel contained in the tip tanks. White line horizontal - Rest position.

Figure 1-16 (Sheet 3)

switch can be moved to the EMERG position which cuts out the primary bus and allows the batteries to supply the essential bus only. The two batteries are capable of supplying the services necessary for flight for 41 minutes (100% battery state-of-charge in day flight conditions) in case of failure of both generators or of engine flameout. To supply the other busses (except for the anti-ice bus which requires operation of both generators), the "SEC BUS RESET" switch must be operated. Battery caution lights ("NO 1 BATT" or "NO 2 BATT") are provided to indicate a battery is at fault or has been disconnected. The aircraft batteries are fitted with temperature sensors. When the sensors detect temperatures higher than 66°C, they cause the "BATT HOT" caution light to come on. This enables the pilot to disconnect the batteries ("BATT" switch to OFF), and prevent battery damage. The system causes illumination of the "BATT HOT" caution light in the presence of overheating of one or both batteries. Correct system operation is checked during the caution lights TEST phase: the "BATT HOT" caution light comes on only if no malfunction affects the system.

AC GENERATION SYSTEM

Ac generation system (Figure 1-19) is supplied from a circuit which consists essentially of two 800 VA, single-phase static inverters, powered from the 28 V dc essential bus. The supply of ac power is controlled

CIRCUIT BREAKERS PANELS | FRONT COCKPIT

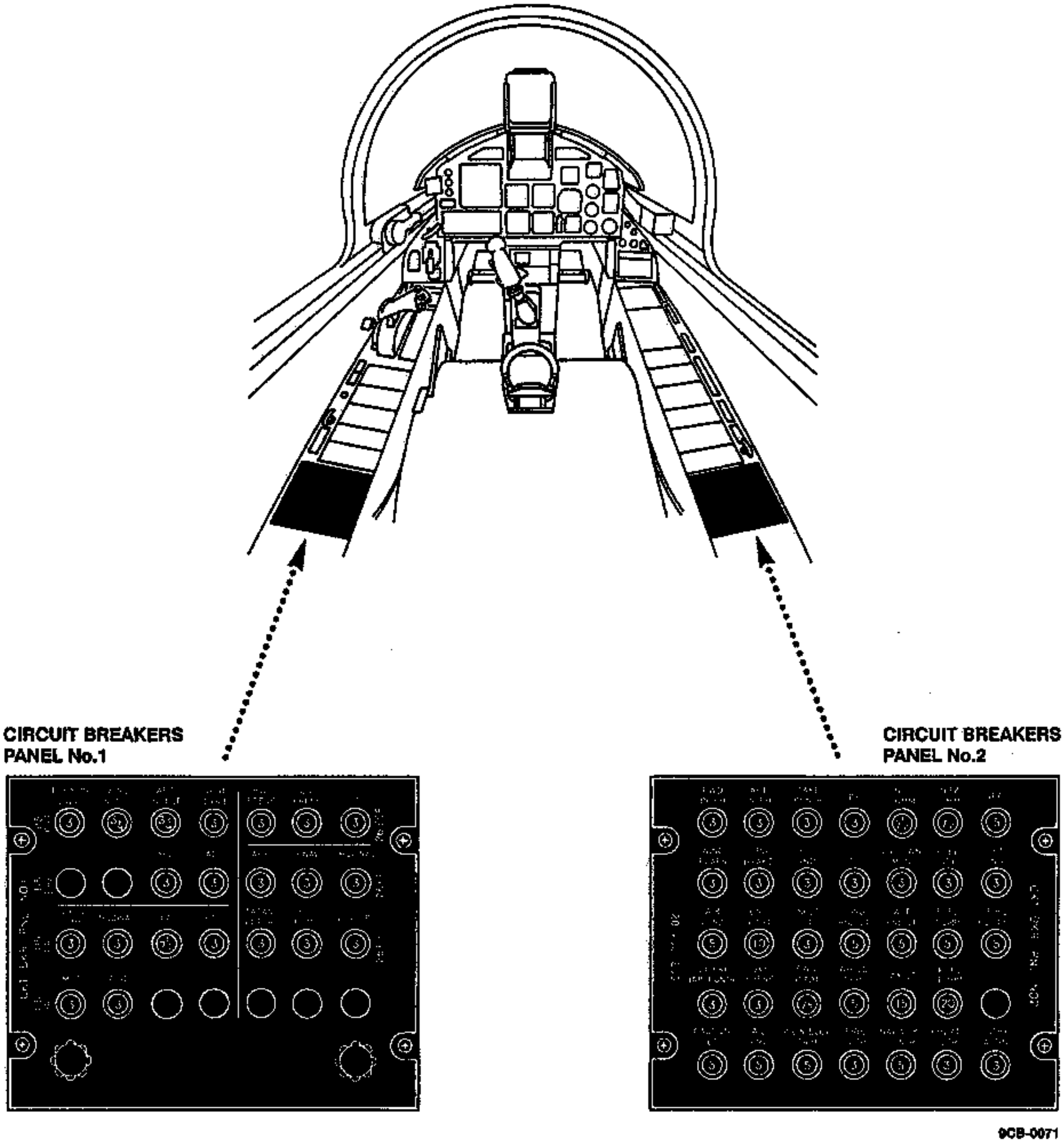


Figure 1-17 (Sheet 1 of 2)

CIRCUIT BREAKERS PANELS | REAR COCKPIT

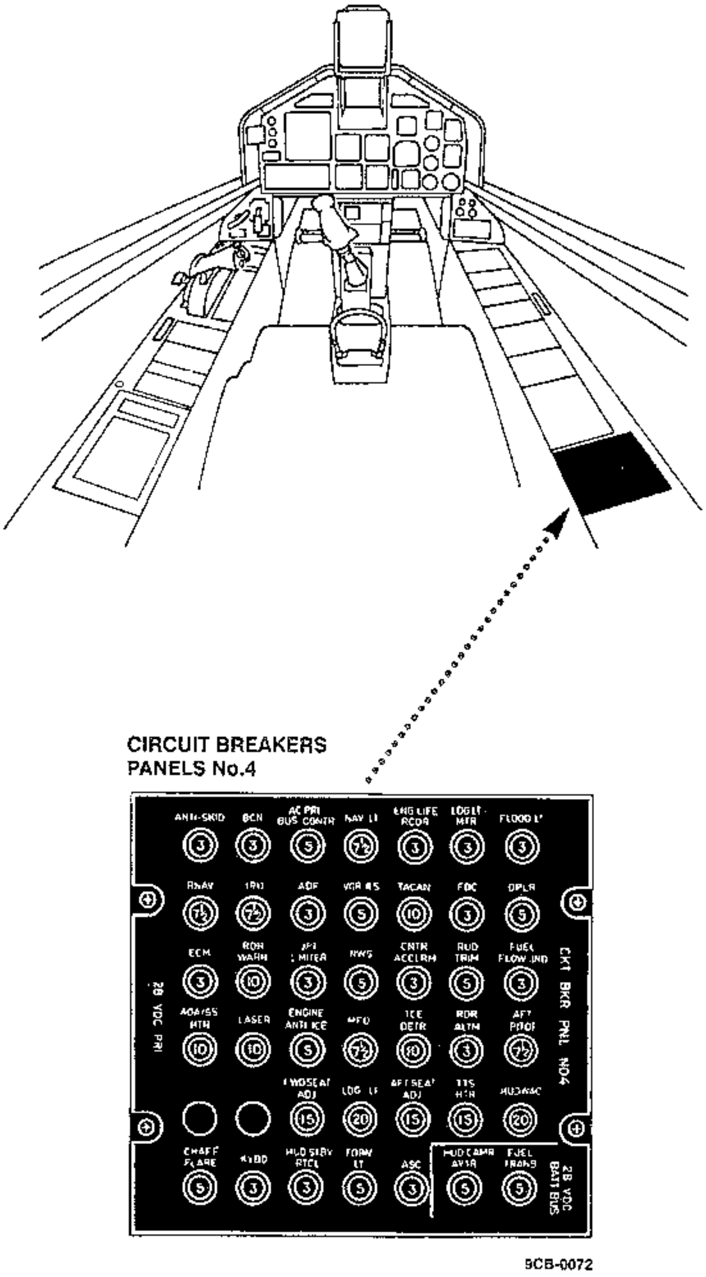


Figure 1-17 (Sheet 2)

DC GENERATION SYSTEM

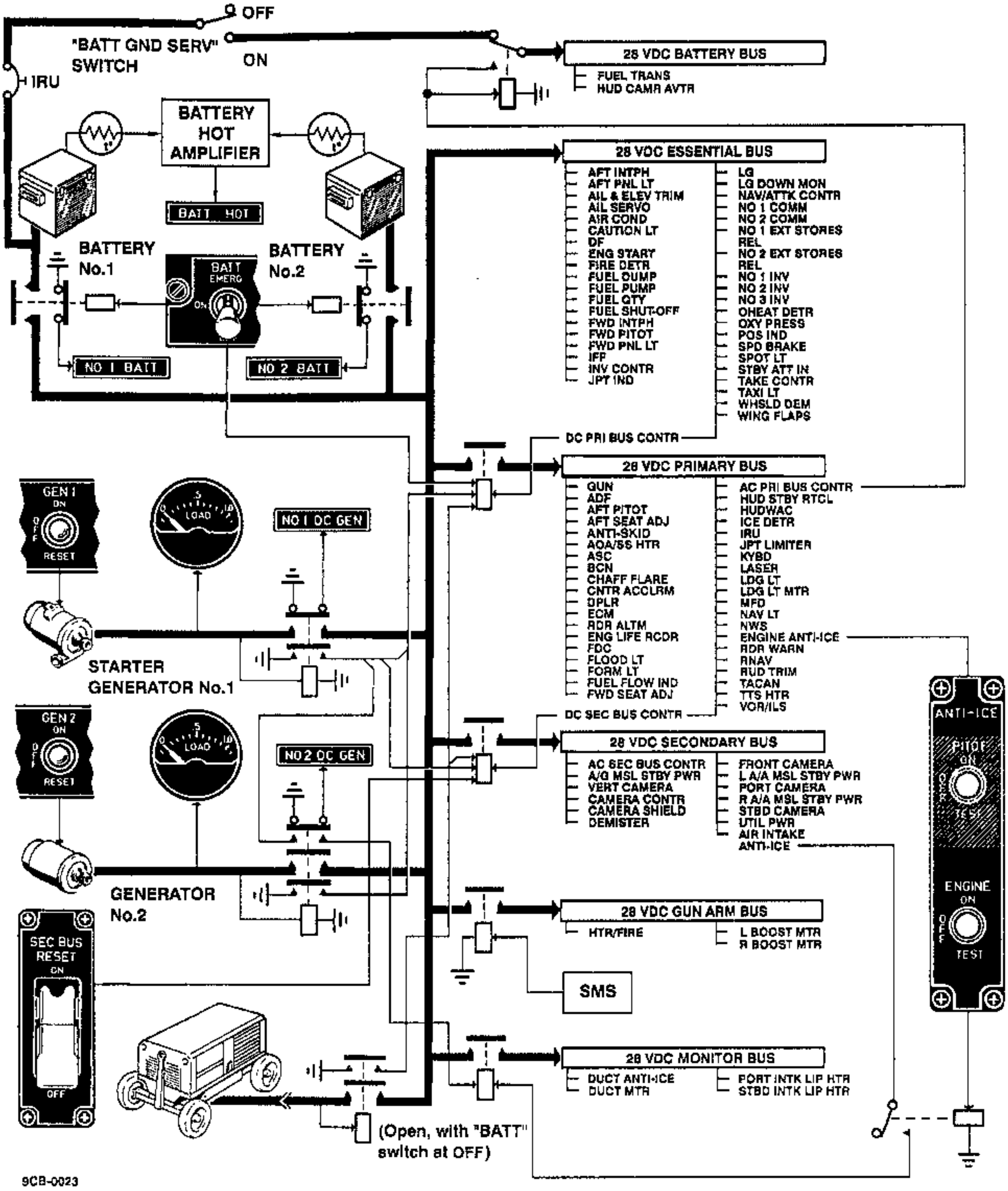


Figure 1-18

AC GENERATION SYSTEM

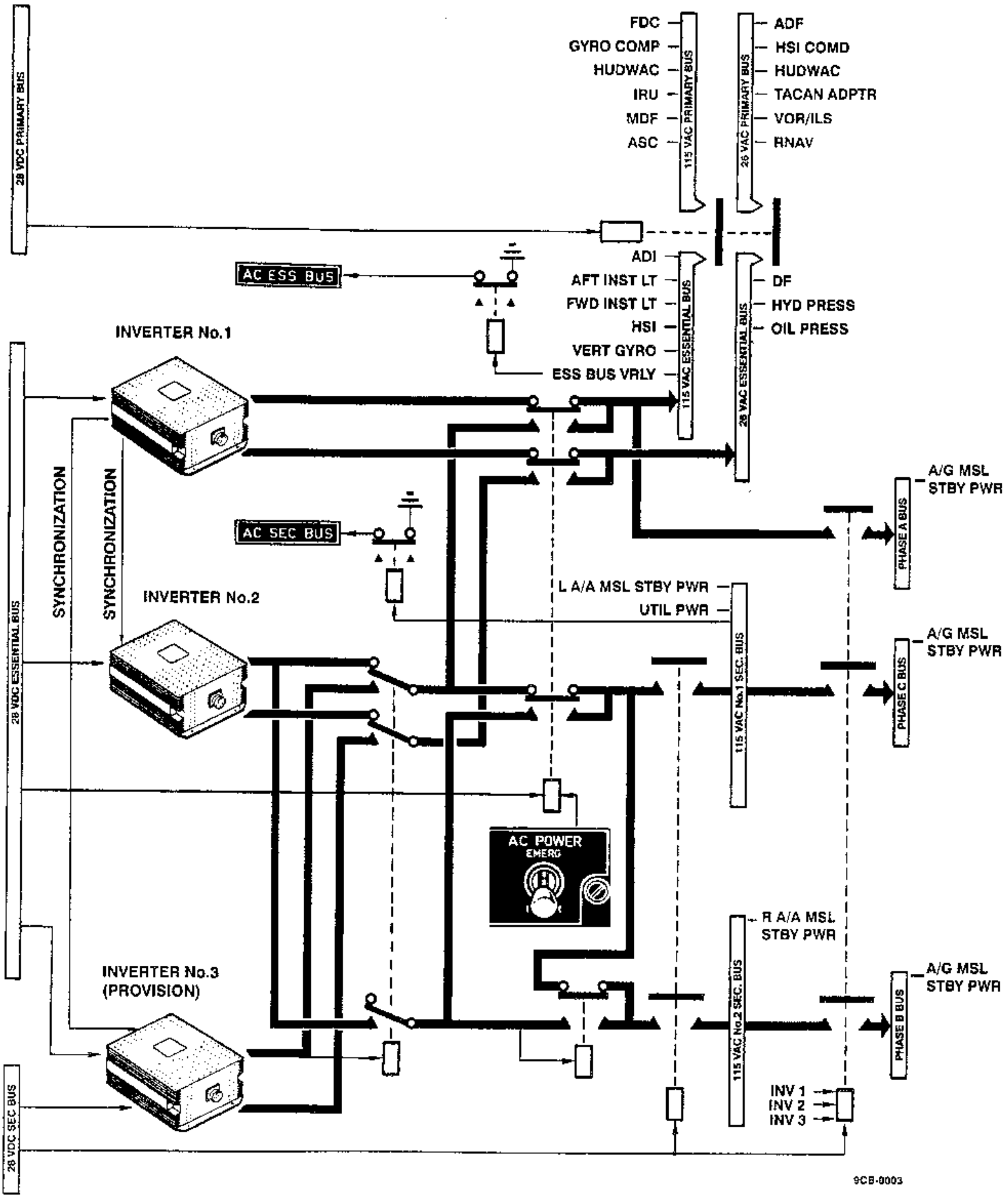


Figure 1-19

by the "AC POWER" switch, and is distributed through four 115 V ac busses and two 26 V ac busses. The four 115 V ac busses are: the essential bus, the primary bus, the No 1 secondary bus and the No 2 secondary bus. The two 26 V dc busses are the essential bus and the primary bus.

ELECTRICAL POWER SYSTEM CONTROLS

The electrical power system controls and indicators are described and illustrated in figure 1-20.

HYDRAULIC POWER SYSTEM

The hydraulic power system (Figure 1-21) operates at a nominal pressure of 176 ± 5 bar and consists of a main system and an emergency system. The main hydraulic power system provides the hydraulic pressure necessary to operate the following circuits: landing gear, wheel brakes, nosewheel steering, wing flaps, speedbrake and aileron servo control. The main supply system consists of a fluid reservoir, an engine-driven variable-flow hydraulic pump, two filters, a relief valve, a pressure accumulator and a zero setting selector valve (for ground operation only). The pressure that builds up in the accumulator from the initial charge pressure of 59 bar (860 psi) during normal operation, provides sufficient power for extension of the landing gear and the wing flaps, for operation of the wheel brakes and the temporary operation of the aileron servo- control in case of hydraulic pump failure. The emergency system provides the hydraulic pressure required for extension of the landing gear in an emergency, and for operation of the emergency brake. This system comprises a solenoid-operated separation valve set to operate at 108 bar, and controlled by a switch located on the left landing gear leg, a pressure accumulator, fitted with a pressure gauge and charged to an initial charge of 59 bar, and a zero setting selector valve (that can be operated on the ground only). Both the main and the emergency systems are fitted with a pressure indicating system connected to two pressure gauges labelled "MAIN" and "EMER" and located on the two instrument panels.

OPERATION OF HYDRAULIC POWER SYSTEM

When the engine is running, hydraulic fluid is pumped out of the pressurized reservoir by the engine-driven hydraulic pump and discharged into the main supply system. When 108 bar is exceeded, the solenoid-operated separation valve between the main and emergency systems permits fluid to be directed from the main to the emergency system until this is also brought to operating pressure. At this stage both the "MAIN" and "EMER" pressure gauges in the cabin will read the same maximum value, which is the hydraulic pump setting value. The system pressure will be constantly restored as hydraulic loads are applied. The same operating pressure is also available in the two pressure accumulators of the main and emergency systems with a reserve of fluid sufficient to carry out a few maneuvers in the event of hydraulic pump failure. This balance of the pressures in the two systems takes place only when the valve is energized, viz. with the aircraft resting on the wheels. When the aircraft is airborne, the main gear strut extension de-energizes the solenoid operated separation valve which closes and isolates the emergency system from the main system. This precludes the possibility that a failure in either system may jeopardize the operation of the other system, and ensures sufficient pressure and fluid for an emergency extension of the landing gear and emergency braking. When the aircraft is on the ground with its weight on the wheels, the landing gear switch again energizes the separation valve, and the valve opens in one direction only at its setting value. Under this condition, all pressure stored in the accumulator is available in the emergency system to permit brake application by the emergency handle. If, however, pressure should decrease below the valve setting value (because of an excessive number of brake applications or circuit losses), a passage of pressurized fluid will take place from the main to the emergency system to ensure full brake availability.

HYDRAULIC POWER SYSTEM CONTROLS AND INDICATORS

The hydraulic power system controls and indicators are described and illustrated in figure 1-22.

ELECTRICAL POWER SYSTEM CONTROLS AND INDICATORS

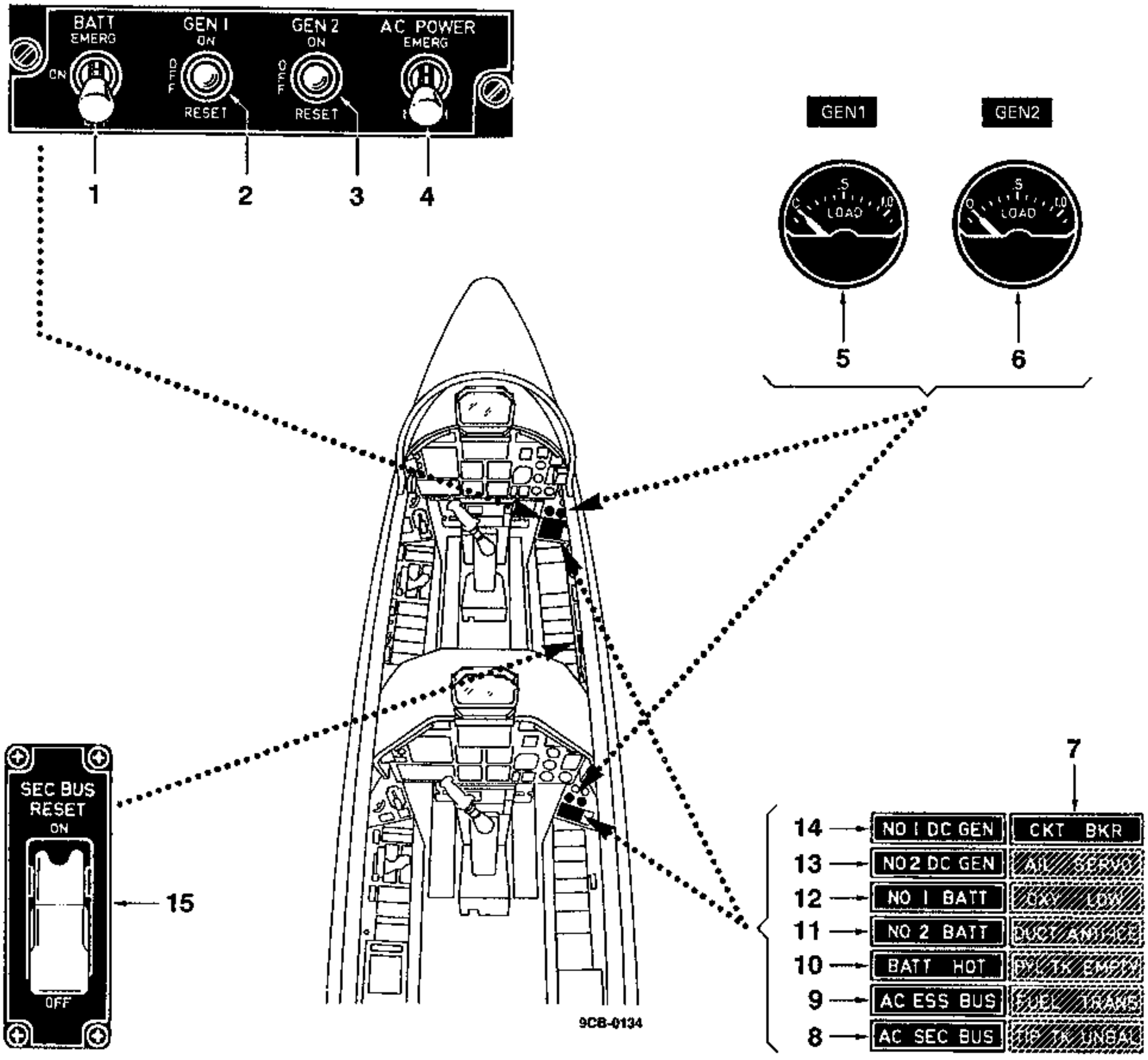


Figure 1-20 (Sheet 1 of 3)

ELECTRICAL POWER SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "BATT" switch	ON - Connects the batteries in parallel to the 28 V dc busses. OFF - De-energized position. EMERG - Connects the batteries in parallel to the 28 V dc essential bus only.
2. "GEN 1" switch	ON - Generator No 1 shunt field circuit is energized and, with the engine running, the generator is enabled to feed power to the dc busses. OFF - Generator No 1 shunt field circuit is de-energized and the generator feeds no power. RESET - Restores the original position of the field control relay incorporated in the dc generator control panel.
3. "GEN 2" switch	ON - Generator No 2 shunt field circuit is energized, with the engine running and rpm above 60%. Generator No 2 is enabled to feed power to the dc busses. OFF - Generator No 2 shunt field circuit is de-energized and the generator feeds no power. RESET - Restores the original position of the field control relay incorporated in the dc generator control panel.
4. "AC POWER" switch	NORM - Connects the two inverters. EMERG - In case of failure of inverter No 1, connects inverter No 2 to the ac primary and essential busses. To pass from one position to the other, the toggle switch must first be pulled and then moved to the new position.
5. "LOAD GEN 1" loadmeter	Provides indication of the aircraft electrical load with respect to the maximum capacity of generator No 1.
6. "LOAD GEN 2" loadmeter	Provides indication of the aircraft electrical load with respect to the maximum capacity of generator No 2.
7. "CKT BKR" caution light	Illuminate - Indicates that a cockpit circuit breaker, of less than 10 A, has tripped disconnecting the associated electrical circuit.

Figure 1-20 (Sheet 2)

ELECTRICAL POWER SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "AC SEC BUS" caution light	Illuminated - Indicates that the ac secondary bus is disconnected.
9. "AC ESS BUS" caution	Illuminated - Indicates that the ac primary and light essential busses are not powered.
10. "BATT HOT" caution light	Illuminated - Indicates that one or both batteries are overheated.
11. "NO 2 BATT" caution light	Illuminated - Indicates that battery No 2 is at fault or disconnected.
12. "NO 1 BATT" caution light	Illuminated - Indicates that battery No 1 is at fault or disconnected.
13. "NO 2 DC GEN" caution light	Illuminated - Indicates that generator No 2 is at fault or disconnected.
14. "NO 1 DC GEN" caution light	Illuminated - Indicates that generator No 1 is at fault or disconnected.
15. "SEC BUS RESET" switch	ON (guard up) - Allows the dc and ac secondary bus to be reconnected in case of failure of both generators or in case of failure of generator No 1, provided that the dc primary bus is energized. OFF (guard down) - De-energized position.

Figure 1-20 (Sheet 3)

LANDING GEAR SYSTEM (Figure 1-23)

The landing gear system provides normal extension and retraction of the landing gear and emergency extension of the landing gear. Hydraulic power for operation of the landing gear is supplied by the hydraulic power system through a selector valve which is electrically controlled by the landing gear control lever. Retraction and extension time is approx 5 seconds. The landing gear is held in the retracted position both by hydraulic pressure and by the locking of the doors of the bay in which each single gear is housed. Each landing gear leg is maintained locked in the extended position both by hydraulic pressure and by a mechanical detent incorporated in the actuating cylinder. When the landing gear is extended, the doors return to the closed position. Lowering the landing gear causes partial retraction of the speedbrake, if fully extended, to provide sufficient ground clearance and prevent the speedbrake from

HYDRAULIC POWER SYSTEM

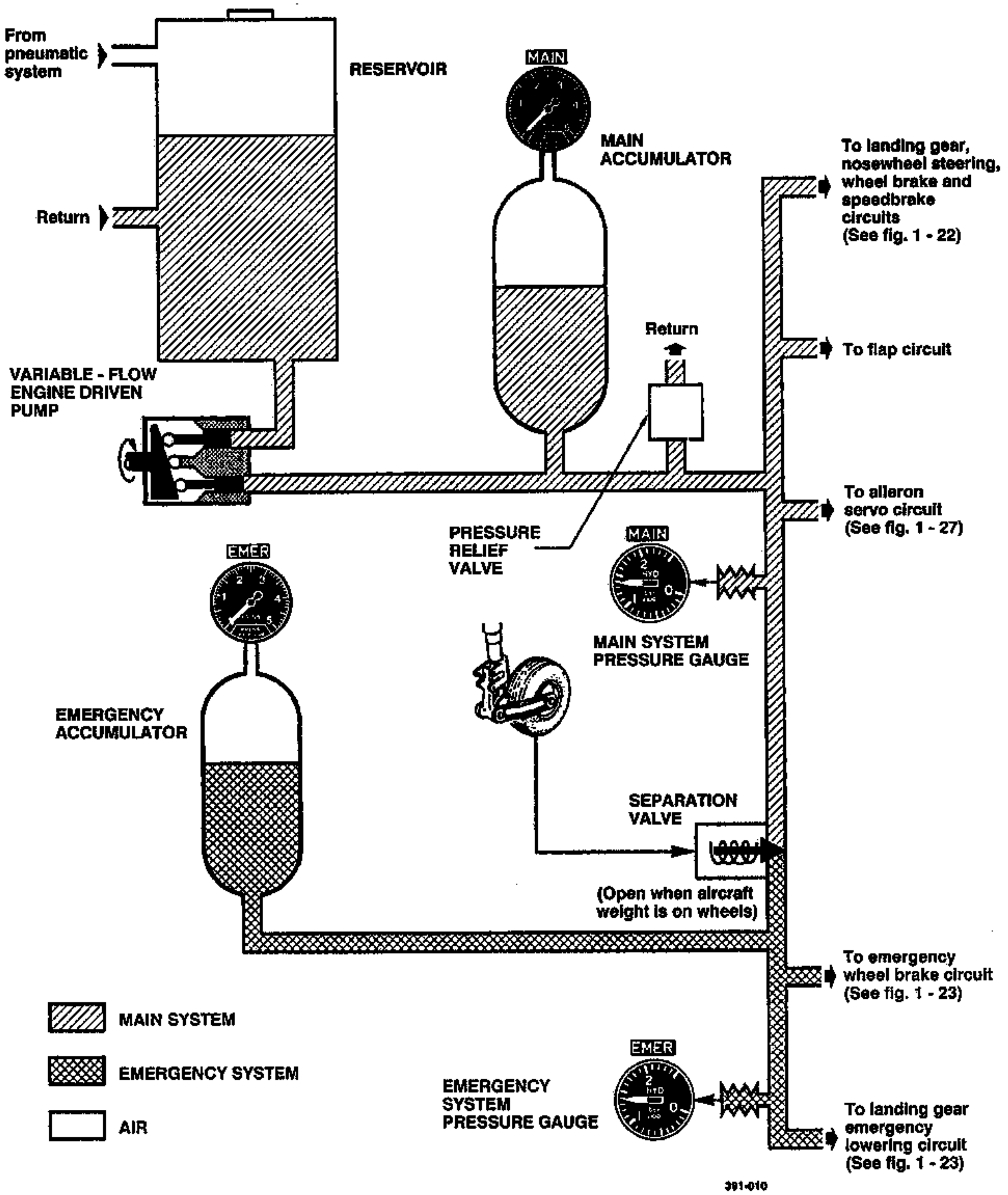
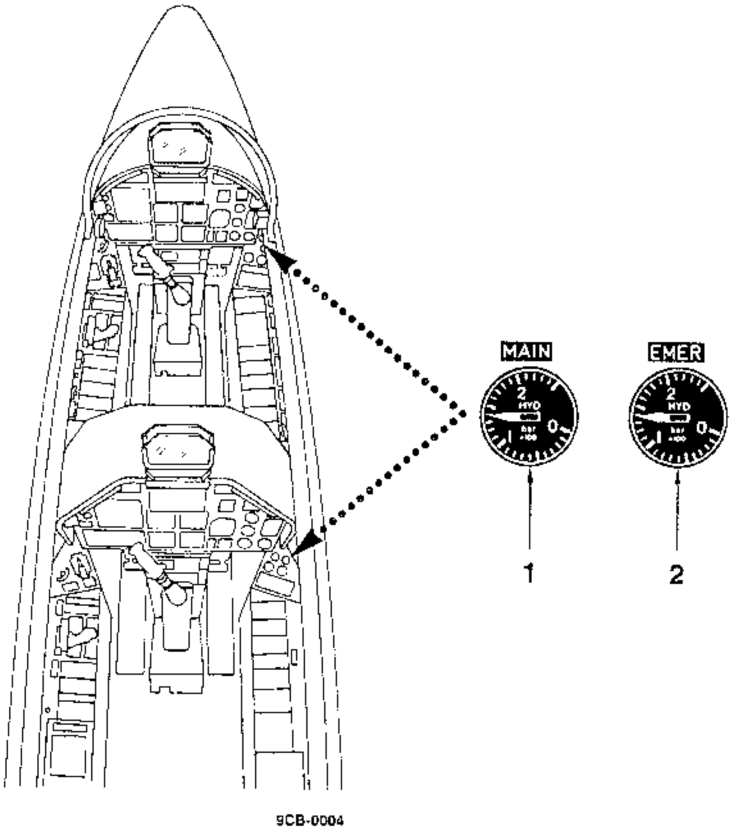


Figure 1-21

HYDRAULIC POWER SYSTEM CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. Main hydraulic system pressure gauge	Indicates the pressure in the main hydraulic system in bar.
2. Auxiliary hydraulic system pressure gauge	Indicates the pressure in the emergency hydraulic system in bar.

Figure 1-22

LANDING GEAR SYSTEM

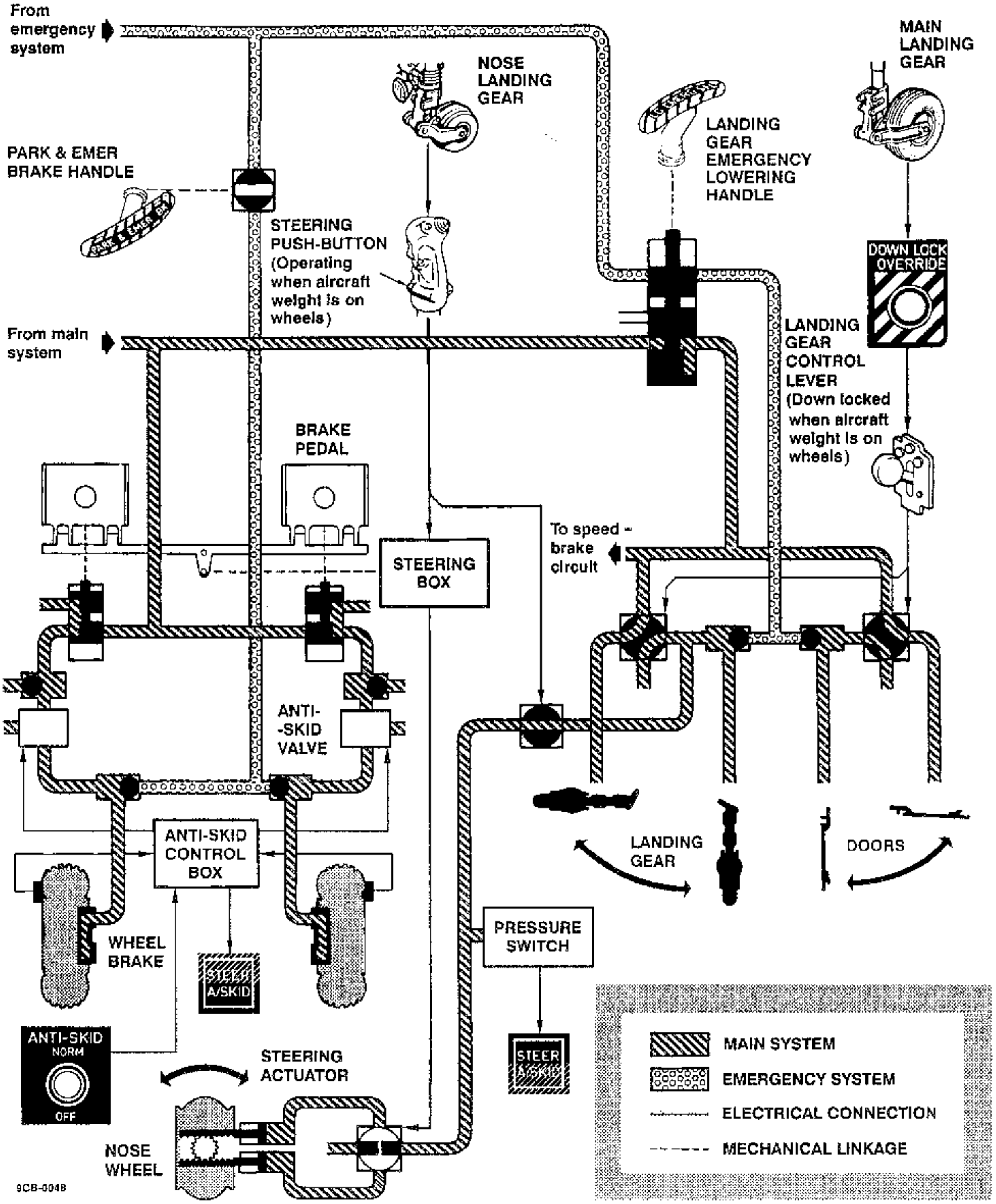


Figure 1-23

hitting the ground on landing. Three green lights, a red light and an audible signal in the headset indicate a safe or an irregular position of the landing gear. A handle is available for the emergency extension of the landing gear, should a hydraulic or electrical malfunction occur in the main system. Retraction of the landing gear on the ground while the aircraft weight is on the wheels is prevented by an automatic device which locks the landing gear control lever in the LG DOWN position. A push-button ("DOWN LOCK OVERRIDE"), however, enables the landing gear control lever to be released for emergency retraction of the landing gear on the ground.

LANDING GEAR INDICATING SYSTEM

Three landing gear position indicator lights, located on the landing gear control panel (Figure 1-24), illuminate with green light to indicate that the landing gear is down and locked. A red warning light incorporated in the landing gear control lever grip illuminates whenever the position of the landing gear is not consistent with the position of the control lever. This light illuminates also when the throttle is retarded to less than 75% RPM if altitude is lower than approx 10 000 ft and speed is approx 165 KIAS, to warn the pilot that the landing gear is not lowered. Concurrent with the illumination of the light in the landing gear control lever grip, an audible warning signal is fed into the headset. This signal can be silenced by means of the "WARNING SILENCE" push-button located on the left of the landing gear control lever. The audible signal is also silenced by advancing the engine throttle lever, but this also causes the warning light to go out. Electrical power for the operation of the landing gear position indicator lights, warning light and audible warning signal is supplied from the 28 V dc essential bus. The landing gear indicating system also provides a gear-down signal through a pilot-activated push-button located on the throttle grip. When the landing gear is down and locked, pressing this push-button feeds a two-tone audio signal in the radio transmission. This signal is heard both by the pilot and the air- traffic controller.

LANDING GEAR EMERGENCY EXTENSION

The "LG EMERG SEL" handle provides an emergency means of extending the landing gear in case an electrical or hydraulic failure should prevent the use of the main system. When this handle (Figure 1-24) is pulled, a separate circuit, fed from the emergency hydraulic accumulator, operates the doors and landing gear actuators until the landing gear is locked in the down position. In this case, the doors remain open. Actuation of the handle also sets pressure in the speedbrake circuit to zero, thus causing the speedbrake, if extended, to retract by aerodynamic effect.

WHEEL BRAKES

The wheel brake control circuit is connected to and supplied by the main hydraulic system (Figure 1-23). It consists essentially of two pairs of sensitive selector valves connected to the rudder pedals and two braking units of the multiple disc type fitted to the wheels of the main landing gear. In case of failure of the hydraulic pump, application of the brakes is possible by use of the hydraulic pressure stored in the main accumulator. If no pressure is available in the main system, the brakes can still be operated using the pressure stored in the emergency accumulator. In this case, however, the brakes are not applied by means of the pedals but by operation of the "PARK & EMER BK" handle in the front cockpit or of the "EMERGENCY BRAKE" handle in the rear cockpit (Figure 1-25). No differential braking is possible since the hydraulic pressure acts concurrently and equally on both brakes.

ANTI-SKID SYSTEM

The HYDRO AIRE anti-skid system is designed to modulate the hydraulic pressure delivered to the brakes. This ensures that maximum friction between the wheels and the runway is obtained for all aircraft configurations, runway conditions and pressure on the pedals. Wheel locking is also prevented. An "ANTI-SKID" switch on the left console in each cockpit provides for system engagement/disengagement. Operation of the system is also conditional upon the position of the landing gear and the aircraft speed. A microswitch on the landing gear leg engages the system only when the aircraft is on the ground. A centrifugal unit disengages the system when the aircraft speed is below 10 kt (parking speed). The "A/SKID" advisory light below the right glareshield, remains off to indicate system engagement ("ANTI-SKID" switch at NORM), and illuminates to indicate system failure or disengagement ("ANTI-SKID" switch at OFF).

NORMAL BRAKE OPERATION

Normal braking is obtained by depressing the brake pedals. Differential braking may be used (when the nosewheel steering is not engaged), to mantain the desired aircraft ground track.

STEERING SYSTEM

The steering system (Figure 1-23) is electrically controlled and hydraulically operated by the main hydraulic system. It provides directional control of the aircraft during ground operation within a 56-degree steering angle to the left and right. Pressing the push-button on the control stick grip engages the nosewheel steering. Engagement is indicated by the illumination of the "STEER" advisory light below the right glareshield, and the nosewheel can thus be controlled by the movement of the rudder pedals. The steering system is disengaged by pressing the steering button again. The steering system is available for operation only when the aircraft weight is on the wheels (the associated microswitch is mounted on the nosewheel leg). The electronic amplifier is energized as soon as the landing gear control lever is moved to the LG DOWN position. If, after this selection, the "STEER" advisory light illuminates, a failure in the system is indicated. The nosewheel may be slaved to the rudder pedals even if the steering system is not engaged and the aircraft is airborne. When the steering system is not engaged, the hydraulic fluid contained in the actuator is used to dampen nosewheel shimmy.

LANDING GEAR SYSTEM CONTROLS

The landing gear, wheel brake, anti-skid, and steering controls, are described and illustrated in figures 1-23, 1-24 and 1-25.

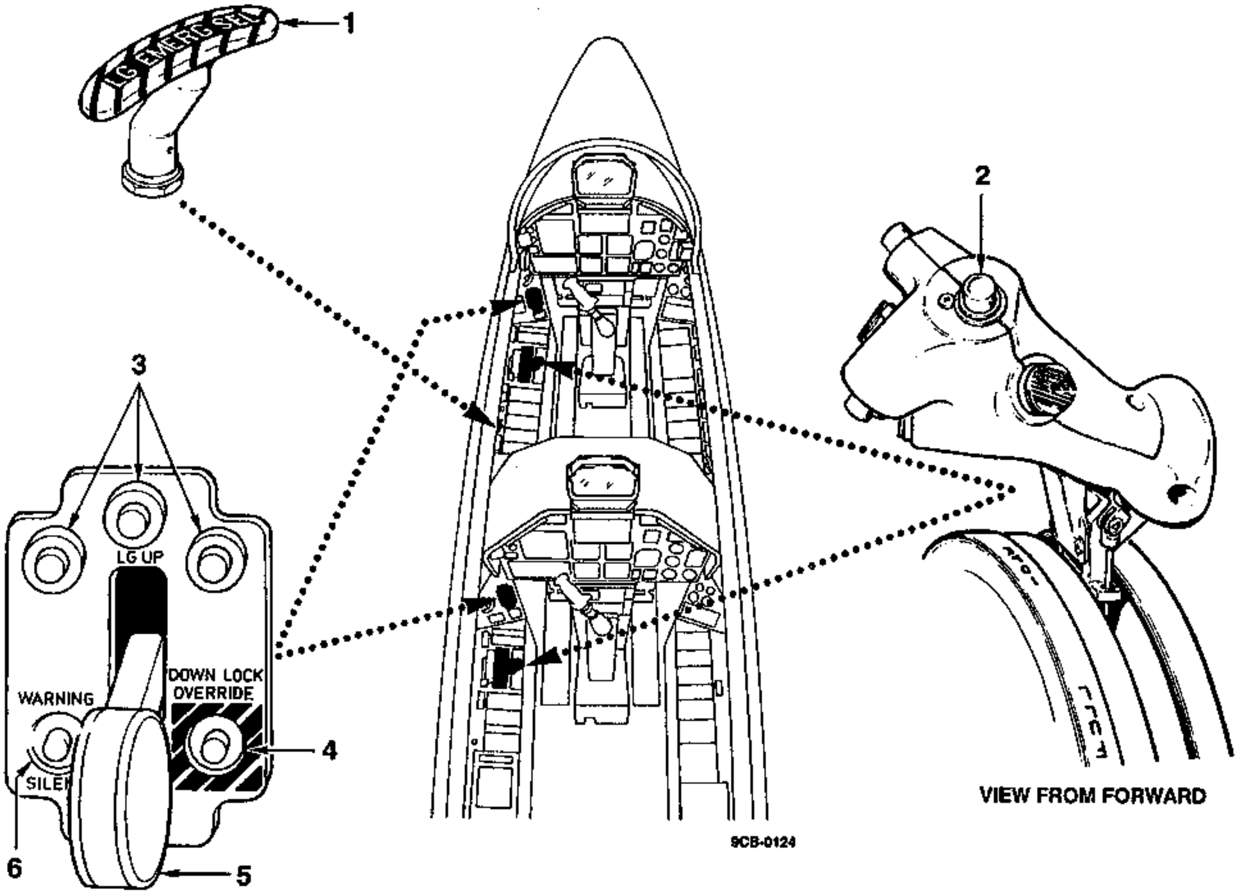
FLIGHT CONTROLS (Figure 1-26)

The primary flight controls (ailerons, elevators and rudder) are moved by rigid push-rods, while the secondary flight controls (trim tabs) are controlled by electro-mechanical control systems. The aileron and elevator control systems consist of two interconnected control sticks; the rudder control system consists of two pairs of interconnected rudder pedals. The aileron control system comprises a servo-control circuit. Aerodynamic balance of the ailerons is obtained by Irving diaphragms and balance tabs mounted in the trailing edge (preset at a 3-degree angle up from neutral). Aerodynamic balance of the elevator is obtained by balance tabs mounted in the trailing edge. The rudder pedals are of the pendulum-type, and can be adjusted forward and aft by means of the "PEDAL ADJ" knob on the instrument panel centerstand.

AILERON SERVO-CONTROL SYSTEM (Figure 1-27)

This system reduces the stick forces required by the pilot for aileeron operation. This is achieved through a servo-control circuit which uses reduced hydraulic pressure from the hydraulic power system. When the stick is deflected laterally, the circuit operates two servo-control actuators connected to the ailerons. A shut-off and pressure reducing valve controlled by the "AIL SERVO" switch, allows disconnection of the servo control and reduction of pressure from the main system pressure of 176 bar to 146 bar for the aileron servo system. The "AIL SERVO" caution light, activated by a pressure transmitter, illuminates when the hydraulic pressure in the servo control circuit drops below 59 bar. The illumination of this caution light is evidence of a low pressure condition in the main system, however hydraulic pressure should be periodically checked on the dedicated pressure gauge. When pressure in the circuit is below 14 bar, aileron servo control automatically disengages and reverts to mechanical. An artificial feel device is

LANDING GEAR CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. "LG EMERG SEL" handle	Pulled out - Causes extension of the landing gear irrespective of the position of the landing gear control lever. NOTE • The main landing gear doors remain open. • The controlled partial retraction of the speedbrake does not take place automatically, but pressure is relieved in the speedbrake circuit and the speedbrake retracts by aerodynamic effect.

Figure 1-24 (Sheet 1 of 2)

LANDING GEAR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
2. Landing gear position	Pressed - Transmits a radio signal to the ground, to indicate that the landing gear is down and locked.
3. Landing gear position indicator lights	Illuminated (green light) - Indicates that the corresponing gear leg is down and locked.
4. "DOWN LOCK OVERRIDE" push-button	Pressed - Unlocks the LG DOWN position of the landing gear control lever when the aircraft weight is on the wheels, and permits landing gear emergency retraction.
5. Landing gear control lever.	LG DOWN - Causes lowering of the landing gear. LG UP - Causes retraction of the landing gear. **CAUTION** When the aircraft weight is on the wheels, an automatic device connected to a safety switch prevents movement of the lever to the LG UP position, thus precluding inadvertent retraction of the landing gear. Grip illuminated - Warns the pilot that the landing gear is not extended or that the landing gear position differs from the lever position. **NOTE** A warning signal sounds in the headset when the throttle is retarded to less than 75% RPM at altitudes below approx 10 000 ft and at airspeeds lower than approx 165 KIAS if the landing gear is up.
6. "WARNING SILENCE" push-button	Pressed - Silences the warning signal in the headset, which warns push-button warns the pilot that the landing gear is not extended.

Figure 1-24 (Sheet 2)

WHELL BRAKES, ANTI-SKID AND NOSEWHEEL STEERING CONTROLS AND INDICATORS

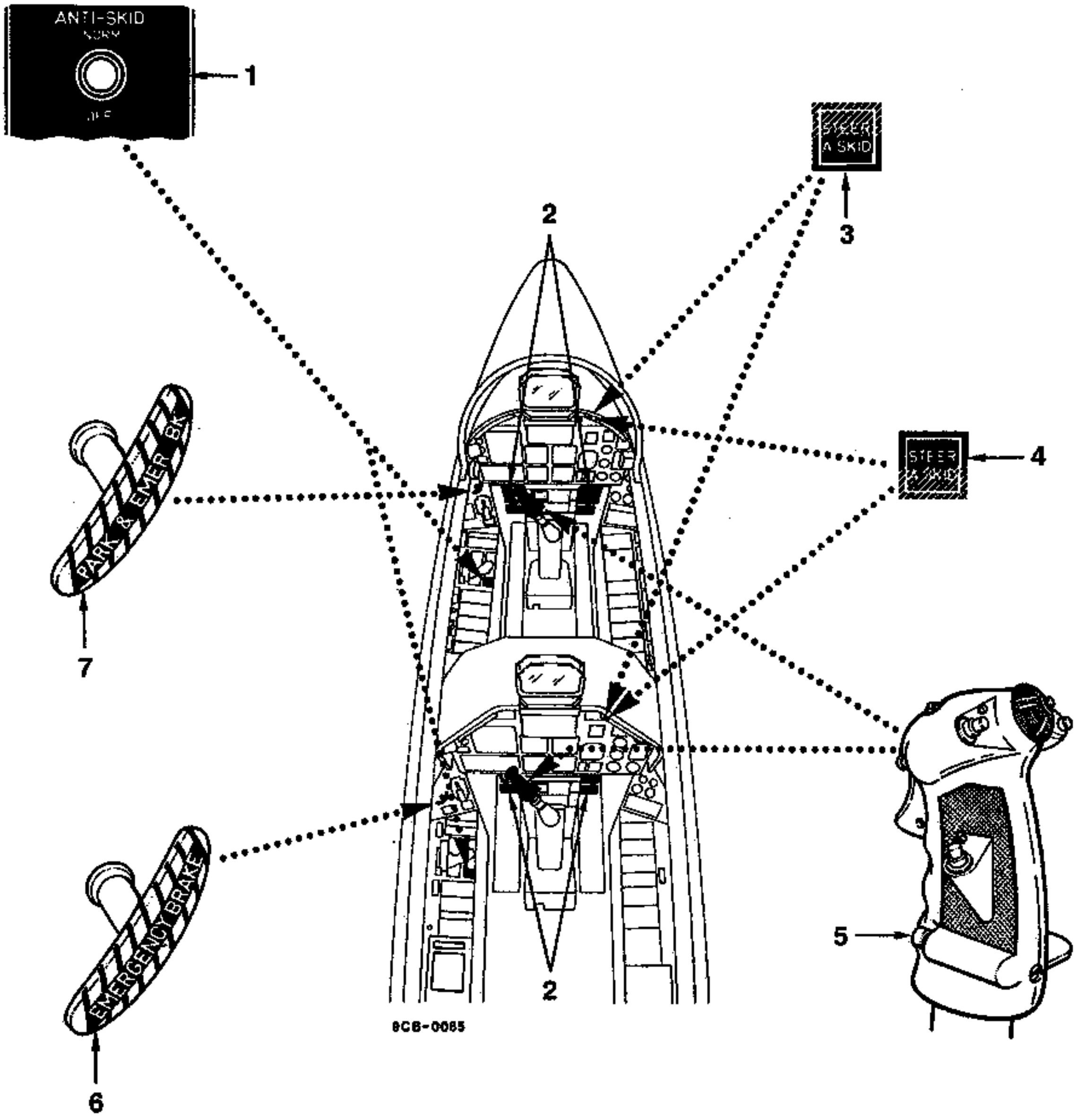


Figure 1-25 (Sheet 1 of 3)

WHEEL BRAKES, ANTI-SKID AND NOSEWHEEL STEERING CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "ANTI-SKID" switch	OFF - The anti-skid system is disengaged. NORM - The anti-skid system is engaged and becomes operative at touch-down.
2. Brake pedals	Pressed - Operate the corresponding wheel brake in proportion to the amount of force applied.
3. "A/SKID" advisory light	Illuminated - The anti-skid system is disengaged light ("ANTI-SKID" switch at OFF), or there is a failure in the system (ANTI-SKID" switch at NORM).
4. "STEER" advisory light	Illuminated - Indicates that the rudder pedals are connected to the nosewheel steering system. **NOTE** When the light illuminates but the pilot has not engaged the steering system, this light indicates that the solenoid-operated selector valve has failed in the open position. Under this condition, the rudder pedals are connected to the steering system irrespective of whether the steering system was engaged by the pilot or not, and the aircraft is airborne or with its weight on the wheels.
5. Steering switch	Pressed - Permits nosewheel steering to be controlled by the rudder pedals until the nosewheel is raised from the ground. **NOTE** In case of failure of the steering system, the nosewheel may be slaved to the rudder pedals when the landing gear control lever is moved to LG DOWN. This condition is indicated by the illumination of the "STEER" light.
6. "EMERGENCY BRAKE" handle	Pulled out - Applies brakes using the emergency circuit hydraulic pressure: the braking action is proportional to the extent the handle is out and is equal on both wheels.

Figure 1-25 (Sheet 2)

WHEEL BRAKES, ANTI-SKID AND NOSEWHEEL STEERING CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
7. "PARK & EMER BK" handle	Pulled out - Applies brakes using the emergency circuit hydraulic pressure: the braking action is proportional to the extent the handle is out and is equal on both wheels. Pulled out and rotated 90° clockwise - Sets the brakes for parking.

Figure 1-25 (Sheet 3)

installed in the aileron control linkage to create stick forces proportional to the aileron deflection. This gives the pilot the feel of lateral control, and returns the aileron control to the center position. An electrical actuator, controlled by the trim switch on the control stick, is connected to the artificial feel device. The actuator changes the neutral point of the artificial feel device and, therefore, corrects the aircraft lateral trim. Lateral trim control is available also with the "AIL SERVO" switch OFF and the ailerons operating in the manual mode. In this case, however, the rate of trimming is greatly reduced, especially at high speeds.

GUST LOCK DEVICE

The elevator and rudder controls can be locked on the ground by means of a device (Figure 1-28) located under the instrument panel. This device consists of a lever hinged at the top, which is normally held in the vertical rest position by a spring and a spring-loaded latch. When locking of flight controls is required, the latch is disengaged and the lever moved out of its rest position and engaged with the locking pin on the control stick base. This operation concurrently locks the elevator control and the rudder pedals as a pin engages in the rudder pedal fulcrum.

TRIM TABS

The trim tabs provide aircraft trimming along the longitudinal, directional and lateral axes. Longitudinal trimming is provided by a trim tab fitted to the left elevator and operated by an electrical actuator. Directional trimming is provided by a trim tab fitted to the rudder and operated by an electrical actuator housed in the vertical stabilizer. Lateral trimming is provided by an electrical actuator connected to a torque bar. Through an auxiliary spring fitted to the torque bar, the actuator displaces the neutral point of the stick, hence of the aileron. Because of the servo- control, the torque bar feeds into the system the artificial feel which enables the pilot to sense the stick forces. The lateral and longitudinal trim control consists of a five-position switch located on the top of the control stick grip. The directional trim control is a center-off position switch located on the left console. Operation of the controls in the rear cockpit overrides the corresponding controls in the front cockpit.

TRIM POSITION INDICATORS

The longitudinal trim circuit incorporates an indicator consisting of a pointer with a side-viewed miniature aircraft and a graduated dial. Consistent with the movement of the elevator tab, the miniature aircraft takes a nose-up or nose-down attitude proportional to the amount of tab displacement. The directional and lateral trim circuits comprise two green neutral position indicator lights. The indication is visible only when the aircraft weight is on wheels, and enables the pilot to make sure, prior to takeoff, that the rudder and elevator tabs are at neutral. After takeoff, the lights of the two indicators extinguish.

PRIMARY AND SECONDARY FLIGHT CONTROLS AND INDICATORS

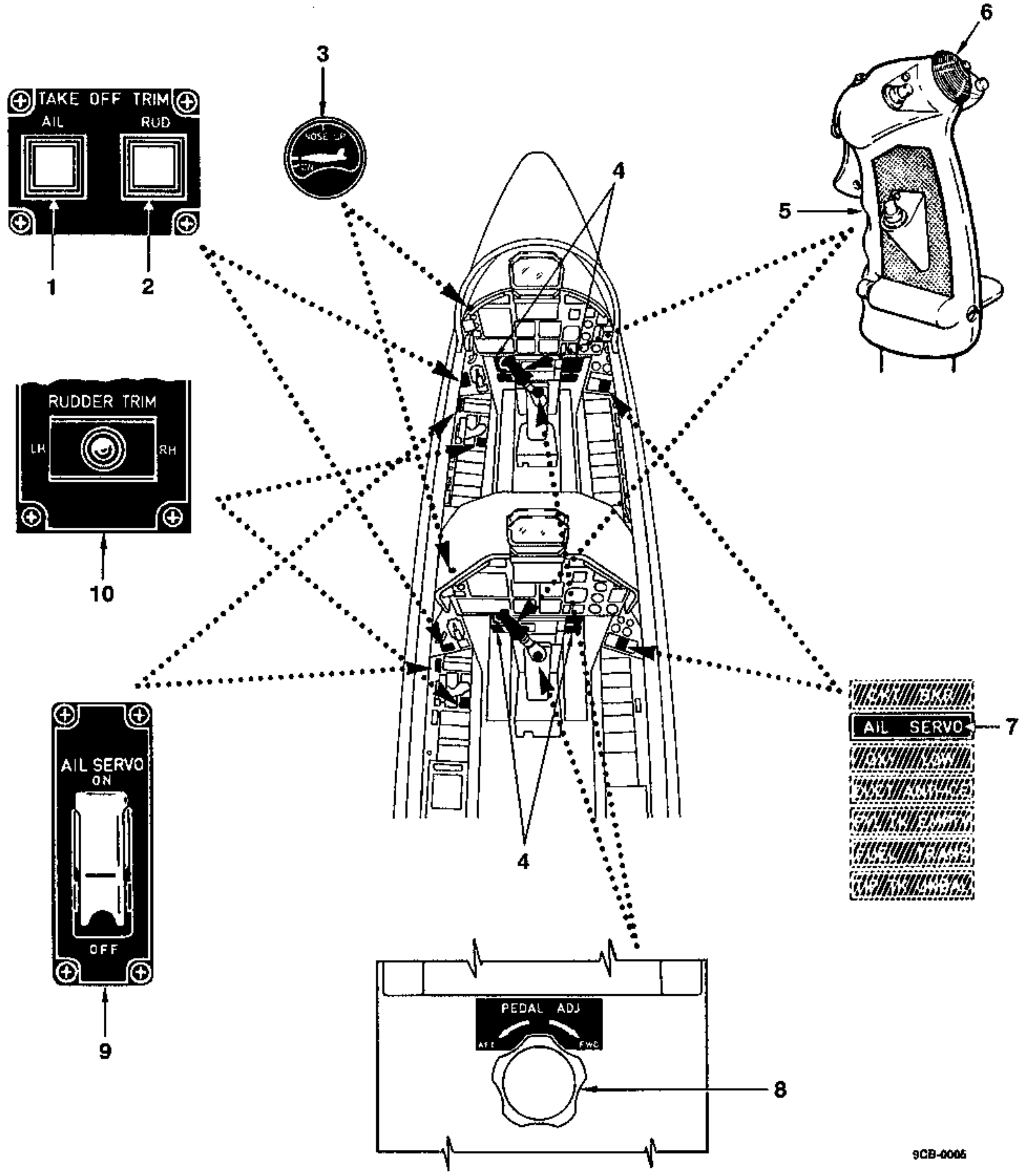


Figure 1-26 (Sheet 1 of 3)

PRIMARY AND SECONDARY FLIGHT CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "TAKE-OFF TRIM-AIL" advisory light	Illuminated - Indicates that the control stick is at neutral (central position). NOTE The light operates only when the aircraft weight is on wheels.
2. "TAKE-OFF TRIM-RUD" advisory light.	Illuminated - Indicates that the rudder trim tab is at neutral. NOTE The light operates only when the aircraft weight is on the wheels.
3. Longitudinal trim indicator	Through the miniature aircraft, indicates the position of the elevator trim tab.
4. Rudder pedals	Moving the pedals deflects the rudder surface.
5. Control stick	When moved, controls aileron and elevator deflections.
6. Trim switch	Moved to right or to left - Displaces the lateral neutral point of the control stick to obtain lateral trimming of the aircraft. Moved forward or aft - Operates the actuator which controls the elevator trim tab to obtain longitudinal trimming of the aircraft. NOTE • The trim switch in the rear cockpit overrides the switch in the front cockpit. • When released, the switch automatically returns to the neutral (center-off) position.
7. "AIL SERVO" caution light	Illuminated - Indicates low, or lack of, pressure in the aileron servo control circuit.

Figure 1-26 (Sheet 2)

PRIMARY AND SECONDARY FLIGHT CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "PEDAL ADJ" knob	Rotated clockwise (to FWD) - Moves the rudder pedals away from the pilot. Rotated counterclockwise (to AFT) - Moves the rudder pedals toward the pilot.
9.. "AIL SERVO" switch	ON (guard down) - The aileron servo control circuit is operative. OFF (guard up) - The aileron servo control circuit is disconnected.
10. "RUDDER TRIM" switch	LH - Momentary position - Connects power to the actuator controlling the trim tab on the rudder to obtain directional trimming of the aircraft to the left. RH - Momentary position - Connects power to the actuator controlling the trim tab on the rudder to obtain directional trimming of the aircraft to the right. **NOTE** • The control located in the rear cockpit overrides the control located in the front cockpit. • When released, the switch automatically returns to the center-off position.

Figure 1-26 (Sheet 3)

WING FLAP CONTROL SYSTEM

The hydraulically-operated and electrically-controlled wing flaps are of the slotted type and extend from the aileron to the fuselage on each wing. The flaps are attached to two gearboxes mounted at the wing trailing edge. A linkage connected to these boxes permits a considerable amount of rearward movementof the wing flaps during lowering. The two wing flaps are interconnected and are actuated by a single actuating cylinder mounted in the fuselage. The wing flaps can be set to one of the three positions corresponding to the positions of the relevant control lever, namely: UP, retracted; T/O, intermediate position for takeoff; DN, extended for landing. The flap electrical circuit is powered from the 28 V dc essential bus.

The flap system controls and indicators are described and illustrated in figure 1-29.

SPEEDBRAKE CONTROL SYSTEM

The hydraulically-operated and electrically-controlled speedbrake is mounted on the lower side of the fuselage and consists of a hinged panel which, when opened, extends down and forward into the air stream. The speedbrake opens and closes in about 2 seconds and can be positioned as desired. When the landing gear is extended, the speedbrake, if down, retracts to the intermediate position to ensure a safe ground clearance on landing. The speedbrake contains a hook for target towing. The speedbrake circuit

AILERON SERVO CONTROL SYSTEM

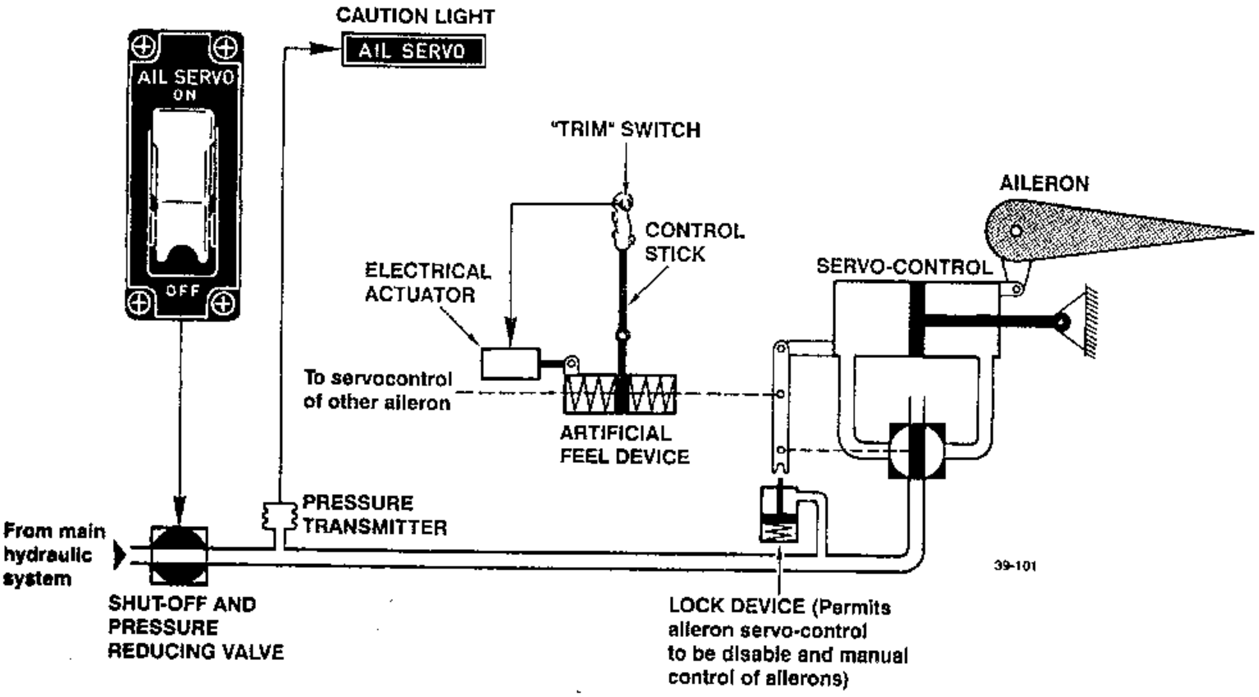


Figure 1-27

is powered from the 28 V dc essential bus. The speedbrake system controls and indicators are described and illustrated in figure 1-29.

ACCESS TO THE CABIN (Figura 1-30)

Three retractable footboards, one for the front pilot and two for the rear pilot, are available on the aircraft left side to permit access to the cabin. When pulled out, each footboard locks automatically in the fully extended, horizontal position. A release footplate on the footboard, when pressed, releases the footboard which springs back automatically.

CANOPY

The cockpits are enclosed by a two-piece, transparent canopy hinged on the right side. The two pieces are joined at the intermediate arch which also incorporates the rear cockpit windshield. The canopy is balanced by a torque tube and a jack, and is operated manually. The jack also provides for canopy open

GUST LOCK DEVICE

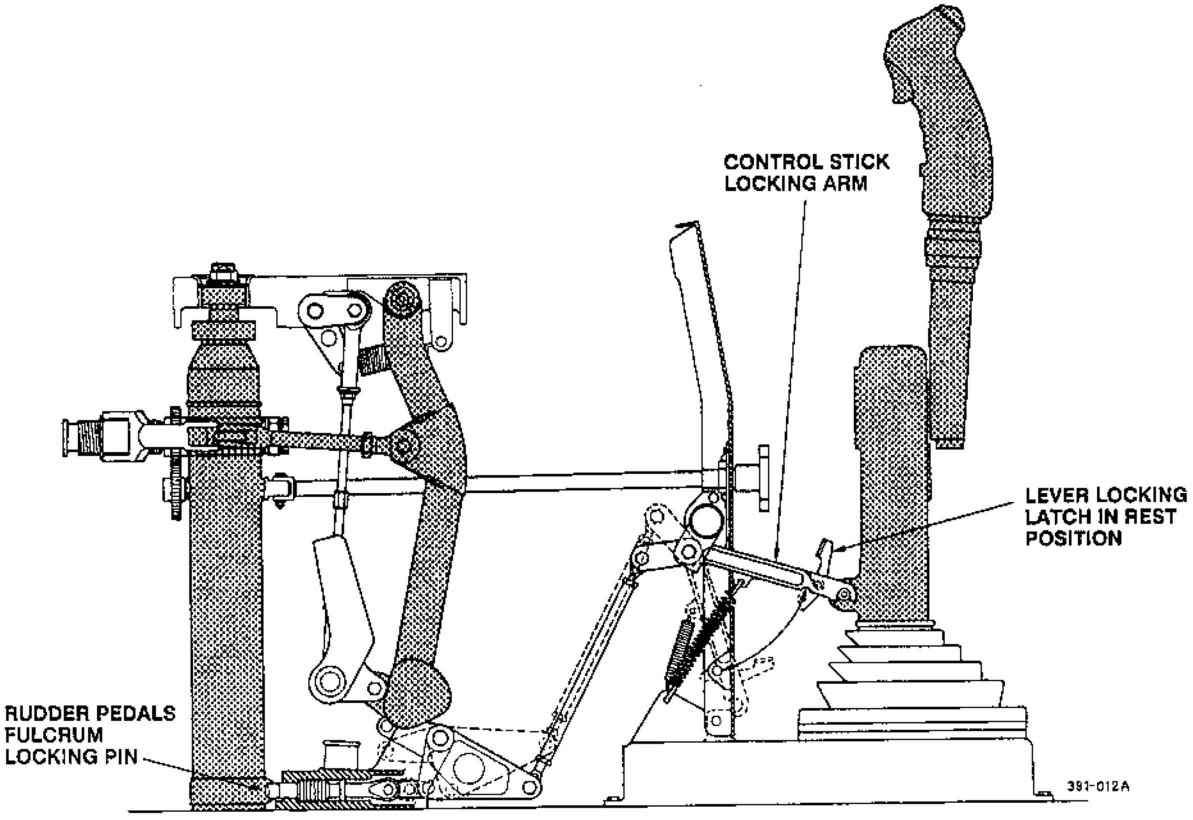


Figure 1-28

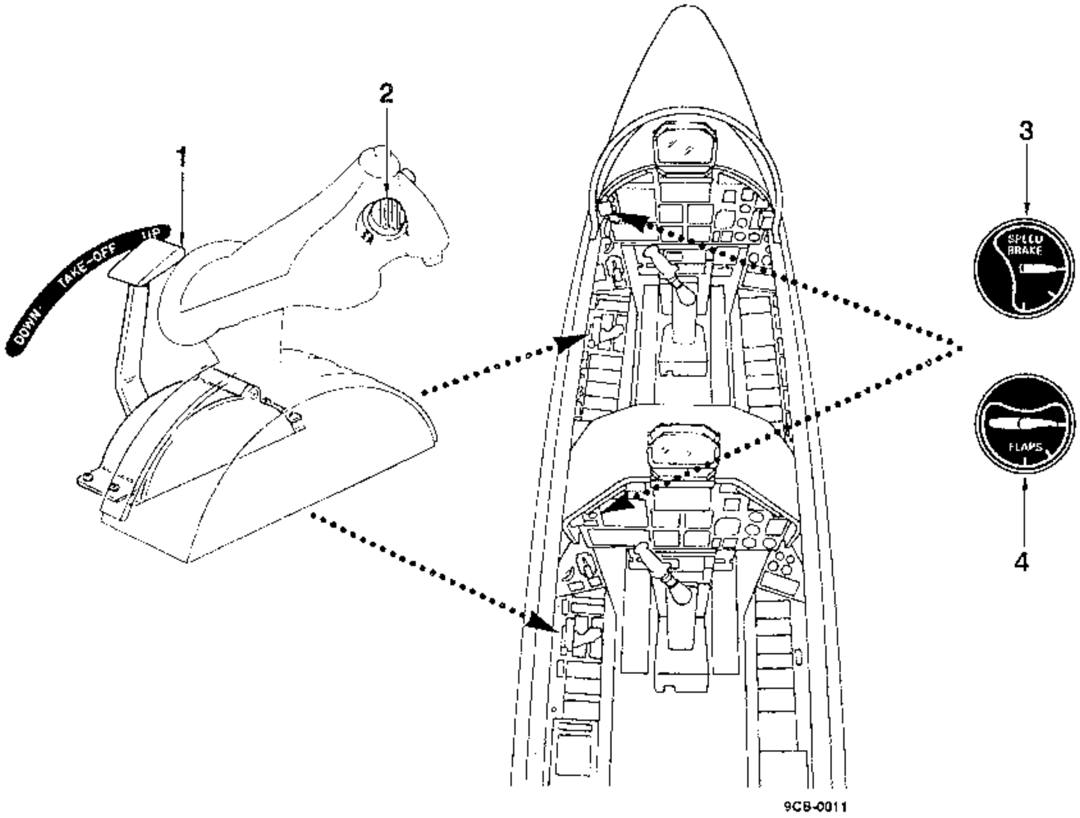
travel limit. To ensure the cabin is airtight, the canopy sill is fitted with a seal which inflates automatically when the canopy is locked and the aircraft is airborne. This seal deflates when the aircraft weight is on the wheels. The two sections of the canopy can be cut along their periphery by a severance charge that can be detonated on the ground by either pilot or by the ground crew if canopy opening by normal means is prevented. A "CANOPY" warning light illuminates when the canopy is not closed and locked. This light starts flashing when the throttle is advanced to more than 90% rpm. A plate, mechanically linked to the canopy locking handle, covers a red colored area to provide a further visual indication of canopy safe: if the handle has not locked the canopy, the red area remains in view. The canopy normal controls are described and illustrated in figure 1-31, the emergency controls in figure 3-9.

CANOPY OPERATION

Unlocking and Opening from the Outside

To open the canopy from the outside, press the forward end of the external handle which is normally spring-loaded in the horizontal rest position. This action releases the five canopy latches, and the canopy can be pushed upward to the full open position. The canopy is then locked in the open position by the jack.

FLAPS AND SPEEDBRAKE CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. Flap control lever	UP - Causes flap retraction to the full up position. T/O - Causes extension or retraction of the flaps to the intermediate position. DN - Causes extension of the flaps to the full down position. NOTE Failure to place the lever exactly in the selected position results in the flaps failing to attain this selected position (the "FLAPS" indicator does not move). In this case, slightly move the lever; then set it back into position.

Figure 1-29 (Sheet 1 of 2)

FLAPS AND SPEEDBRAKE CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
2. Speedbrake control switch	IN - Controls speedbrake retraction. OUT - Controls speedbrake extension. **NOTE** • The control in the rear cockpit overrides the control in the front cockpit. • The speedbrake can be stopped in any position by releasing the switch which automatically springs back to the center-off position.
3. "SPEED BRAKE" position indicator	3 o'clock - Indicates that the speedbrake is fully retracted. Center - Indicates that the speedbrake is in the intermediate position. 6 o'clock - Indicates that the speedbrake is fully extended. **NOTE** The pointer can also set to positions between marks as consistent with the actual speedbrake position.
4. "FLAPS" position indicator	UP (1st mark) - Indicates that the flaps are retracted. T/O (2nd mark) - Indicates that the flaps are in the intermediate position. DOWN (3rd mark) - Indicates that the flaps are in the full down position.

Figure 1-29 (Sheet 2)

Closing and Locking from the Inside

Lower the internal jack release handle and close the canopy. When the canopy is properly closed, open the compass-like canopy locking lever to release the handle from the rest position, and rotate it counterclockwise (LOCK direction). Locking occurs in the last portion of travel. When the canopy is locked, the "CANOPY" warning light goes out to advise that the canopy is properly closed and locked. Then return the compass-like lever to the initial rest position.

ACCESS TO THE CABIN

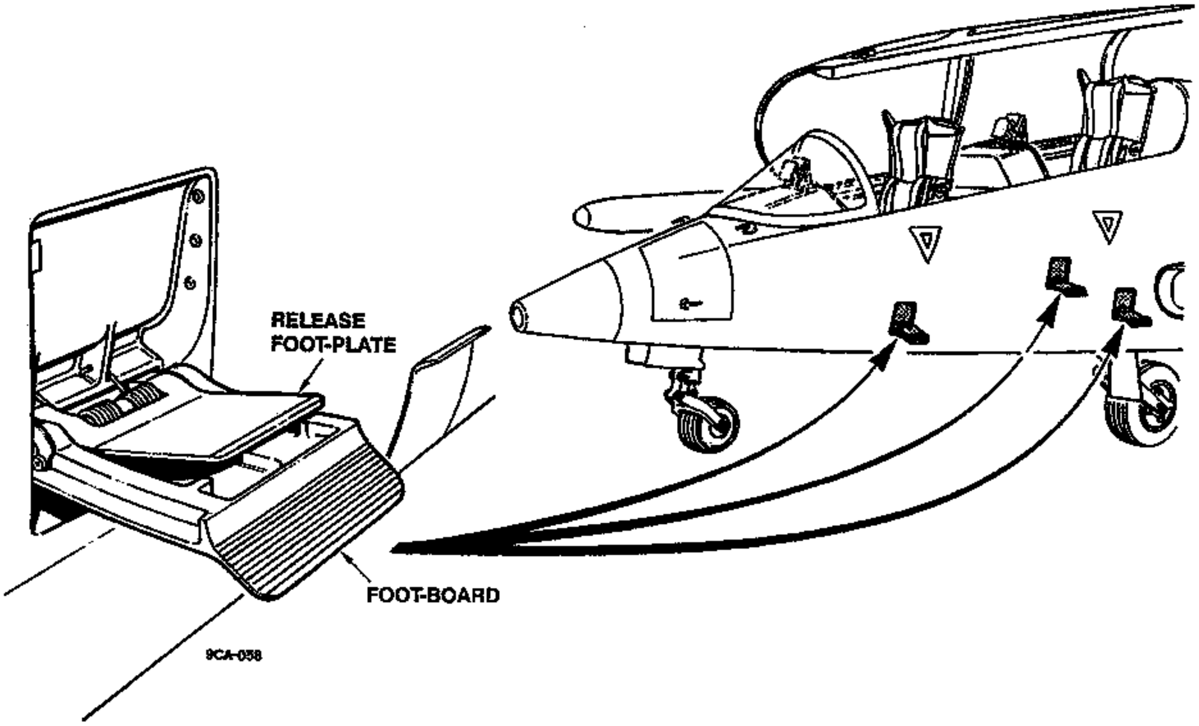


Figure 1-30

Unlocking and Opening from the Inside

Open the compass-like locking lever, and rotate the lever clockwise (UNLOCK direction). Unlocking occurs only in the last portion of travel. Grasp the internal jack release handle (front cockpit) or the internal fixed handle (rear cockpit) and push the canopy up to the full open position. Return the compass-like lever to the initial rest position.

Closing and Locking from the Outside

Unlock the canopy by lowering the internal balance jack release handle, and lower the canopy until it is closed. When lowering the canopy, hold it with the external handle. Press the aft end of the external handle. When released, the handle springs back to the horizontal position.

Canopy Severance on the Ground

Severance of the canopy transparency from inside the cabin is achieved by first removing the safety pin and then by pushing up and forward either of the two handles located on the right canopy frame (figure

CANOPY CONTROLS

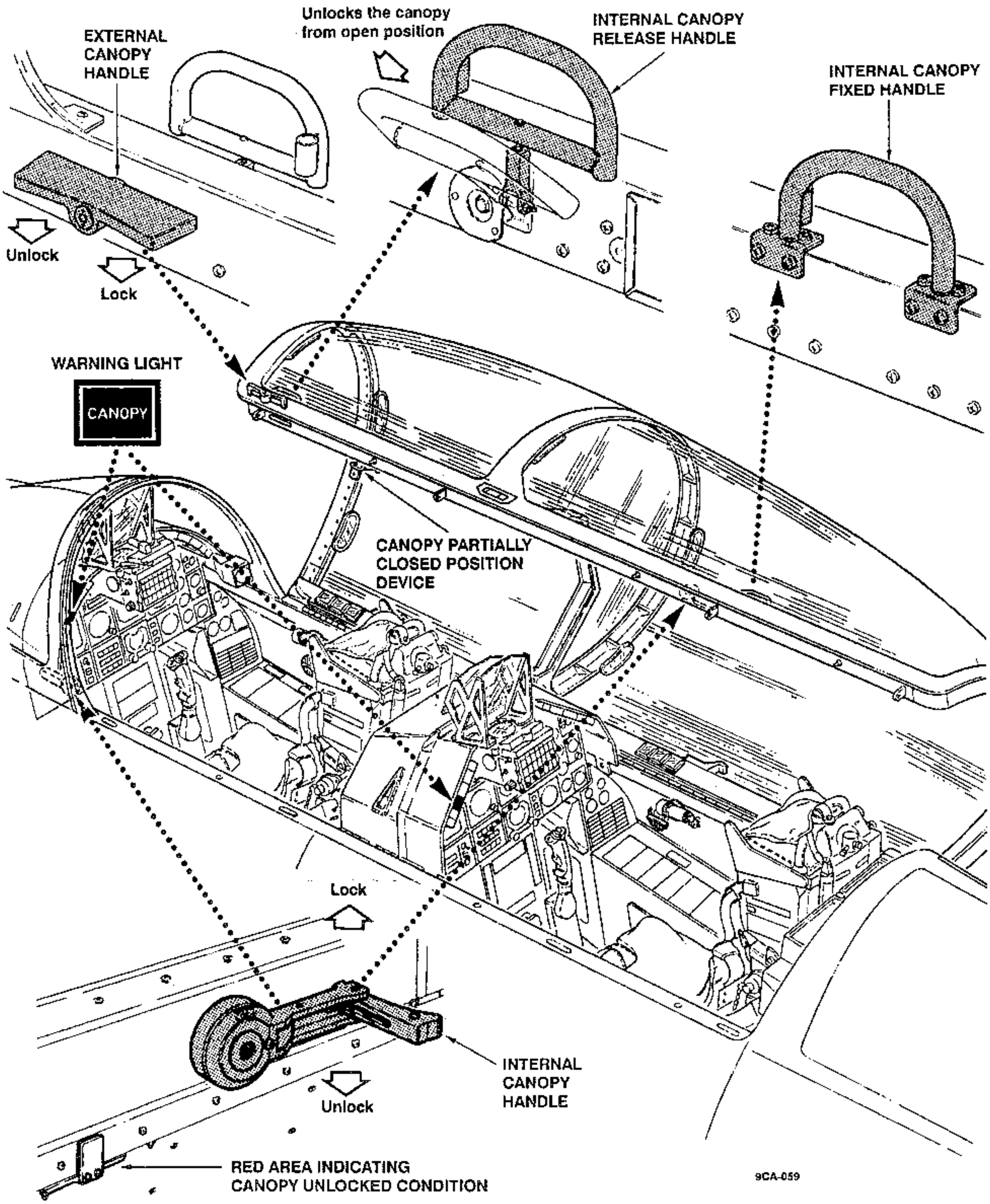


Figure 1-31

3-9). This operation initiates detonation of the severance charge, which cuts the transparency of both both canopy sections. Canopy severance can also be obtained by the ground personnel by opening one of the two doors located on the canopy sides and pulling the handle and lanyard attached to each door (figure 3-9).

WARNING

> Do not remove the safety pin from the internal handles unless the canopy cannot be opened on the ground and emergency egress is required.

MK IT-10LK EJECTION SEAT

The pilot's seat in each cockpit is a Martin Baker IT-10LK, fully automatic, cartridge-operated, rocket-assisted ejection seat, providing escape from the aircraft for most combinations of altitude, speed, attitude and flight path, within an envelope from zero altitude and speed to the max speed and absolute ceiling. The seat is ejected through the canopy transparency which is shattered by two breakers mounted on the top of the seat. Man/seat separation and parachute deployment after ejection are automatic.

SEAT DESCRIPTION

The seat consists of three main components: the ejection gun, the seat structure and the seat pan. The ejection gun provides the initial power to eject the seat and the means of attachment of the seat to the aircraft structure. The seat structure is the member to which all other seat components are attached, and slides during ejection on the guide rails fitted to the ejection gun. This structure is locked in position on the gun by a latch assembly which unlocks automatically only at the time of ejection. A shaped pack containing the man-carrying parachute and the duplex drogue assembly (controller drogue and stabilizer drogue) is secured to the upper part of the structure to form the pilot's headrest, and includes the combined parachute and seat harness. A shoulder harness retraction unit is attached to the structure and can be unlocked for forward movement by the occupant. The same unit brings the occupant into the correct pre-ejection posture at the time of ejection. A drogue gun extracts the duplex drogue assembly subsequent to ejection, whilst the automatic sequence for deployment of the main parachute and separation of the occupant from the seat is ensured by a barostatic time release unit. The seat pan, accommodating the personal survival pack, is attached to sliding members on the seat structure and its height from the aircraft floor can be adjusted by use of an electrically-powered actuator. Attached to the underside of the seat pan is a rocket pack incorporating two pairs of efflux nozzles of different bore to impart an angled trajectory to the seat (to the left on the front seat, to the right on the rear seat), in order to avoid any risk of collision in case of accidental simultaneous ejection of both seats. A manual separation handle is connected to a firing unit which fires the barostatic time release unit and the drogue gun thus initiating main parachute development and man/seat separation. An emergency oxygen cylinder, mounted on the left rear side of the seat pan, is automatically tripped on ejection providing approximately 10 minutes oxygen, sufficent to sustain the seat occupant during ejection and before separation from the seat. Provision is made for manual operation of the emergency supply should the aircraft main oxygen system fail. An automatic leg restraint system is fitted to the seat pan to draw back and restrain the occupant's legs to provide for leg clearance during ejection, and prevent flailing in the airstream. The aircraft is also fitted with a "SEAT" warning light which warns the pilot that the seat firing handle safety pin is still inserted in the ejection seat. The ejection seat controls are described and illustrated in figure 1-32.

SEAT SAFETY PINS (Figure 1-33)

Five ejection seat safety pins, handled by the ground crew, are located in the firing sears of the following components:

- Initiator connected to the seat firing handle.

EJECTION SEAT CONTROLS AND INDICATORS

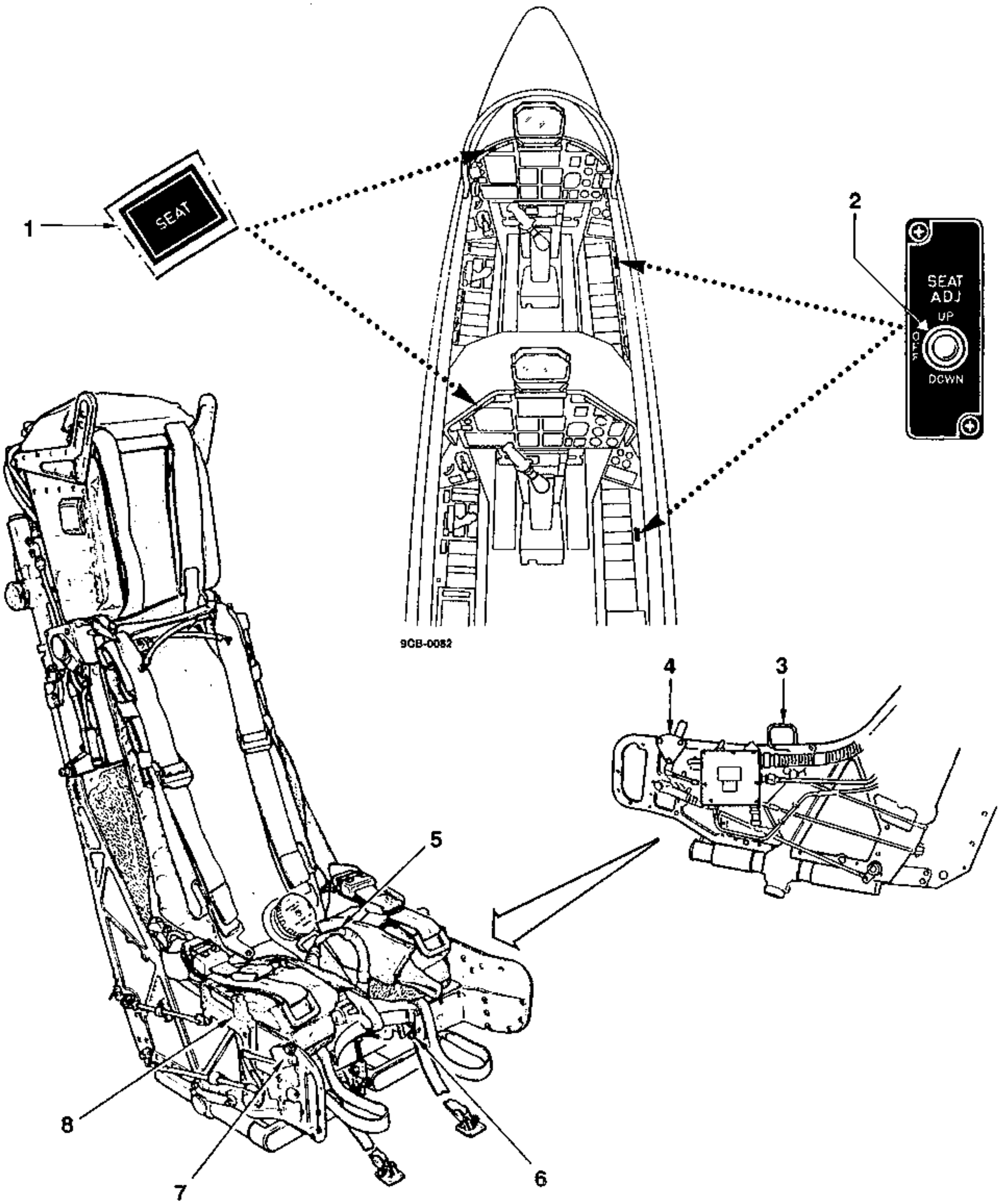


Figure 1-32 (Sheet 1 of 3)

EJECTION SEAT CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "SEAT" warning light	Illuminated - The seat firing handle safety pin is still inserted in the ejection seat. Flashing - Indicates that the engine throttle has been moved beyond 90% rpm, and the seat firing handle safety pin is still inserted.
2. "SEAT ADJ" switch	OFF - De-energized position. UP - Raises the seat pan. DOWN - Lowers the seat pan. When released, the switch automatically returns to center, locking the seat in the selected position. **CAUTION** To avoid overheating the actuator motor, do not operate the switch for more than one minute, and allow intervals of at least eight minutes between subsequent actuations.
3. Emergency oxygen handle	Pulled - Allows supply of the oxygen contained in the cylinder on the seat. This oxygen must be used under emergency conditions only.
4. Go-forward handle	Forward - Allows the shoulder harness to slide in both directions. The pilot can lean forward. Aft - Allows the shoulder harness to slide backward only. Once the pilot returns to the backward position, forward movement is restrained. **NOTE** The handle has two positions and can be moved only after it is released from its detent.
5. Seat firing handle	Pulled - Causes ejection of the seat.
6. Leg restraint line snub levers	Pressed - Allow the lines to slide in both directions. In rest position - The leg restraint lines slide downward only.

Figure 1-32 (Sheet 2)

EJECTION SEAT CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
7. Leg restraint release lever	Pulled aft - Releases the two leg restraint lines from the seat.
8. Manual separation handle	Pulled - (after pressing the push-button) - Fires the barostatic time release unit and the drogue gun, thus manually overriding all the automatic delay functions and causing the deployment of the main parachute and separation of the pilot from the seat. **CAUTION** With the seat firing handle in its housing, the separation handle is mechanically locked in rest position. Operation of the separation handle is possible only after actuation of the seat firing handle.

Figure 1-32 (Sheet 3)

- Rocket pack initiator.
- Manual separation firing unit.
- Drogue gun.
- Barostatic time-release unit.

The safety pins, interconnected by a red streamer, are to be removed by the ground crew prior to flight and stowed in the housing contained in the ejection seat backrest lower right side. For removal and insertion of the pins in the sears, the ground crew must press the push-button incorporated in the pin. The only safety pin handled by the pilot is located on the ejection seat firing handle. Prior to flight, the pilot will remove the pin from the seat and insert it in the special housing attached to the canopy fixed handle. For removal and insertion of this pin, the pilot must press the push-button incorporated in the "T" shaped grip.

COMMAND FIRING SYSTEM

A cartridge unit mounted on the right console in the rear cockpit at the aft cockpit bulkhead (fig 1-34) enables the rear seat occupant (but not vice versa) to command the ejection of the rear seat followed, after a delay of 0.35 seconds, by the ejection of the front seat. This can be set prior to flight by selecting the lever fitted to the unit to the ON (up) position. The combined ejection of the two seats is initiated by pulling the rear seat firing handle.

EJECTION SEAT OPERATION (Figure 1-34)

Ejection is initiated by pulling the seat firing handle situated between the pilot's thighs, in front of the seat pan. The operation of the handle fires the cartridge of the initiator located on the underside of the seat pan. The gas produced by this cartridge fires the cartridge of the harness retraction unit. This unit draws the occupant back to the correct posture for ejection. At the same time the gas reaches the gun

EJECTION SEAT SAFETY PINS

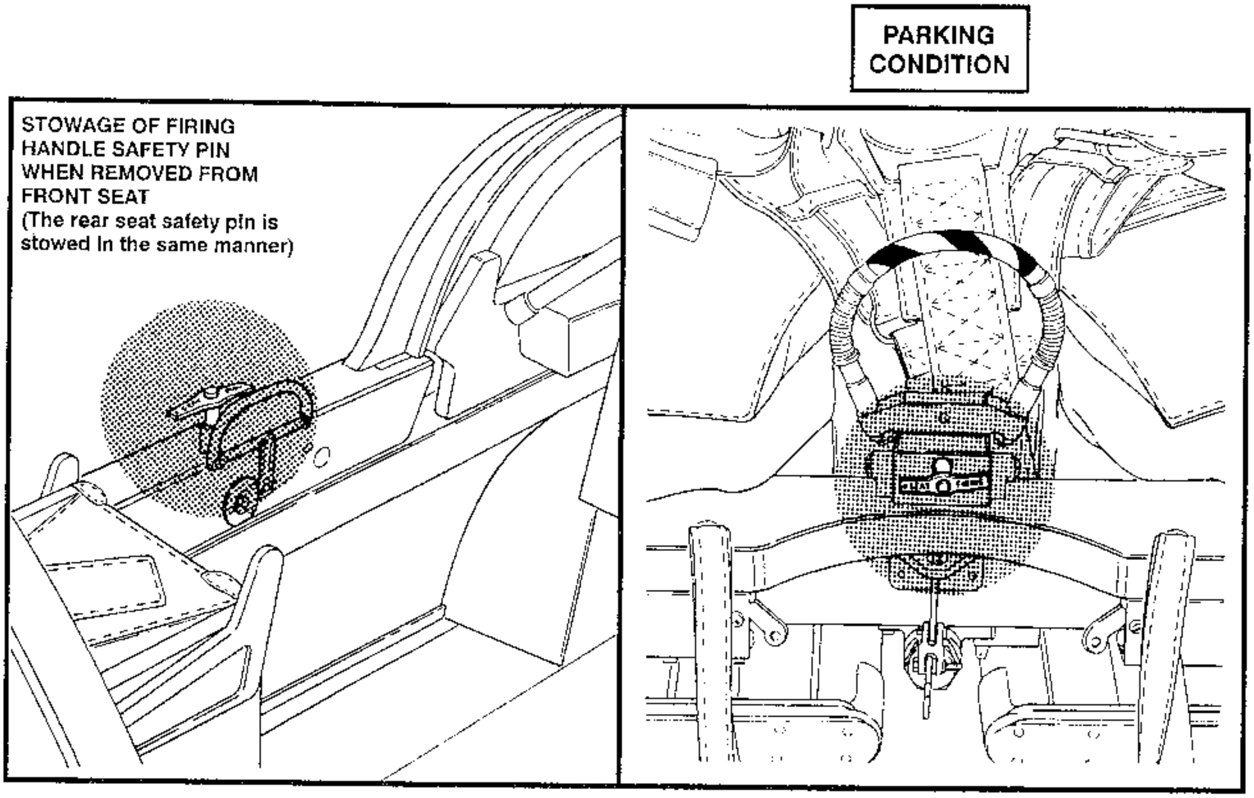


Figure 1-33 (Sheet 1 of 2)

firing unit where it mechanically detonates the gun primary cartridge which in turn causes the extension of the inner piston tube, to which the seat is connected, and the consequent disengagementfrom the latch mechanism that secures the seat to the aircraft. The upward movement of the seat operates, through two trip rods, the time-delay mechanism both of the drogue gun and the barostatic time release unit, and causes automatic retraction of the pilot's legs. At the same time the seat movement actuates the lever which operates the emergency oxygen cylinder. The ejection of the seat also disconnects an electrical connector which causes the IFF system to transmit an emergency signal. After approx 1.8 meters of gun stroke, the static line of the remote rocket pack initiator is pulled taut. After approx 2 meters of stroke, when the gun separates from the outer cylinder which remains with the aircraft, the rockets provide the necessary thrust to mantain a constant acceleration. The thrust provided by one of the rocket pack nozzles is greater than that provided by the other three, and this imparts to the seat a lateral movement while the rockets are burning. The thrust from the rockets ceases approx 0.45 second after ejection. After 0.5 seconds, the drogue gun withdraws the two drogues for seat stabilization. After 1.5 seconds of seat movement, the time release unit actuates both the mechanism releasing the drogue scissor shackle and the locks which secure the harness straps and the leg restraint garters to the seat. As the scissor shackle opens, the load due to the drag of the main stabilizer drogue transfers to the main parachute. During parachute deployment, the occupant is momentarily held in the seat by two sticker straps to ensure that

EJECTION SEAT SAFETY PINS

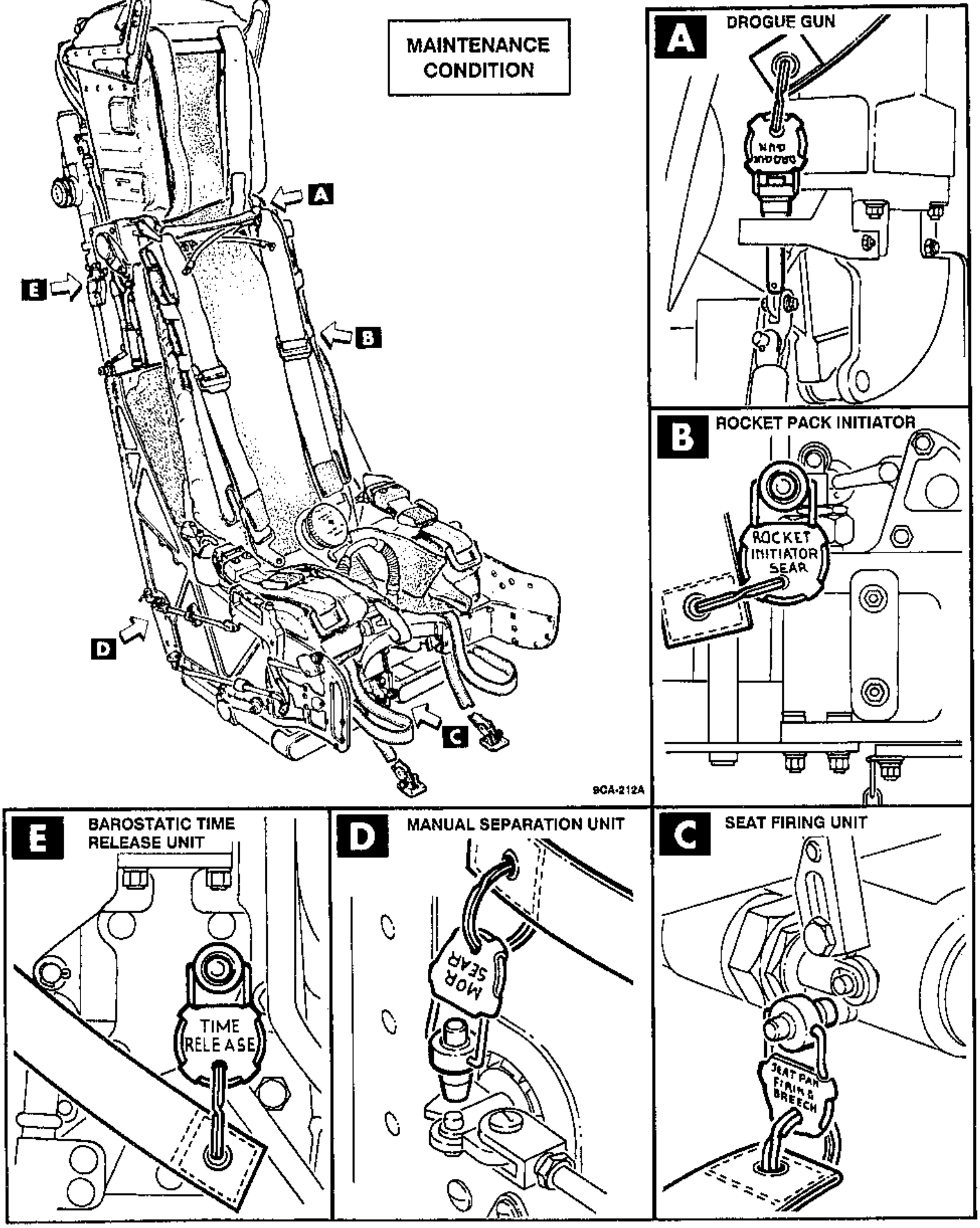


Figure 1-33 (Sheet 2)

EJECTION SEAT FIRING SYSTEM

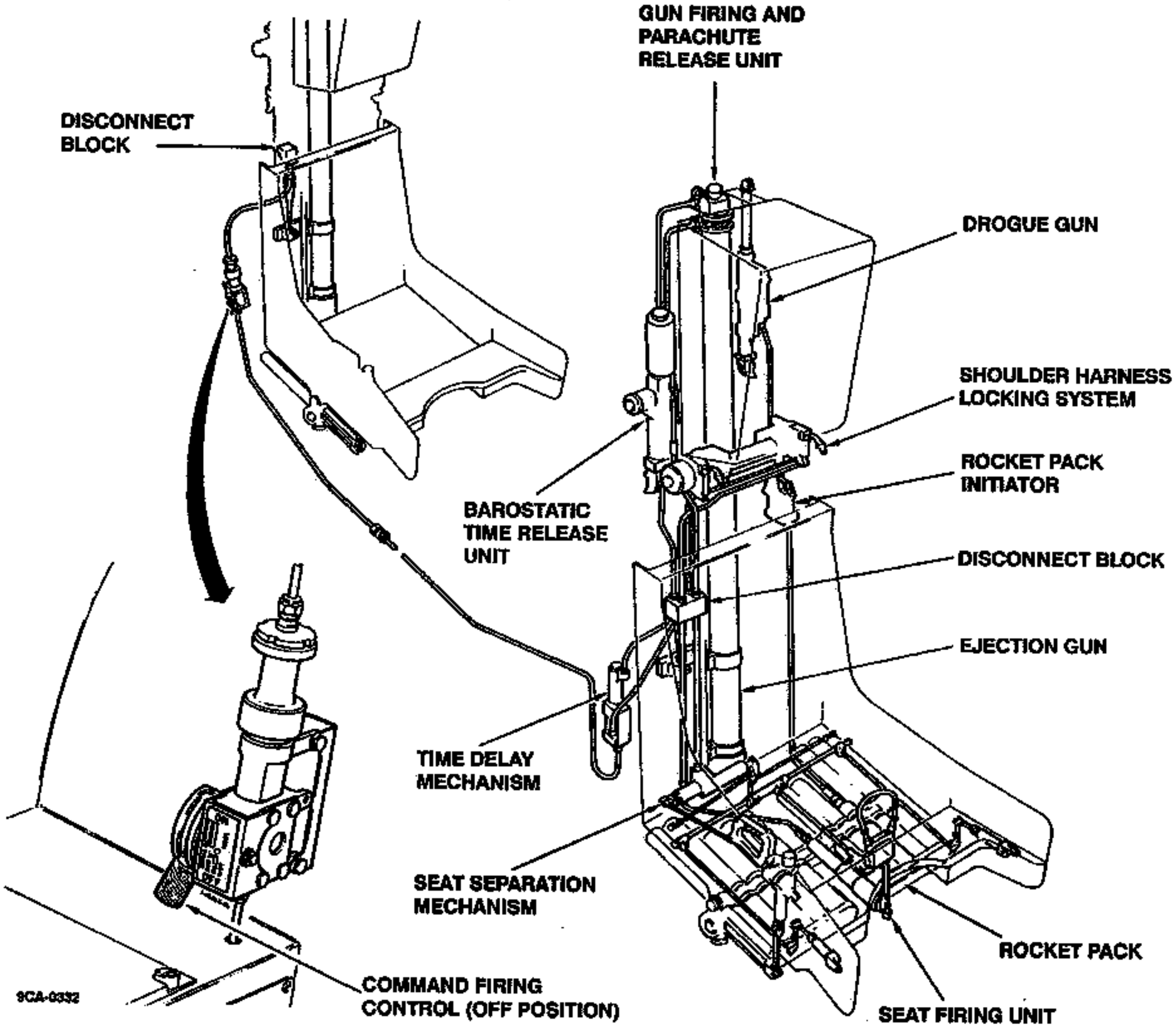


Figure 1-34

the separation of the occupant from the seat takes place only after the parachute has deployed, and to avoid any possibility of a collision between occupant and seat. A barostat, fitted to the time release unit, prevents this unit from operating at altitudes above 5000 meters (16500 feet). When ejection occurs at altitudes above 5000 meters (16500 feet), the occupant descends in the seat suspended below the stabilizer drogue, and separation does not take place until the seat and occupant have descended to 5000 meters (16500 feet). In the case of a high speed ejection, between 2100 meters (7000 feet) and 5000 meters (7000 feet), the separation does not occur until the seat senses a deceleration force of less than 2.25 g. After main parachute deployment, the survival pack can be released by operating either of the two quick-release connectors located on the rear part of the parachute harness. The pack thus remains suspended below a 4.5 meter long line attached to the pilot's life jacket and is subsequently used as needed. The parachute harness can be released when required by rotating and pressing the quick- release fitting front disc with a sharp blow.

EJECTION SEAT EQUIPMENT

The ejection seat equipment is illustrated in figure 1-35.

AIR CONDITIONING SYSTEM (Figure 1-36)

The air conditioning system enables the pilot to adjust the temperature inside the cockpit as desired. The "boot strap" type system consists of a pressurization cock, two heat exchangers, a cold air unit, a mixing valve,an ejector shut-off valve and a water separator. Hot air, bled from the 8th stage of the engine compressor, is routed via the pressurization cock to the mixing valve. This valve allows the hot engine bleed air to be mixed with cold air to obtain the desired temperature in the cockpit. Cold air is obtained by routing the hot air, bled from the compressor, through the primary heat exchanger, where it is cooled by outside air; the air is then compressed in the cold air unit and cooled again in the secondary heat exchanger before being expanded in the turbine section, where it loses energy and is, therefore, further cooled. The turbine power output is used to drive the compressor. Cooling of the heat exchangers is ensured in flight by ram air entering an intake on the fuselage right side and flowing out from the fuselage lower side. At speeds below 165 kts, the ejector shut-off valve opens automatically. The ejectors thus expel the compressor bleed air and draw in cold air from the outside to ensure that the heat exchangers operate even when the ram air flow is reduced or is null (on the ground). The mixing valve is controlled by a temperature control box. Air is distributed to the various outlets and diffusers in the cabin through a manifold located under the cockpit floor.

WINDSHIELD DEMISTING SYSTEM

The cockpit conditioning air is used, through ports at the base of the windshield and canopy, to prevent mist formation on the windshield and canopy transparencies. When particularly unfavorable conditions do not permit sufficient demisting, the pilot can operate the "WINDSHIELD/DEMIST" switch (fig 1-40). This switch opens a cock which exhausts hot air, directly bled from the compressor, into the ports at the base of the windshield. Immediate demisting of the transparency is thus obtained.

EMERGENCY COCKPIT VENTILATION SYSTEM (Figure 1-36)

This system ensures cockpit ventilation if the air bled from the compressor becomes contaminated (due to oil leaks or to other defects in the engine). The system consists of a ram air scoop and of an electrical circuit controlling the opening of the cockpit over-pressure dump valve. The ram air scoop is manually operated through the "RAM AIR SCOOP" handle. A non-return valve in the ram air scoop ensures sealing when the scoop is closed and the cockpit is pressurized. At altitudes below 8000 feet (initial pressurization altitude), the handle may be pulled out without any prior action; ventilation takes place immediately since the overpressure-dump valve is held open by the pressurization system altitude switch, and air is free to circulate in and out the cockpit. At altitudes above 8000 feet, the cockpit is pressurized and cockpit pressure must first be reduced to atmospheric pressure by operating the "CABIN PRESS" switch;

EJECTION SEAT EQUIPMENT

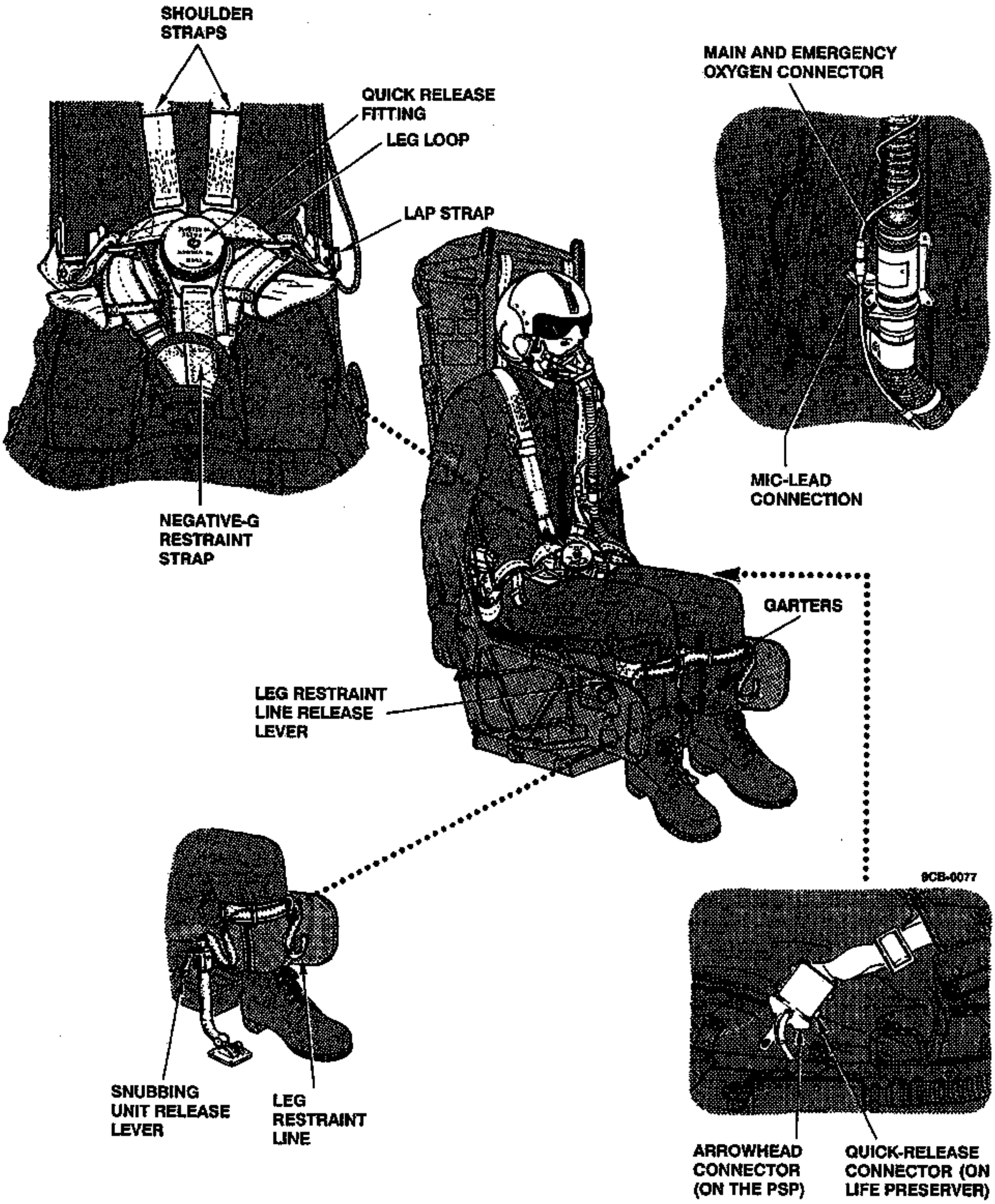


Figure 1-35

only then should the "RAM AIR SCOOP" handle may be pulled. Operation of this handle automatically opens the overpressure-dump valve and allows a free flow of ventilation air to enter the cockpit throughtwo ventilation outlets and to flow out from the open overpressure-dump valve. The two ventilation outlets located on the right side in each cockpit, can be moved to direct the airflow as desired. The electrical power required for operation of the cockpit ventilation system is supplied from the 28 V dc essential bus.

COCKPIT PRESSURIZATION SYSTEM (Figure 1-36)

The same air used for cockpit conditioning is also utilized for cockpit pressurization. A pressure regulator, in the back of the aft cockpit, meters the outflow of air from the cockpit. At altitudes below 8000 feet the cockpit is unpressurized. The overpressure-dump valve and the pressure regulator are openthus permitting free circulation of air in and out of the cockpit. At altitudes above 8000 ft, the overpressure-dump valve is automatically closed and the air in the cockpit can only flow out through the pressure regulator. The cabin altimeter provides the pilot with the indication of correct pressurization operation by indicating an altitude lower than the altitude read on the flight altimeter, in accordance with the pressurization schedule shown in figure 1-37. The overpressure-dump valve prevents overstressing of the fuselage structure resulting from an excessive cockpit pressure (pressure regulator malfunction). This valve and the pressure regulator also prevent overstressing from a negative pressure differential which can occur during a rapid dive. In both cases the overpressure-dump valve operates automatically by relieving the excess pressure in either direction. Cockpit sealing against the canopy sill is provided by a seal incorporated in the canopy frame. The seal is automatically inflated with pressurized air on take-off, as soon as the aircraft weight is off the wheels, through the switch actuated by the left landing gear leg. During landing, the operation is reversed: as soon as the aircraft weight is on the wheels, the seal is deflated.

COCKPIT TEMPERATURE CONTROL SYSTEM

Temperature in the cockpit is controlled by a valve that mixes the hot and cold air. The valve is controlled by an automatic temperature adjusting device comprising an electronic regulator and a four-position selector (OFF, AUTO, MANUAL COLD, MANUAL HOT).

AIR CONDITIONING SYSTEM CONTROLS

The controls and indicators of the air conditioning and pressurization system are described and illustrated in figure 1-38.

ANTI-G SUIT SYSTEM

The pilot's anti-g suit is connected through a hose to a coupling located on the left console in the cockpit. This coupling is connected to a pressure regulating valve which receives pressurized air from the engine compressor. Positive acceleration causes the valve to open, inflating the anti-g suit. For each additional "g" acceleration force, a corresponding increase in air pressure is produced in the anti-g suit. A button on top of the valve can be pressed to check the system operation.

ICE AND RAIN PROTECTION SYSTEMS

The ice and rain protection systems provide anti-icing of the air intakes, and of the external probes. These systems also provide anti-icing and rain removal of the windshield transparency.

AIR CONDITIONING SYSTEM

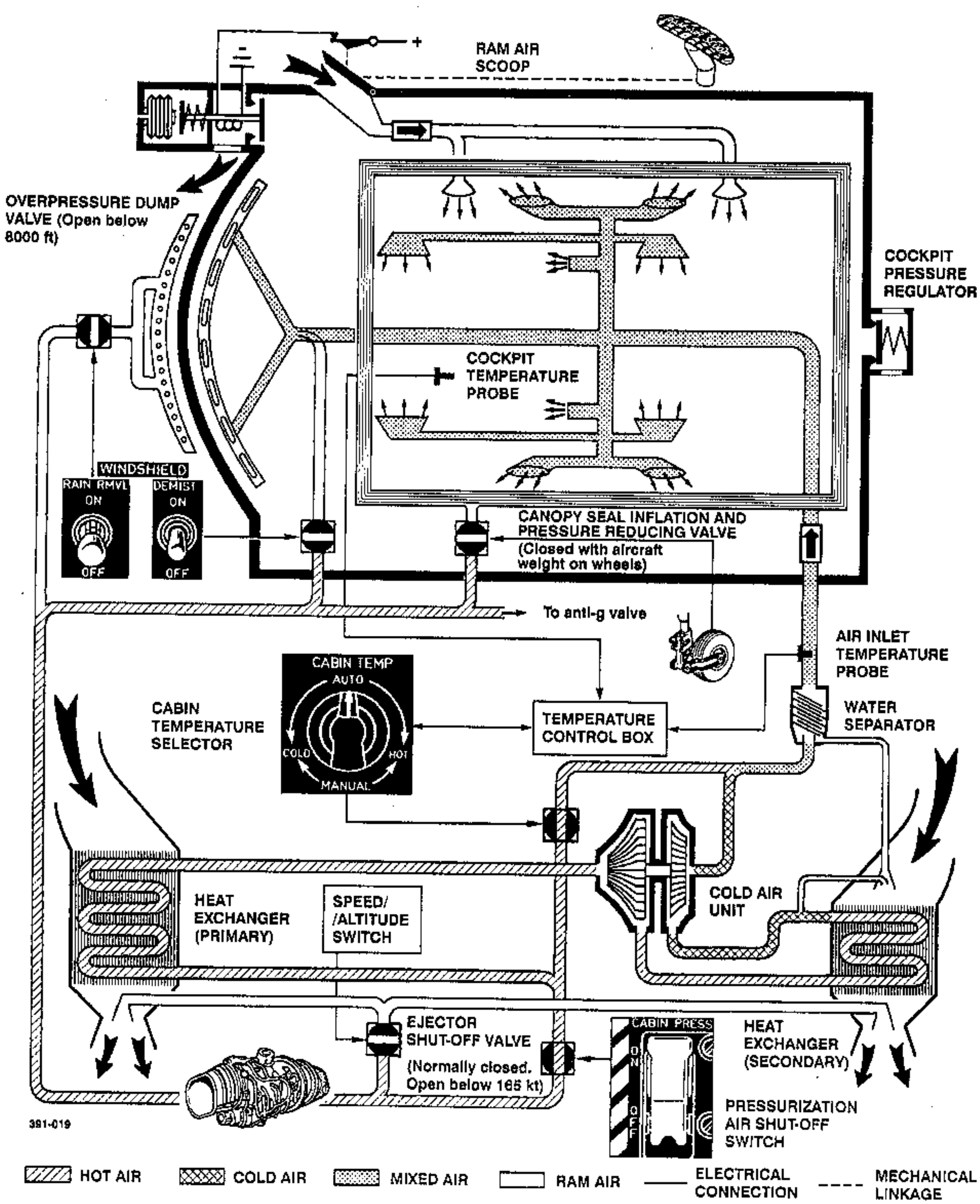


Figure 1-36

COCKPIT PRESSURE SCHEDULE

Figure 1-37

AIR INTAKE ANTI-ICE SYSTEM

The air intake lips and ducts are de-iced by means of electrically-generated heat. The system is electrically controlled by the "ANTI-ICE/ENGINE" switch powered from the 28 V dc primary bus. When set to ON this switch energizes the heaters of the air intake lips and ducts, and operates the hot air system protecting the engine front face. Special thermostats are provided to mantain the electrical heaters at a preset temperature. A "DUCT ANTI-ICE" caution light, when illuminated, indicates that the aircraft air intake anti-ice system is inoperative. An "ANTI-ICE/ENG" indicator indicates the system status. In the event of electrical supply failure, the anti-ice valve which controls the hot air system will fail to the open position.

EXTERNAL PROBES HEATING SYSTEM

The Pitot tubes, the AOA transmitter, the sideslip transmitter and the total temperature sensor (TTS) probe are electrically heated to prevent ice formation or accretion. The heaters are controlled by the "ANTI-ICE/PITOT" switch (fig 1-39) located on the right console in both cockpits. The "ANTI-ICE/PITOT" switch located in the front cockpit controls heating of the left Pitot tube, the AOA

AIR CONDITIONING CONTROLS AND INDICATORS

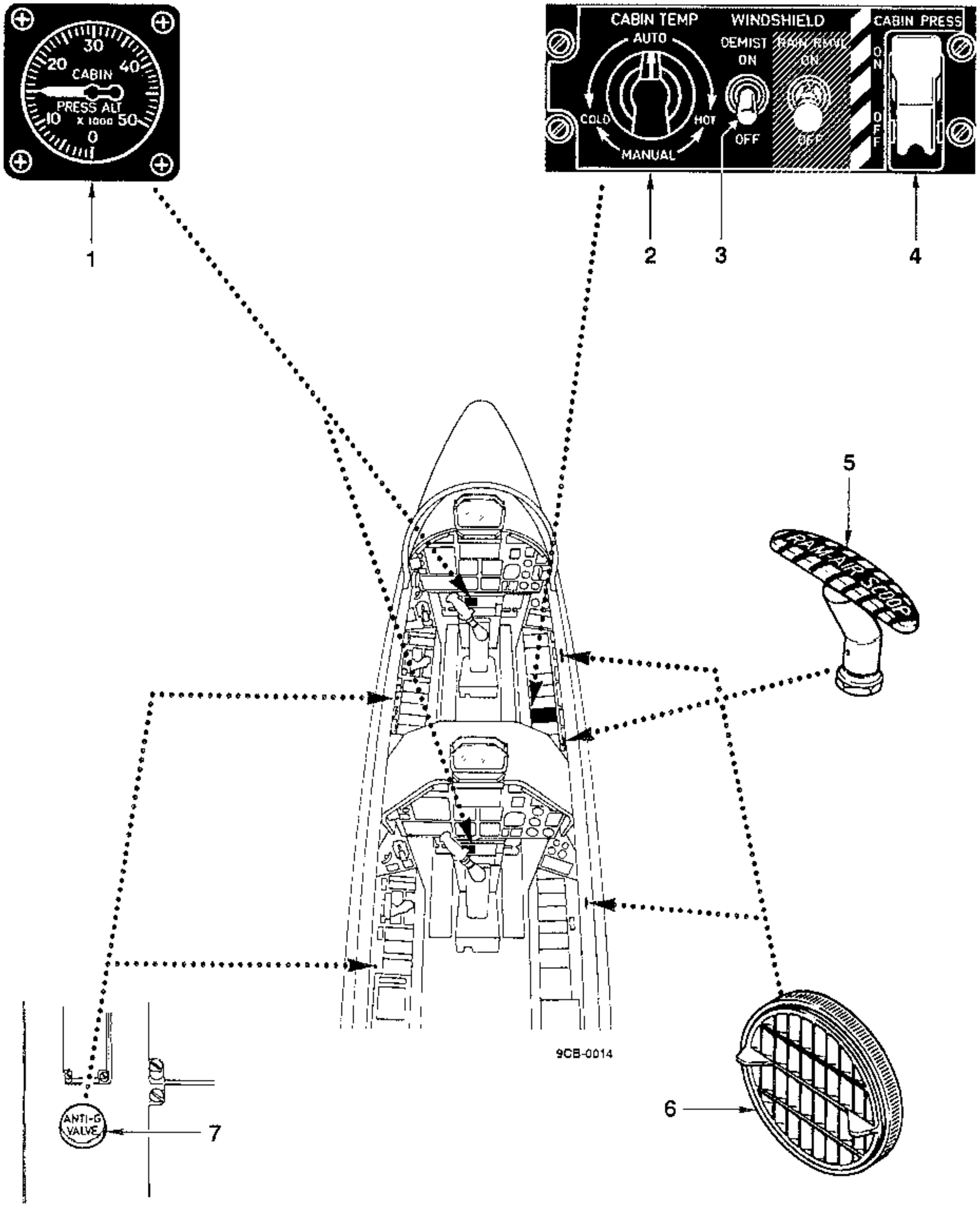


Figure 1-38 (Sheet 1 of 2)

AIR CONDITIONING CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Cabin altimeter	Provides a direct reading of the cockpit altitude, thus an indication that the pressurization system is operating
2. "CABIN TEMP" selector switch	When rotated, permits automatic or manual selection of the cockpit temperature. AUTO - Engages the automatic system to maintain cockpit temperature at the selected value. MANUAL - Permits cockpit temperature to be manually adjusted in case of failure of the automatic system. **CAUTION** The MANUAL mode of the "CABIN TEMP" selector switch should be used only in case of automatic control system failure. In this case, the pilot should not select too low values as they may cause ice formation in the water separator, and therefore damage to the turborefrigerator.
3. "WINDSHIELD/DEMIST" switch	ON - Opens the cock to exhaust additional hot air onto the windshield, and boosts the action of the demisting system. OFF - Closes the cock of the boosted demisting circuit.
4. "CABIN PRESS" switch	ON (guard down) - Permits air coming from the engine to flow freely in the pressurization and air-conditioning system. OFF (guard and toggle up) - Closes the shut-off valve on the engine air supply line.
5. "RAM AIR SCOOP" handle	Pulled out - Opens the cabin ventilation scoop.
6. Ventilation outlet	Rotated - Permits the ventilation air flow to be adjusted.
7. "ANTI-G VALVE" push-button	Pressed - Checks operation of the anti-g system.

Figure 1-38 (Sheet 2)

transmitter, the sideslip transmitter, and the TTS probe; the "PITOT/ANTI-ICE" switch located in the rear cockpit controls heating of the right Pitot tube. The AOA transmitter, the sideslip transmitter and the TTS probe sensor heaters are automatically disconnected when the aircraft weight is on wheels. Operation of the heating system is indicated by the relevant magnetic indicator mounted on the "ANTI-ICE" indicator panel located on the front and rear instrument panel. Ground test is possible by moving the switch to the TEST position.

WINDSHIELD ICE AND RAIN PROTECTION SYSTEM

Hot air, directly bled from the engine compressor, can be directed to a nozzle located at the outer base of the windshield by operating the "WINDSHIELD/RAIN RMVL" switch (Figure 1-39). This switch is fitted to the front cockpit only. The system is mainly designed for anti-icing, but may also be used in flight and during ground operation to remove rain from the windshield and improve visibility.

ICE DETECTION SYSTEM

This system is capable of providing a timely and reliable indication of an ice formation hazard to the pilot. The system comprises a probe which, in case of ice formation, brings on the "ICE" caution lights (figure 1-39) mounted on the caution lights panel in both cockpits.

ICE AND RAIN PROTECTION SYSTEM CONTROLS

The controls and indicators of the ice and rain protection systems are described and illustrated in figure 1-39.

COMMUNICATION SYSTEM

The characteristics and functions of the communication system are briefly described in the table "Avionic Equipment" at figure 1-40. The positions of the associated antennas are shown on the same figure.

UHF AM COMMUNICATION SYSTEM (COMM1)

The AN/ARC-159(V) UHF system consists of a transceiver which provides for voice transmission and reception in the ultra-high frequency (UHF) range of 225.000 to 399.975 MHz. The equipment incorporates a separate receiver, tuned to the guard channel and receiving on the emergency frequency of 243.000 MHz. The system also comprises a control panel located on the left console in each cockpit. These panels permit manual selection of any of the 7000 channels, spaced 25 kHz apart, or of the 20 channels preset for the most commonly used frequencies. Each pilot has available a "COMM1/COMM2" push-button, located on the engine throttle, to select the UHF (COMM1) or VHF (COMM2) transceiver. Each cockpit is provided with a "UHF" control panel. Transfer of transceiver control is possible from one control panel to the other by means of a "TAKE CONTR/COMM1" push-button; this permits control to be obtained, but not to be transferred back. The UHF system enables the pilot to carry out two-way voice communications with other aircraft and ground stations. Transmission and reception take place on the same frequency through the antenna mounted on the fuselage underside. The system is powered from the 28 V dc essential bus via the "NO 1 COMM" circuit breaker. The controls and indicators of the UHF system are described and illustrated in figure 1-41.

UHF System Operation

Make sure that the "COMM1" push-button light on the "TAKE CONTR" panel is illuminated to indicate control availability; otherwise, press the push-button and carry out the following operations on the "UHF" control panel:

1. Set the "MODE" selector to MAIN.
2. Set the frequency mode selector to MNL or to PRESET depending upon whether it is desired to select the frequency manually or to select a preset channel.

ICE AND RAIN PROTECTION SYSTEM CONTROLS AND INDICATORS

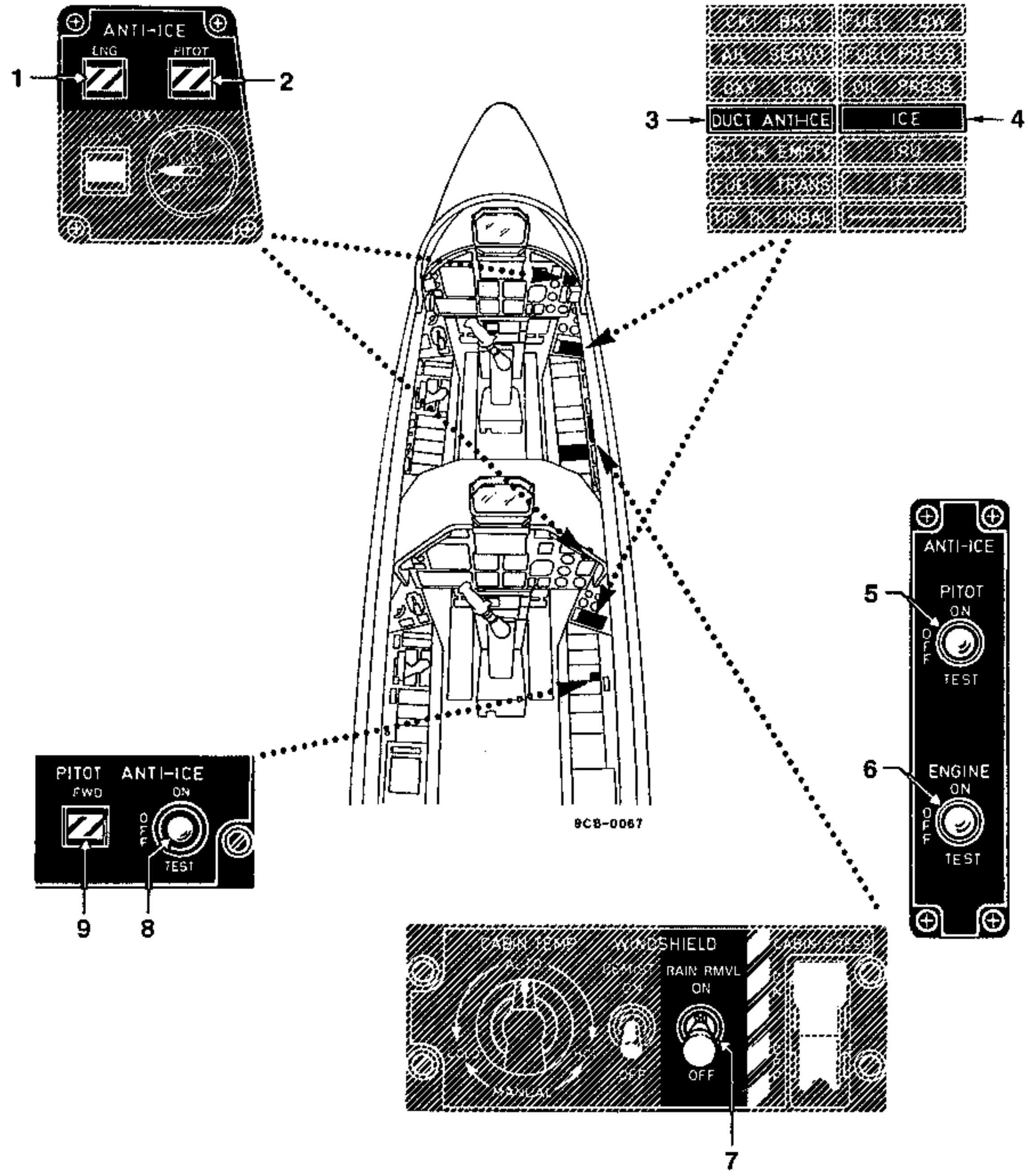


Figure 1-39 (Sheet 1 of 4)

ICE AND RAIN PROTECTION SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "ANTI-ICE/ENG" indicator	ON - Indicates that the engine anti-ice system is operating. OFF - Indicates that the engine anti-ice system is not operating. Striped - Indicates that the engine anti-ice system is operating and that power is not supplied to the indicator.
2. "ANTI-ICE/PITOT" indicator (front cockpit)	ON - Indicates that the left Pitot tube, the AOA transmitter, the sideslip transmitter heaters, and the TTS probe heater are operating, when the aircraft is airborne. OFF - Indicates that the heaters are not operating. Striped - Indicates that power is not supplied to the indicator or the left Pitot heater is faulty.
2. "ANTI-ICE/PITOT" indicator (rear cockpit)	ON - Indicates that the right Pitot tube heater is in operation. OFF - Indicates that the "ANTI-ICE/PITOT" switch is at OFF. Striped - Indicates that power is not supplied to the indicator, or the right Pitot heater is faulty.
3. "DUCT ANTI-ICE" caution light	ON - Indicates that the aircraft air intake anti-ice system is inoperative.
4. "ICE" caution light	ON - Indicates that the aircraft is in a condition conducive to ice formation.
5. "ANTI-ICE/PITOT" switch (front cockpit)	ON - Turns on the electrical heating of the left Pitot tube, the AOA transmitter, the sideslip transmitter, and of the TTS probe. **NOTE** When the aircraft weight is on the wheels, heating of the AOA and sideslip transmitter does not occur. OFF - Turns off the electrical heating of the left Pitot tube, the AOA transmitter, the sideslip transmitter and of the TTS probe.

Figure 1-39 (Sheet 2)

ICE AND RAIN PROTECTION SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
	TEST - Tests operation of the left Pitot tube, the AOA transmitter, the sideslip transmitter and of the TTS probe heating system. Marking "ON" will appear on the "ANTI-ICE/PITOT" indicator. **CAUTION** Maintain the switch in the TEST position only as long as required to have the marking "ON" in view on the indicator. When released, check that the switch returns to OFF.
6. "ANTI-ICE/ENGINE" switch	ON - Turns on the engine anti-ice system OFF - De-energized position. TEST - Tests operation of the engine anti-ice system. Marking "ON" will appear on the "ANTI-ICE/ENG" indicator. **CAUTION** Maintain the switch in the TEST position only as long as required to have the marking "ON" in view on the indicator. When released, check that the switch returns to OFF.
7. "WINDSHIELD/RAIN RMVL" switch	ON - Opens the cock permitting hot air to flow through the nozzle toprevent ice formation or improve visibility in rain. OFF - Closes the cock, stopping the airflow to the nozzle. To pass from the OFF to the ON position, the lever must first be pulled and then moved to ON.
8. "PITOT ANTI-ICE" switch (rear cockpit)	ON - Turns on the electrical heating of the right Pitot tube. OFF - Turns off the electrical heating of the right Pitot tube. TEST - Tests the operation of the right Pitot tube heating system. Marking "ON" will appear on the "ANTI-ICE/PITOT" indicator.

Figure 1-39 (Sheet 3)

ICE AND RAIN PROTECTION SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
9. "PITOT ANTI-ICE/FWD" indicator	ON - Indicates that the left Pitot tube, the AOA transmitter, the sideslip transmitter and the TTS probe heaters are operating. OFF - Indicates that the heaters are not operating. Striped - Indicates that power is not supplied to the indicator, or the left Pitot heater is faulty.

Figure 1-39 (Sheet 4)

3. Operate the manual selectors or the channel selector in accordance with the choice made at step 2.
4. Pull-out the "COMM1" receive switch (on the audio control panel).
5. Adjust the volume of the received signal as desired by rotating the receive switch.
6. To transmit, press the "COMM1/COMM2" push-button on the engine throttle lever.
7. Set the "MODE" selector to BOTH to operate in the UHF band, and concurrently receive on the guard channel (243.000 MHz).
8. For reception and transmission on the guard channel, move the frequency mode selector to GD.
9. To transmit the landing gear-down signal to the ground, press the push- button on the engine throttle grip.
10. To switch the set off, rotate the function selector to OFF.

VHF AM/FM COMMUNICATION SYSTEM (COMM2)

The AN/ARC-186 VHF system consists of a transceiver, an antenna enclosed in the fin cap and two control panels, located on the left console in each cockpit. The system enables the pilots to carry out two-way voice communication in the frequency range from 116.000 to 151.975 MHz in AM and in the frequency range from 30.000 to 87.975 MHz in FM. In the frequency range from 108.000 to 115.975 MHz only reception is possible. Channel spacing in all frequency bands is 25 kHz, and 20 preset channels can be selected. A "COMM1/COMM2" push- button is located on the engine throttle, and permits the COMM2 transceiver to be selected. Transfer of the transceiver control is possible from one "VHF" control panel to the other by means of the "TAKE CONTR/COMM2" push- button,located on the left centerstand in each cockpit. This push-button permits control to be obtained, but not to be transferred back. Power is supplied from the 28 V dc essential bus via the "NO 2 COMM" circuit breaker. The VHF system controls and indicators are described and illustrated in figure 1-42.

VHF System Operation

Make sure that the "COMM2" push-button light on the "TAKE CONTR" panel is illuminated to indicate control availability; otherwise, press the push- button and make the following operations on the "VHF COMM" control panel:

1. Set the "OFF/TR/DF" switch to TR.
2. Set the frequency selector to MAN or to PRE depending upon whether it is desired to select the frequency manually or to select a preset channel.

AVIONIC EQUIPMENT

SYSTEM	DESIGNATION	FUNCTION	RANGE	CONTROLS LOCATION
COMMUNICATION SYSTEM				
AUDIO & INTERPHONE SYS & GROUND CREW JACK BOX	ROCKWELL - COLLINS ITALIANA IA - 210 ROCKWELL - COLLINS ITALIANA IA - 401	Monitoring of received audio signals. Intercommunication between pilots. Intercommunication between pilots and ground crew.	-	Control panel on front and rear right consoles. "COMM1/COMM2" push - button on engine throttles and "CALL" push - button on control sticks.
COMM1 UHF	ROCKWELL - COLLINS AN/ARC - 159(V)	Two - way voice communications.	Line of sight	Control panel on front and rear left consoles.
COMM2 VHF - AM / FM	ROCKWELL - COLLINS AN/ARC - 186(V)	Two - way voice communications.	Line of sight	Control panel on front and rear left consoles.
RADIO - AIDED NAVIGATION SYSTEMS				
TACAN	ROCKWELL - COLLINS AN/ARN - 118(V)	Reception of TACAN stations for bearing, deviation and TO/FROM information. Computation of slant range from TACAN or DME stations.	Line of sight	Control panel on front and rear right consoles.
VOR/ILS	ROCKWELL - COLLINS 51RV - 4B	Reception of VOR stations for bearing, deviation and TO/FROM information. Reception of ILS stations for LOC and GS information.	VOR: Line of sight LOC: 85 miles GS: 35 miles	Control panel on front and rear right consoles.
MARKER BEACON	ROCKWELL - COLLINS ITALIANA MKI - 3	Reception of signals from Marker Beacons.	-	Control panel on front right console.
ADF	ROCKWELL - COLLINS ADF - 60A	Reception of LF - and MF - NDB stations for bearing information.	-	Control panel on front and rear right consoles.
V/UHF - DF	ROCKWELL - COLLINS DF - 301E	Reception of VHF and UHF (AM) Communication stations for bearing information.	-	Same as COMM1 and COMM2 systems.
INDEPENDENT NAVIGATION AND ATTACK SENSOR SYSTEMS				
TACTICAL AREA NAVIGATION (TRNAV)	GEC SENSORS AD - 620K	Computes and displays the aircraft position with respect to any geographical point (waypoint), airport or beacon stored in the system, and other navigation parameters such groundspeed, drift angle, wind vector, etc.	-	Keyboard (Data Entry Panel) on front and rear PDUs. "FIX/MARK" push - button on control sticks.
DOPPLER VELOCITY SENSOR	GEC SENSORS AD - 660A	Measures aircraft velocities with respect to the ground.	-	Control panel on front left console. "LAND/SEA" push - button on front and rear instrument panels.
INERTIAL REFERENCE UNIT	LITTON GUIDANCE LR - 80	Measures aircraft attitude, heading, accelerations and attitude rates.	-	Control panel on front left console. Repeater panel on rear left console.
DIRECTIONAL REFERENCE SYSTEM	AERITALIA / SPERRY CN - 1145 (AN/ASN - 75)	Measures aircraft heading.	-	Control panel on front left console.
ATTITUDE REFERENCE SYSTEM	JET INDUSTRIES VG - 204L	Measures aircraft attitude.	-	Control panel on front left console.
RADAR ALTIMETER	HONEYWELL HG8505AM01	Measures aircraft height above the ground.	-	-
IDENTIFICATION SYSTEM				
IFF	BENDIX AN/APX - 100	Transmits coded replies for identification to ATC.	Line of sight	Control panel on front right console.
DATA DISPLAY CONTROL SYSTEM				
FLIGHT DIRECTOR COMPUTER	ASTRONAUTICS	Provides guidance information to follow the selected path.	-	Control panel on front and rear instrument panels.
MULTIFUNCTION DISPLAY	AERITALIA 8.333.010	Displays synthetic maps, electro - optical weapon aiming, video camera images and checklists.	-	Display and control panel on front and rear instrument panels.
HUD & WEAPON AIMING COMPUTER	KAISER / VDO Type "SABRE"	Provides HUD symbology and attack information for navigation and weapon aiming.	-	Keyboard (Data Entry Panel) on front and rear PDUs and push - buttons on throttles and control sticks.
EMERGENCY LOCATOR TRANSMITTER				
ELT	ARTEX ELT - 110 - 4	Transmits an emergency tone for rescue.	-	Control panel on front right console.

9CB-0262

Figure 1-40 (Sheet 1 of 2)

AVIONIC EQUIPMENT

ANTENNA AND SENSOR LOCATION

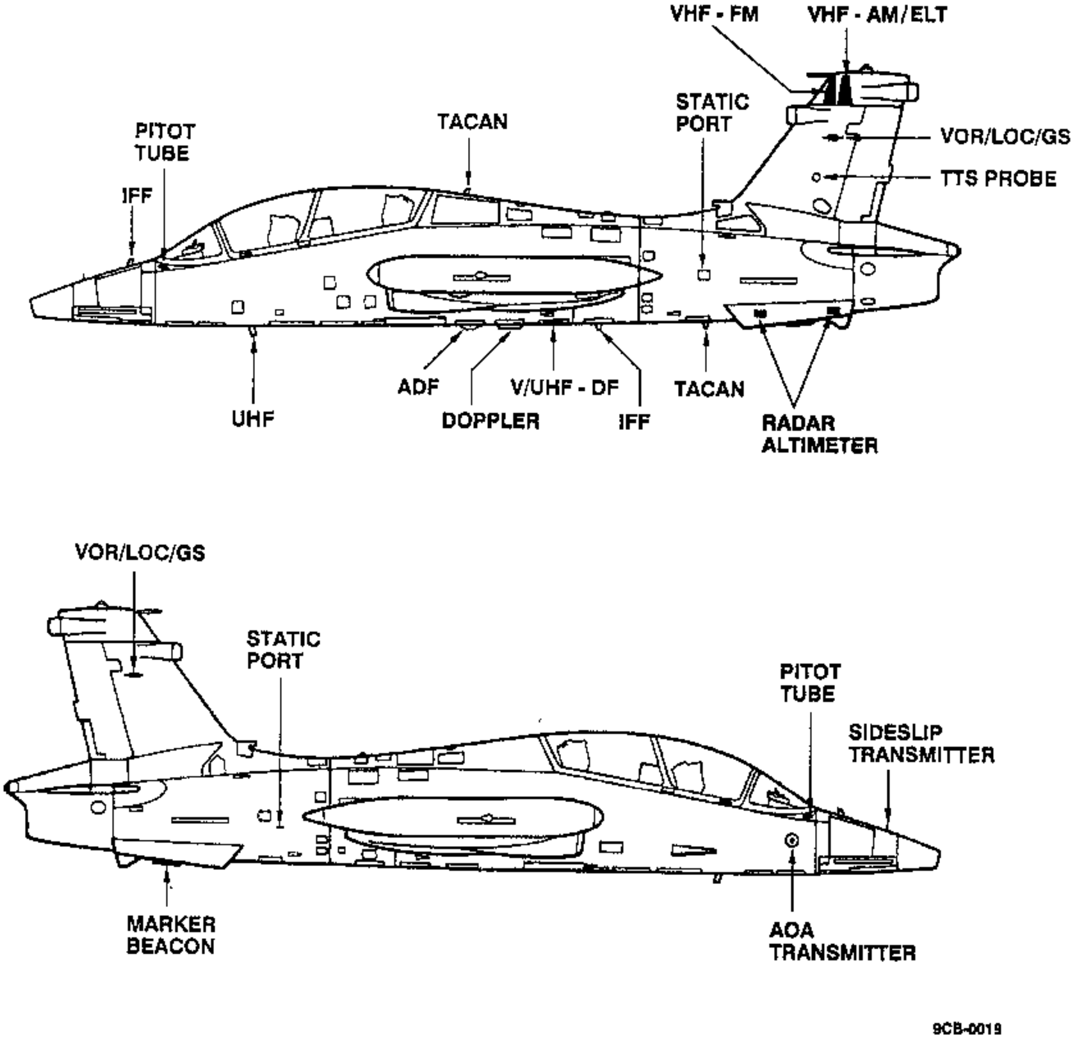


Figure 1-40 (Sheet 2)

UHF SYSTEM CONTROLS AND INDICATORS

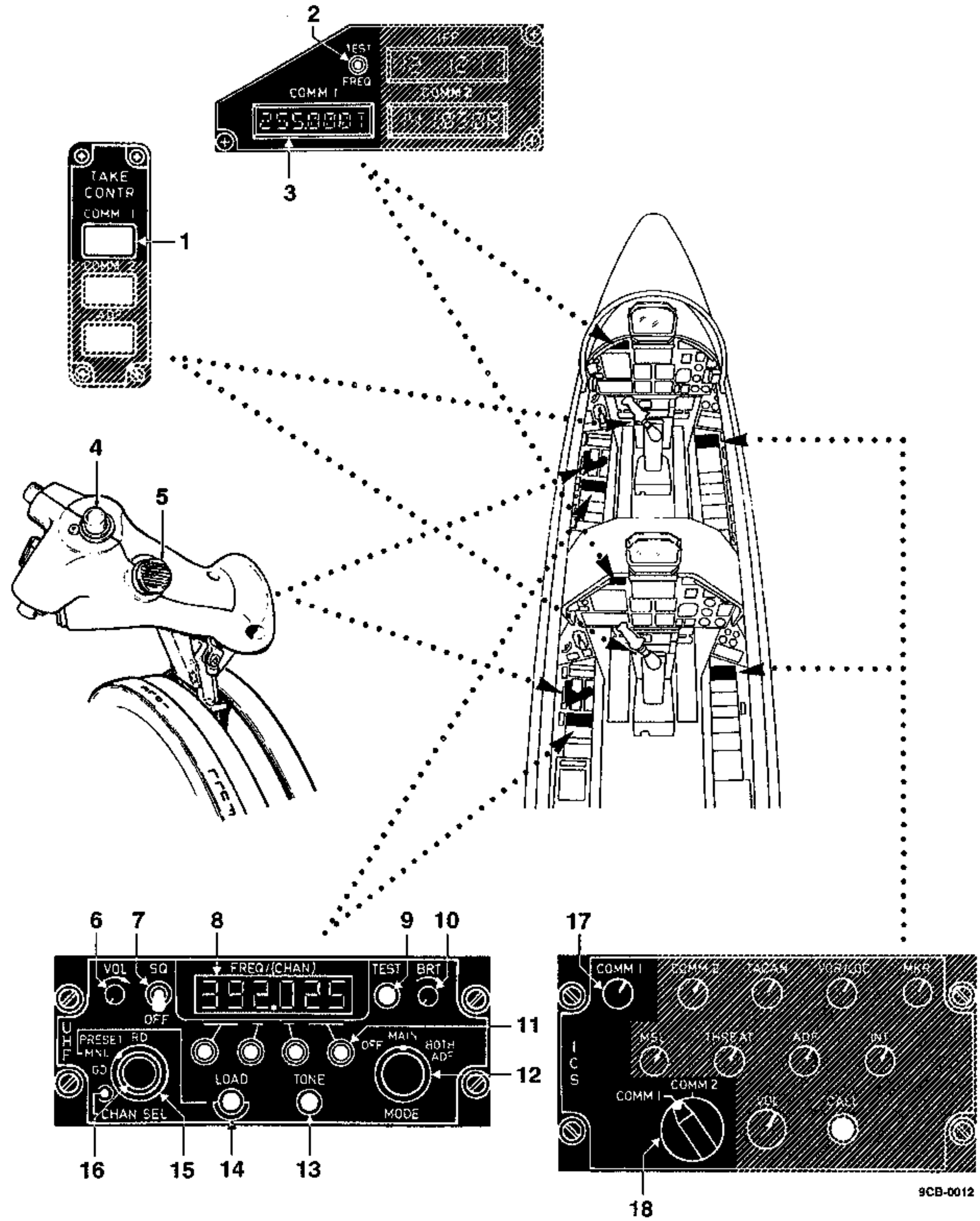


Figure 1-41 (Sheet 1 of 4)

UHF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "TAKE CONTR/COMM1" button light	Pressed and illuminated - Provides control of the UHF push-transceiver. **NOTE** Control cannot be shifted back to the other pilot (by pressing the same push-button again), the pilot who wants control presses the push-button.
2. "TEST/FREQ" switch	"TEST" - Momentarily displays 888.888 on the "COMM1" display to indicate correct operation. Center position - Indicates the manually selected frequency (frequency mode selector to MNL) or the preset channel (frequency mode selector to PRESET). "FREQ" - Momentarily indicates the frequency of the channel shown on the UHF control panel.
3. "COMM1" display	Shows the frequency selected on the UHF control panel.
4. Landing gear position push-button	Pressed - Transmits a signal to the ground, via radio, indicating that the landing gear is down and locked.
5. "COMM1/COMM2" switch	COMM1 - Permits transmission through the UHF system. OFF - The transmitters are not in operation. COMM2 - Permits transmission through the VHF system.
6. "VOL" knob	Inoperative
7. "SQ/OFF" switch	SQ - Connects the squelch circuit. OFF - De-energized position.
8. "FREQ/(CHAN)" display	Displays the manually selected frequency on the six readout indicators.

Figure 1-41 (Sheet 2)

UHF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
9. "TEST" push-button	Pressed - Brings momentarily in view number 888.888 with max brightness
10. "BRT" knob	Rotated - Adjusts the brightness of the UHF control panel.
11. Manual frequency selectors	Rotated - Select the desired frequency. The frequency mode selector must be at MNL. The four selectors set the frequency from right to left: 10 MHz, 1 MHz, 0,1 MHz and 25 KHz.
12. "MODE" selector	OFF - De-energized position. MAIN - Permits transmission or reception on the selected channel and frequency. The guard receiver is off. BOTH - Same as for the MAIN position, but the guard receiver is in operation and receives transmission on the guard frequency. ADF - Permits selection of the ADF function in the V/UHF-DF system.
13. "TONE" push-button	Pressed - Stops reception and transmits a 1020 Hz continuous wave (CW) modulated signal on the selected frequency.
14. "LOAD" push-button	Pressed - The channel selected through the manual frequency selectors on the "FREQ/(CHAN)" display, is stored.
15. Frequency mode selectors	GD - Receiver and transmitter are tuned to the guard frequency (243.0 MHz), and operate when the "MODE" selector is moved to MAIN or BOTH. MNL - The set operates on the frequency displayed on the "FREQ/CHAN" display. PRESET - The set operates on the channel displayed on the "FREQ/CHAN" display. RD - Displays the frequency corresponding to the preset channel.
16. "CHAN SEL" selector	Rotated - Permits selection of any of the 20 preset channels.

Figure 1-41 (Sheet 3)

UHF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
17. "COMM1" receive switch	Pulled out - Permits reception in the headset of the signals received by the UHF transceiver. Rotated - Adjusts the audio volume.
18. "COMM 1/COMM 2" rotary switch	COMM 1 - Permits the landing gear position push-button to transmit the landing gear position signal through the UHF system.

Figure 1-41 (Sheet 4)

3. Operate the manual frequency selectors or the channel selector in accordance with the choice made in step 2.
4. Pull out the "COMM2" receive switch (on the audio control panel).
5. Adjust the volume of the received signal by rotating the "COMM2" receive switch as desired.
6. To transmit, pull upthe "COMM1/COMM2" push-button on the engien throttle.
7. To trans;it the landing gear down signal to the groundstation, press the switch located on the engine throttle grip (in the front cockpit only).
8. To turn the set off, return the mode selector to OFF.

INTERPHONE SYSTEM

The aircraft interphone system provides a voice link between the two pilots; the system also provides cockpit-to-ground crew communications during ground operations. The aircraft is fitted with a ground crew jack box (GCJB) located in the proximity of the left wing tip and connected to the audio integrating system. The interphone system controls and indicators are described and illustrated in figure 1-43.

Operation of Interphone System

To communicate with the other pilot, proceed as follows:

1. Pullout or press the "INT" switch as desired:
   a. If the "INT" switch is pulled out (hot mic), the interphone communication takes place together with the other signals in the headset.

NOTE

An automatic "SQUELCH" circuit is included in the interphone line. This circuit is opened, permitting interphone communication, only in presence of signals higher than a pre-selected threshold, such as the pilot's voice.

It is however possible to obtain attenuation of the signals in the headset and to concurrently increase the volume of the interphone communication by pressing the "CALL" push-button on the audio control panel or on the control stick grip.

VHF SYSTEM CONTROLS AND INDICATORS

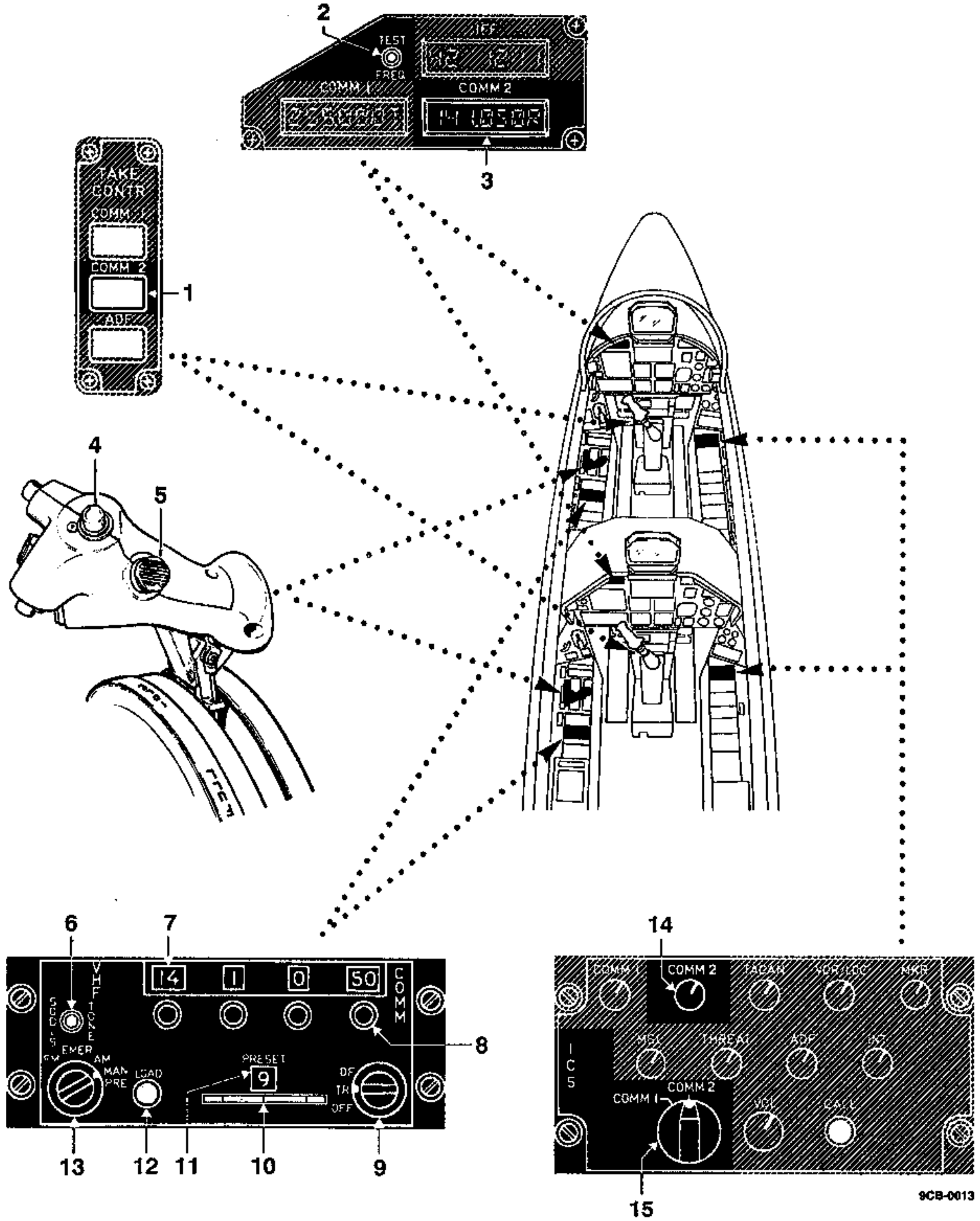


Figure 1-42 (Sheet 1 of 3)

VHF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "TAKE CONTR/COMM2" push-button light	Pressed and illuminated - Provides control of the VHF transceiver. **NOTE** The control cannot be shifted back to the other pilot (by pressing the same push-button again), the pilot who wants control presses the push-button.
2. "TEST/FREQ" switch	"TEST" - Momentarily displays 888.888 on the "COMM2" display to indicate correct operation. Center position - Indicates the manually selected frequency (frequency selector to MAN) or the preset channel (frequency selector to PRE). "FREQ" - Momentarily indicates the frequency of the channel shown on the VHF control panel.
3. "COMM2" display	Shows the frequency selected on the VHF control panel.
4. Landing gear position push-button	Pressed - Transmits a signal to the ground, via radio, indicating that the landing gear is down and locked.
5. "COMM1/COMM2" switch	"COMM1" - Permits transmission through the UHF system. "OFF" - The transmitters are not in operation. "COMM2" - Permits transmission through the VHF system.
6. "SQ DIS/TONE" switch	SQ DIS - The squelch circuit is disconnected. Center position - The squelch circuit is connected. TONE - Momentary position. Permits transmission of a 1020 Hz modulated signal on the selected frequency.
7. Frequency indicators	Display the manually selected frequency in the four windows.
8. Manual frequency selectors	Rotated - Select the desired frequency. The mode selector must be at "MAN"

Figure 1-42 (Sheet 2)

VHF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
9. Mode selector	OFF - De-energized position. TR - The transceiver is energized and permits transmission and reception. DF - Permits selection of the DF function in the V/UHF-DF system.
10. "PRESET" channel selector	Rotated - Permits selection of one of the 20 preset channels.
11 "PRESET" indicator	Indicates the preset channel.
12. "LOAD" push-button	Pressed - Stores the selected frequency in the "PRESET" channel.
13. Frequency selector	EMER FM - Permits the set to operate on a preset FM emergency channel (40.5 MHz). EMER AM - Permits the transceiver to operate on a preset AM emergency channel (121.5 MHz). MAN - Permits the transceiver to operate on the frequency displayed on the frequency indicators. PRE - Permits the transceiver to operate on the channel displayed on the "PRESET" indicator.
14. "COMM2" receive switch	Pulled out - Permits reception in the headset of the signals received by the VHF transceiver. Rotated - Adjusts the audio volume.
15. "COMM 1/COMM 2" rotary switch	COMM 2 - Permits the landing gear position push-button to transmit the landing gear position signal through the VHF system.

Figure 1-42 (Sheet 3)

b. If the "INT" switch is pressed (cold mic), the interphone communication is enabled only when the "CALL" push-button on the audio control panel is pressed. Pressing the "CALL" push-button still provides for attenuation of the radio signals received in the headset and for the concurrent increase of the volume of the interphone communications.

2. To adjust the volume of the interphone communications, turn the "INT" switch.

INTERPHONE SYSTEM CONTROLS AND INDICATORS

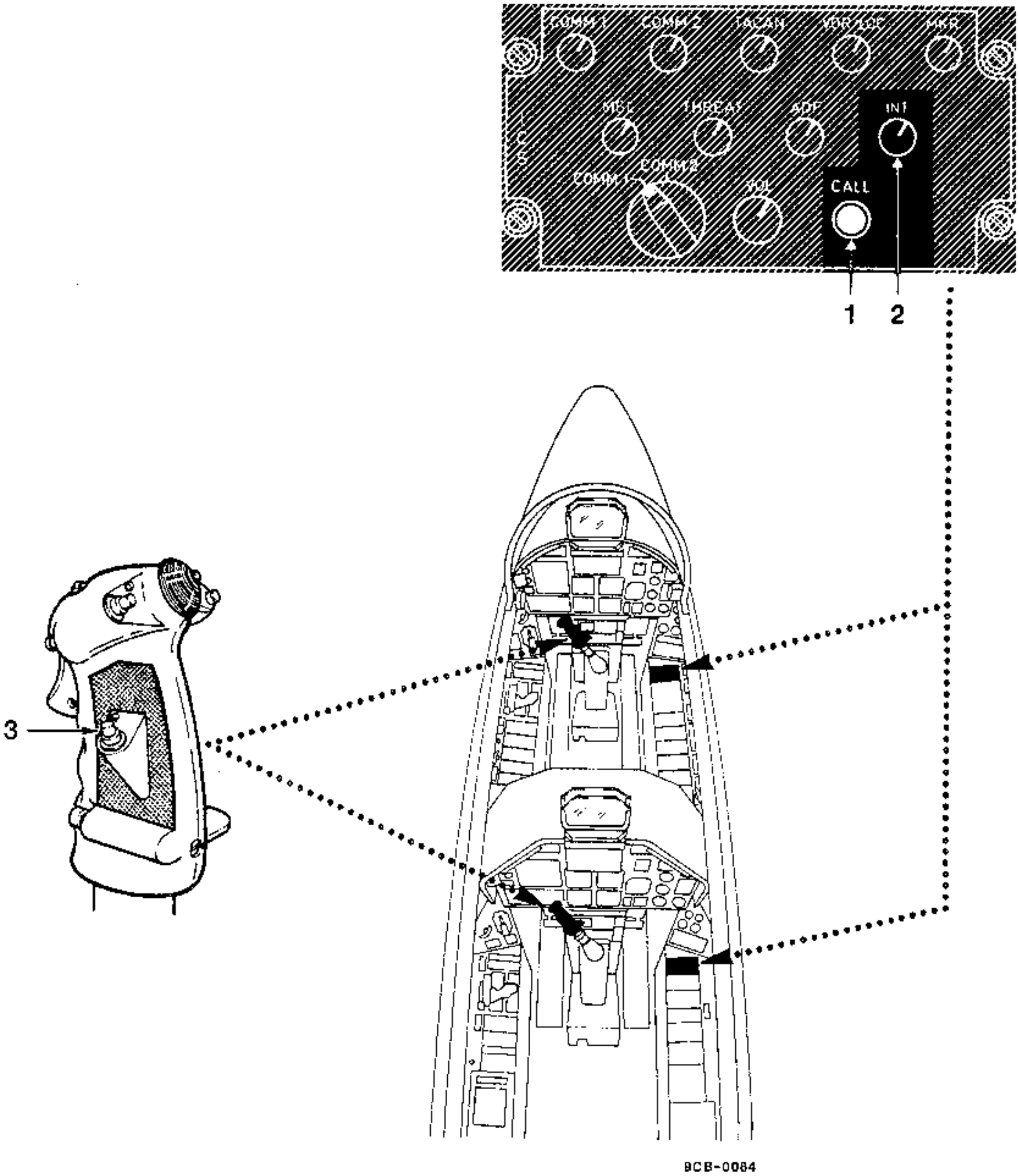


Figure 1-43 (Sheet 1 of 2)

INTERPHONE SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "CALL" push-button on the control panel	Pressed - Attenuates the volume of the received signals while increasing the audio level of the interphone communications.
2. "INT" switch	Pulled out - (Hot mike) - Interphone communications take place with no need to press the interphone push-button and without overriding the other radio signals. Under this condition, the "SQUELCH" circuit provides for attenuation of the background noise. Pressed - (Cold mike) - Interphone communications take place only when the "CALL" push-button on the control panel is pressed. Rotated - Adjusts the volume.
3. Call push-button (on the control stick grip)	Pressed - Attenuates the volume of the received signals while increasing the audio level of the interphone communications.

Figure 1-43 (Sheet 2)

AUDIO INTEGRATING SYSTEM

The ICS-200 audio and interphone system provides for communications between the crew members, mixing and distribution of the signals received from the radio and navigation units, from the radar warning (RWR) system, if installed, from the A/A missiles, if installed, and from the landing gear system, and routing of the microphone signals to the selected transceiver. An "ICS" control panel, located on each right console, incorporates eight receive switches with individual volume adjustment facilities, a "VOL" knob for adjustment of the global volume, a transmit selector switch, a "CALL" push-button and an "INT" switch for selection of the intercommunication mode. The system is powered from the 28 V dc essential bus, and comprises also a "COMM1/COMM2" push-button on each engine throttle and a call push-button on each control stick grip. The audio integrating system controls are described and illustrated in figure 1-44.

OPERATION OF AUDIO INTEGRATING SYSTEM

Set the controls on the audio control panel as follows:

1. Operate the receive switches corresponding to the sets it is desired to use.
2. Adjust the volume by rotating the "VOL" knob.

NOTE

It is advisable that the "VOL" knob be set approximately at mid-travel in order to obtain a satisfactory signal level. The volume of each radio set should then be adjusted by rotating the corresponding knobs on the audio control panel until the output levels of all receivers are properly balanced

AUDIO INTEGRATING SYSTEM CONTROLS AND INDICATORS

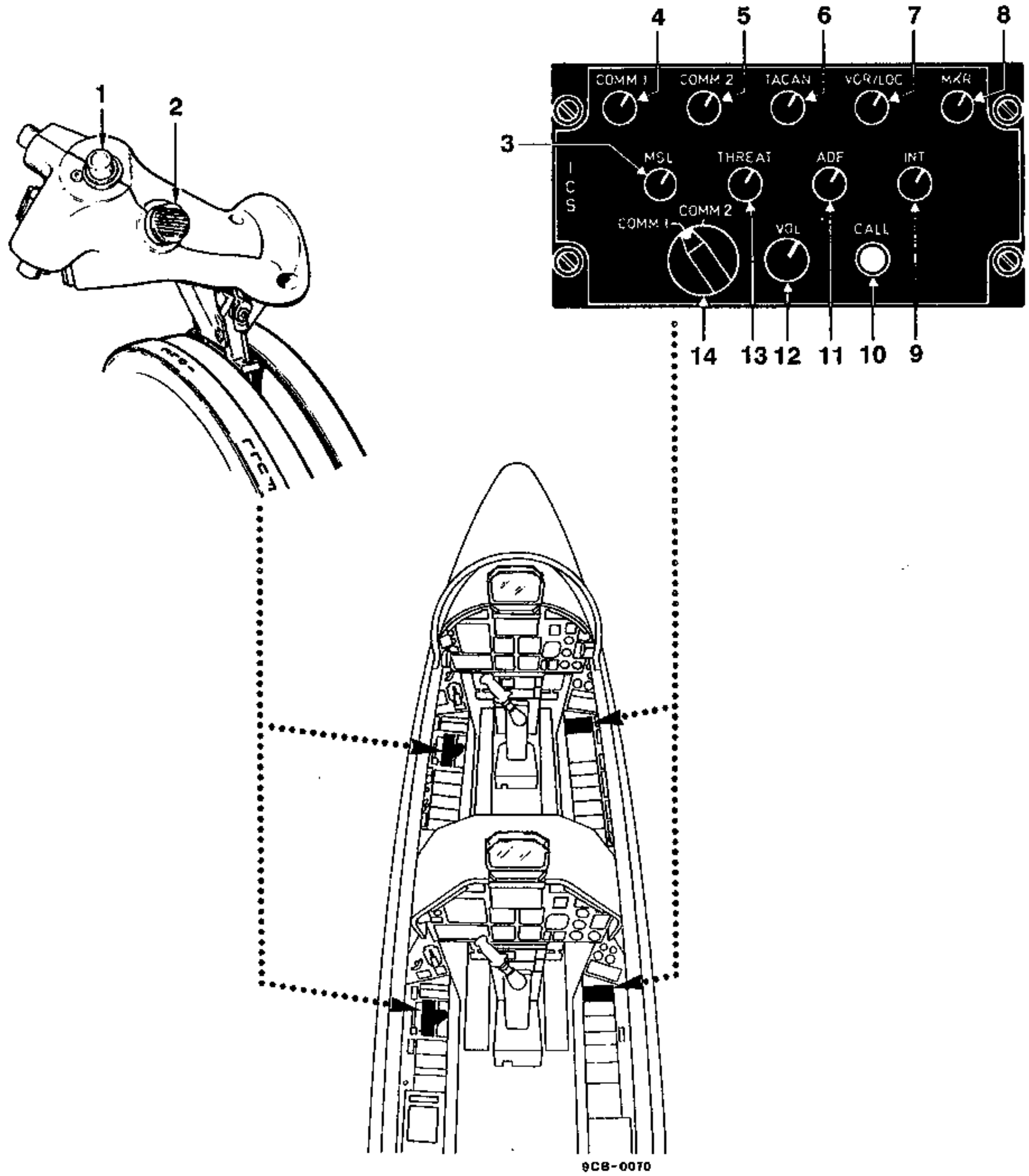


Figure 1-44 (Sheet 1 of 3)

AUDIO INTEGRATING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Landing gear position push-button	Pressed - Transmits a signal to the ground, via radio, indicating that the landing gear is down and locked.
2. "COMM1/COMM2" switch	"COMM1" - Permits transmission through the UHF system. "OFF" - The transmitters are not in operation. "COMM2" - Permits transmission through the VHF system.
3. "MSL" knob	Out - Connects the "MSL" audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the weapon control panel. In - Disconnects the "MSL" audio line from the headset amplifiers.
4 "COMM1" knob	Out - Connects the "COMM1" audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the UHF transceiver. In - Disconnects the "COMM1" audio line from the headset amplifiers.
5. "COMM2" knob	Out - Connects the "COMM2" audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the VHF transceiver. In - Disconnects the "COMM2" audio line from the headset amplifiers.
6. "TACAN" knob	Out - Connects the TACAN audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the TACAN transceiver. In - Disconnects the TACAN audio line from the headset amplifiers.
7. "VOR/LOC" knob	Out - Connects the VOR/LOC audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the VOR/LOC receiver. In - Disconnects the VOR/LOC audio line from the headset amplifiers.

Figure 1-44 (Sheet 2)

AUDIO INTEGRATING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "MKR" knob	Out - Connects the MKR audio line to the headset amplifiers Out and rotated - Adjusts the audio level of the MKR receiver. In - Disconnects the MKR audio line from the headset amplifiers.
9. INT" knob	Out - Permits reception and communication on the interphone line. Out and rotated - Adjusts the audio level of the interphone line. In - Permits reception on the interphone line.
10. "CALL" push-button	Pressed - Attenuates the volume of the received radio signals while increasing the audio level of the interphone communications.
11. "ADF" knob	Out - Connects the ADF audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the ADF receiver. In - Disconnects the ADF audio line from the headset amplifiers.
12. "VOL" knob	Adjusts the audio level of the signals received in the headset.
13. "THREAT" knob	Out - Connects the "THREAT" audio line to the headset amplifiers. Out and rotated - Adjusts the audio level of the RWR processor. In - Disconnects the "THREAT" audio line from the headset amplifiers.
14. "COMM 1/COMM 2" rotary switch	Selects the set to be used for transmission of the landing gear signal.

Figure 1-44 (Sheet 3)

LIGHTS SYSTEM

COCKPIT LIGHTS SYSTEM

The cockpit lights system comprises the control panel lights, instrument lights, red/white spot lights and white flood lights. There are four spot lights, one on each side of each cockpit. They are normally pointed at the instrument panel but can be detached from their supports and used as required and permitted by the length of the electric cord. Rotation of the knurled ring to the white dot selects white light, while rotation to the red dot brings a red screen across the lamp and gives red light. Light intensity is adjusted by rotating the red knurled knob. Pressing the push-button on the same knob will instantaneously give full brightness. Intermittent operation of the button, with the light detached from its support, enables Morse code signals to be transmitted when necessary. There are six white flood lights in the front cockpit and five in the rear cockpit. The flood lights can partially swivel to direct the light beam as necessary. Except for the spot lights which are controlled independently, the cockpit lights system is controlled from the "LIGHTS" control panel located on the right console in each cockpit. This panel houses the "CONSOLE" knob which controls the control panel lights, the "FLOOD" knob which controls the flood lights, and the "INST" knob which controls the instrument lights. The lights on the consoles are powered from the primary bus. All other interior lights are powered from the 28 V dc essential bus.

EXTERIOR LIGHTS SYSTEM

The exterior lights system consists of five navigation lights, six formation lights, an anti-collision light, a landing light, a nose light and a taxi light (Figure 1-45).
The navigation lights comprise two wingtip lights (red on the left wing tip, green on the right), a white light on the tail fairing and two white lights located one on the top of the fuselage mid-section and one on the bottom of the fuselage nose. The anti-collision light is mounted on the fin. The retractable landing light is installed under the left wing. The nose light is mounted in the aircraft nose. The taxi light is fitted to the nose landing gear leg. The exterior lights system is controlled from the "LIGHTS" control panel located on the right console in the front cockpit, from the "LDG LT/TAXI/NOSE LT" control panel located on the left side of the instrument panel, and from the "FORM LIGHTS" control panel located on the right console in the front cockpit. The illumination of the landing light depend on the position of the landing gear control lever (which must be set to down), whilst the taxi light illuminates only when the landing gear is down. The extinguishment of these lights (and retraction of the landing light) takes place automatically when the landing gear control lever is moved to LG UP even if the landing and taxi light switch is in the LDG LT or TAXI/NOSE LT position. When the switch is in the TAXI/NOSE LT position and the landing gear is up the nose light is on.

LIGHTS SYSTEM CONTROLS

The lights system controls are described and illustrated in figure 1-46.

OXYGEN SYSTEM

The oxygen system (Figure 1-47) comprises a low pressure demand type oxygen regulator mounted on the ejection seat and four interconnected cylinders having a total capacity of 68 liters. A pressure gauge and an "OXY FLOW" indicator, both powered from essential bus via the 'OXY PRESS' circuit breaker, are installed in each cockpit to monitor the oxygen system. The system has an operating pressure of 27.5 bar and can be refilled through a single filler valve accessible through an access door on the lower left side of the forward fuselage. The approximate duration of the oxygen supply is given in the table at figure 1-48. A pressure reducing valve reduces the system pressure from 27.5 bar to 5 bar for breathing. An "OXY LOW" caution light illuminates when pressure in the system falls below 7 ± 0.3 bar. An emergency oxygen supply is available from a bottle mounted on the ejection seat, and providing approximately 10 minutes duration. The oxygen system controls and indicators are described and illustrated in figure 1-49.

OPERATION OF OXYGEN SYSTEM

1. Supply lever - ON.
2. Diluter lever - N.

In this position, the regulator mixes air with oxygen in varying quantities according to the altitude, and supplies the mixture every time the pilot inhales. Above 28 000 ft cockpit altitude, the regulator supplies

EXTERIOR LIGHTS

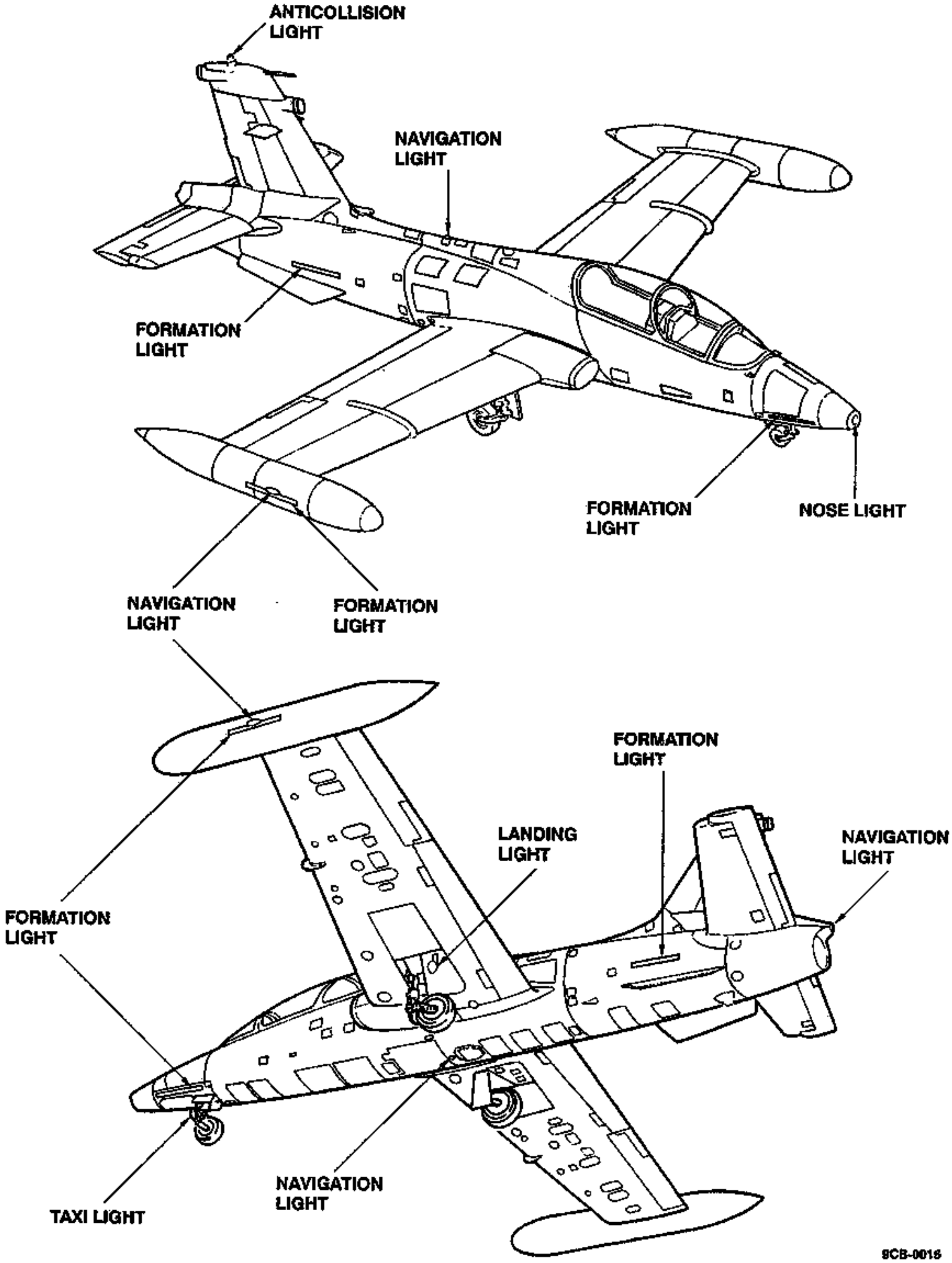


Figure 1-45

LIGHTS SYSTEM CONTROLS

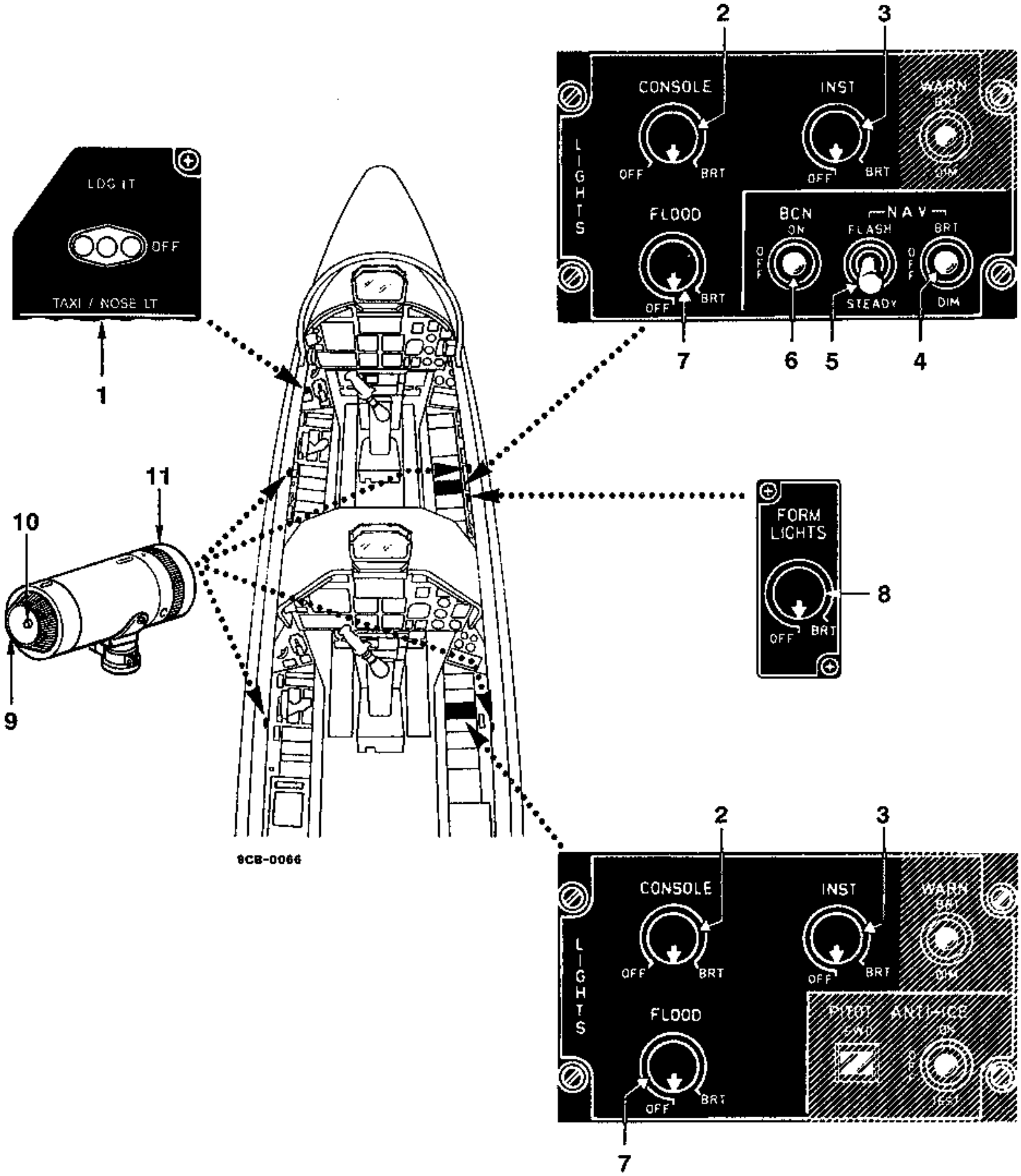


Figure 1-46 (Sheet 1 of 3)

LIGHTS SYSTEM CONTROLS

NOMENCLATURE	FUNCTION
1. "LDG LT/TAXI/NOSE LT"	LDG LT - Causes extension and illumination switch of the landing light. TAXI/NOSE LT - Causes illumination of the taxi light when the landing gear is down. - Causes illumination of the nose light when the landing gear is up. OFF - Causes retraction and extinguishment of the landing light or extinguishment of the taxi light or nose light.
2. "CONSOLE" knob	BRT - Turns on and controls the intensity of the control panel lights. OFF - Turns off the control panel lights.
3. "INST" knob	BRT - Turns on and controls the intensity of the instrument lights. OFF - Turns off the instrument lights.
4. "NAV BRT/DIM" switch	BRT - Turns on the navigation lights with maximum brightness. DIM - Turns on and dims the brightness of the navigation lights. OFF - Turns off the navigation lights.
5. "NAV STEADY/FLASH" switch	STEADY - Selects a steady illumination of the navigation lights. FLASH - Causes the tail and wingtip navigation lights to flash.
6. "BCN" anti-collision	ON - Turns on the anti-collision light. light switch OFF - Turns off the anti-collision light.
7. "FLOOD" knob	BRT - Turns on and controls the brightness of the cockpit lights. OFF - Turns off the cockpit lights.
8. "FORM LIGHTS" knob	BRT - Turns on and controls the brightness of the formation lights. OFF - Turns off the formation lights.

Figure 1-46 (Sheet 2)

LIGHTS SYSTEM CONTROLS

NOMENCLATURE	FUNCTION
9. Red knurled knob	Rotated clockwise - Turns on and controls the brightness of the spot lights.
10. Momentary illumination push-button	Pressed - Momentary position - Causes the spot light to illuminate only as long as the button is held pressed. The spot light can thus be used for intermittent light signals.
11. Knurled ring	Rotated clockwise - Brings a red screen across the lamp changing the light color from white to red. Rotated counterclockwise - Remove the red screen from the lamp.

Figure 1-46 (Sheet 3)

pure oxygen. From 36 000 ft the regulator delivers 100% oxygen with an automatic pressure breathing regulated by an aneroid capsule which expands versus the altitude. From an altitude of 49 000 ft the pressure breathing is regulated at about 45 mbar by the overpressure safety valve.

3. "OXY FLOW" indicator (blinker). It must alternately display white and striped markers corresponding to the breathing cycle.
4. Observe the "OXY" pressure gauge to check the oxygen supply.

NOTE

> As the aircraft attains high altitudes and low temperatures, the oxygen cylinders contained in the wings become chilled. As the cylinders grow colder, the oxygen pressure gauge indication reduces, sometimes rather rapidly. With a 40°C decrease in the temperature of the cylinders, the gauge pressure indication can be expected to drop as much as 20 percent. This rapid fall in pressure shall not be cause for unnecessary alarm. All the oxygen is still there and as the aircraft descends to warmer altitudes the pressure will rise again, then the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the aircraft is in level flight, or while it is descending is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

INDICATING AND RECORDING SYSTEMS

The indicating and recording systems consist of the following subsystems:

- Independent instruments
- Recording system
- Warning and caution lights system
- Central display system.

OXYGEN SYSTEM

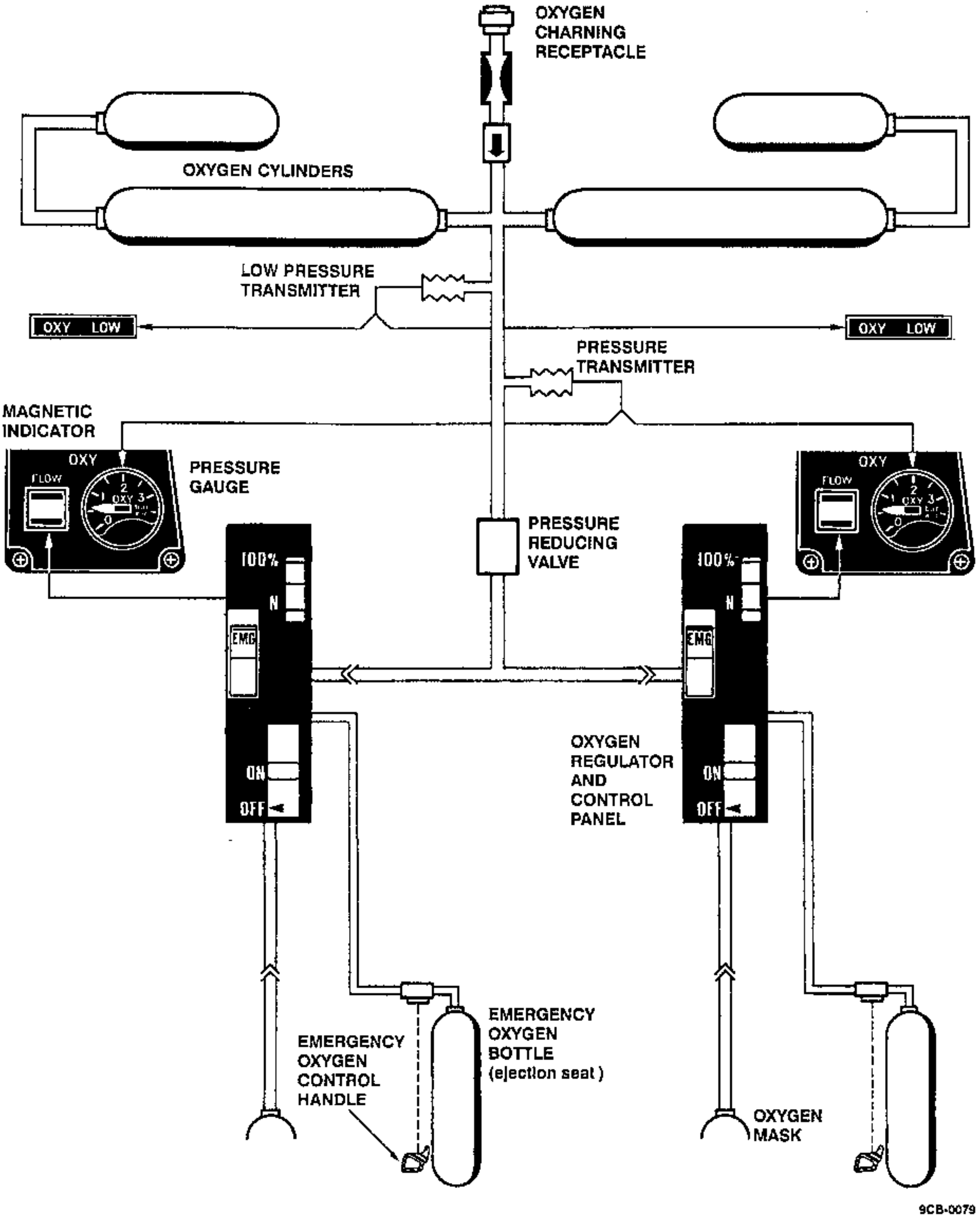


Figure 1-47

OXYGEN DURATION CHART-TWO CREW MEMBERS

COCKPIT ALTITUDE FT	PRESSURE - bar								**OXY LOW** CAUTION LIGHT ON BELOW 7 BAR
	30	27,5	25	20	15	10	7	5	
28 000 AND ABOVE	3 : 00	2 : 43	2 : 26	1 : 52	1 : 18	0 : 44	0 : 24	0 : 10	EMERGENCY ⇩ DESCEND TO ALTITUDE NOT REQUIRING USE OF OXYGEN
	3 : 00	**2 : 43**	**2 : 26**	**1 : 52**	**1 : 18**	**0 : 44**	**0 : 24**	**0 : 10**	
25 000	2 : 35	2 : 20	2 : 06	1 : 36	1 : 07	0 : 38	0 : 21	0 : 09	
	3 : 26	**3 : 07**	**2 : 48**	**2 : 09**	**1 : 30**	**0 : 51**	**0 : 28**	**0 : 12**	
20 000	2 : 03	1 : 51	1 : 39	1 : 16	0 : 53	0 : 30	0 : 16	0 : 07	
	4 : 07	**3 : 44**	**3 : 20**	**2 : 34**	**1 : 47**	**1 : 01.**	**0 : 33**	**0 : 14**	
15 000	1 : 38	1 : 29	1 : 20	1 : 01	0 : 42	0 : 24	0 : 13	0 : 05	
	4 : 36	**4 : 10**	**3 : 44**	**2 : 52**	**2 : 00**	**1 : 08**	**0 : 37**	**0 : 16**	
10 000	1 : 19	1 : 12	1 : 04	0 : 49	0 : 34	0 : 19	0 : 10	0 : 04	
	4 : 31	**4 : 06**	**3 : 40**	**2 : 49**	**1 : 58**	**1 : 07**	**0 : 36**	**0 : 16**	
8 000	1 : 13	1 : 06	0 : 59	0 : 45	0 : 32	0 : 18	0 : 09	0 : 04	
	4 : 19	**3 : 54**	**3 : 30**	**2 : 41**	**1 : 53**	**1 : 04**	**0 : 35**	**0 : 15**	
5 000	1 : 05	0 : 59	0 : 53	0 : 40	0 : 28	0 : 16	0 : 08	0 : 03	
	3 : 50	**3 : 28**	**3 : 07**	**2 : 23**	**1 : 40**	**0 : 57**	**0 : 31**	**0 : 13**	
0	0 : 53	0 : 48	0 : 43	0 : 33	0 : 23	0 : 13	0 : 07	0 : 03	
	2 : 50	**2 : 34**	**2 : 18**	**1 : 46**	**1 : 14**	**0 : 42**	**0 : 23**	**0 : 10**	
	HOURS AND MINUTES OXYGEN REMAINING								

100% OXYGEN

NORMAL OXYGEN

NOTE

FOR ONE CREW MEMBER ONLY, OXYGEN DURATION IS APPROXIMATELY DOUBLE

NOTE

DATA ARE BASED ON MIL-D-8683B AND ARE FURNISHED FOR GUIDANCE ONLY SINCE OXYGEN CONSUMPTION CHANGES INDIVIDUALLY

9CB-0261

Figure 1-48

OXYGEN SYSTEM CONTROLS AND INDICATORS

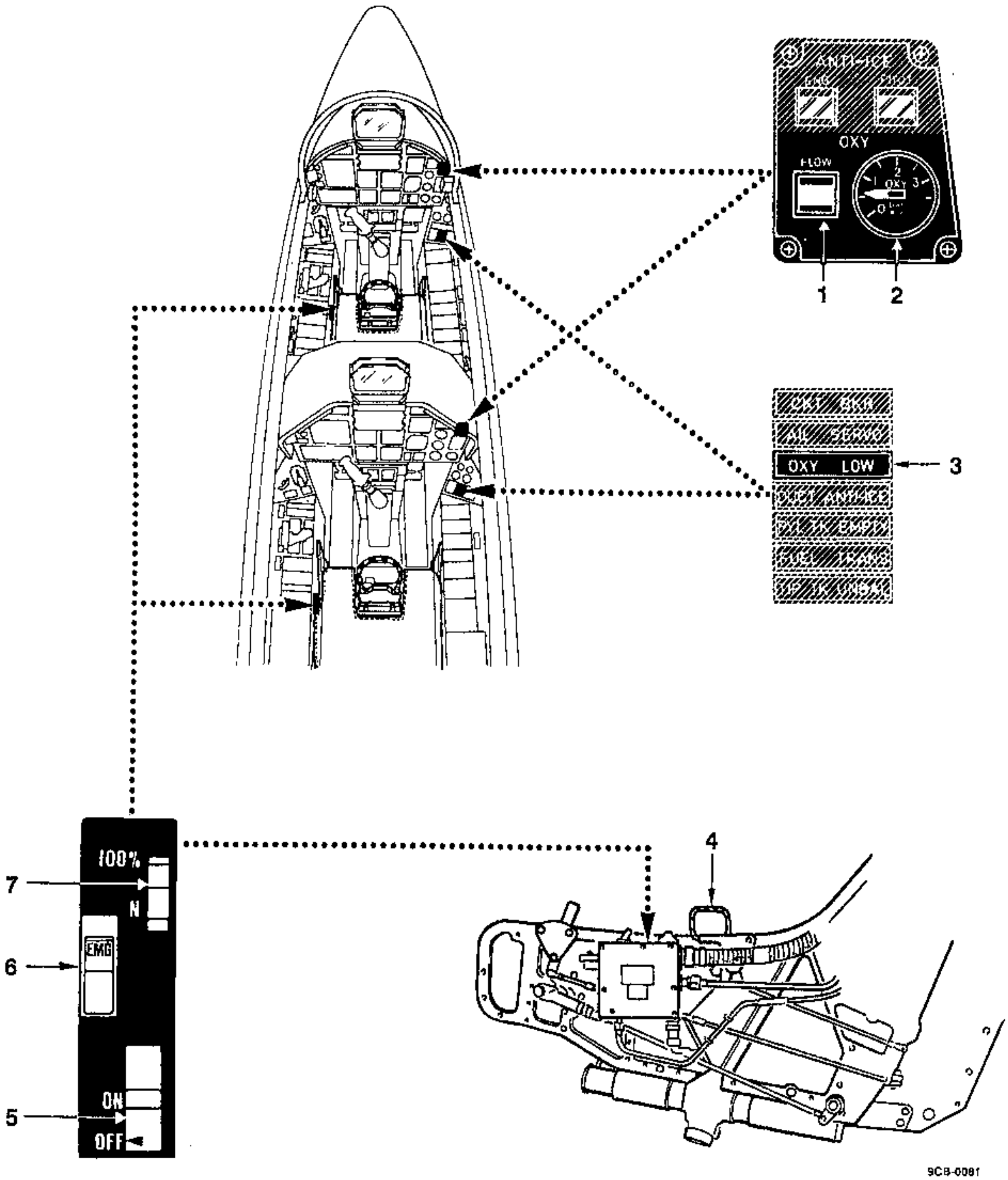


Figure 1-49 (Sheet 1 of 2)

OXYGEN SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "OXYGEN FLOW" indicator	Shows an alternate white and striped pattern during the pilot's breathing cycle to indicate regular oxygen flow.
2. "OXY" pressure gauge	Indicates the oxygen pressure in the system in bars.
3. "OXY LOW" caution light	On - When pressure in the system drops below 7 bar.
4. Emergency oxygen handle	Pulled - Causes the oxygen contained in the seat bottle to be supplied through the system regulator. The flow cannot be interrupted and continues for approx 10 minutes, after which the emergency oxygen is depleted.
5. Supply lever	ON - Provides oxygen supply. OFF - Oxygen supply is interrupted.
6. "EMG" emergency lever	Pressed forward - Continuously delivers pressurized oxygen to the mask. Pressed aft - Oxygen is supplied at normal pressure.
7. Diluter lever	N - Provides regulated mixture of cockpit air and oxygen as a function of the cockpit altitude. 100% - Provides a supply of 100% oxygen.

Figure 1-49 (Sheet 2)

INDEPENDENT INSTRUMENTS

Each cockpit is fitted with the following independent instruments:

- Cabin altimeter
- Accelerometer
- Clock
- Stand-by compass

Cabin Altimeter

The cabin altimeters are located on the centerstand in each cockpit. They indicate the cabin pressure altitude. The cabin altimeters provide a means to check the correct operation of the cockpit pressurization system.

Accelerometer

The accelerometer (Figures 1-3 and 1-6) provides indication of the "normal" inertia forces (loads along the vertical axis of the aircraft) expressed in "g" units. In addition to the conventional main pointer, the instrument incorporates two recording pointers (one for the positive "g" and one for the negative "g"), which remain at the maximum travel positions reached by the main pointer, thus providing a record of the maximum "g" loads sustained. These recording pointers are returned to the normal (1 "g") position by pressing the knob on the lower left side of the instrument.

Clock

A clock is mounted on both instrument panels (Figures 1-3 and 1-6). A knurled knob in the lower left corner is used to wind the clock when in the normal position, whilst in the pulled-out position it sets the clock hands. The instrument includes a stopwatch using two hands, one for the minutes and one for the seconds. A knob on the upper right corner of the instrument is used to start, stop and return the elapsed-time mechanism to the initial position.

Stand-by Compass

A conventional stand-by magnetic compass is mounted on the right side of the front instrument panel (Figure 1-3).

RECORDING SYSTEM

Airborne Strain Counter

The aircraft is fitted with an airborne strain counter system (ASC) which acquires, pre-processes and stores the local structural strain data during flight. The system consists of an ASC unit, an accelerometer and seven strain gauges mounted in the seven most significant points of the aircraft. Where access is difficult, an extra strain gauge is provided for redundancy. The ASC is interfaced with a ground support unit to allow post-flight data transfer and subsequent processing.

Counting Accelerometer

The aircraft is equipped with a counting accelerometer (fatigue meter). This records the normal acceleration of the aircraft center of gravity, and allows the fatigue life expended by the aircraft structure to be computed. A micro-switch located in the front landing gear control lever allows the counting accelerometer to operate only when the landing gear control lever is in the UP position.

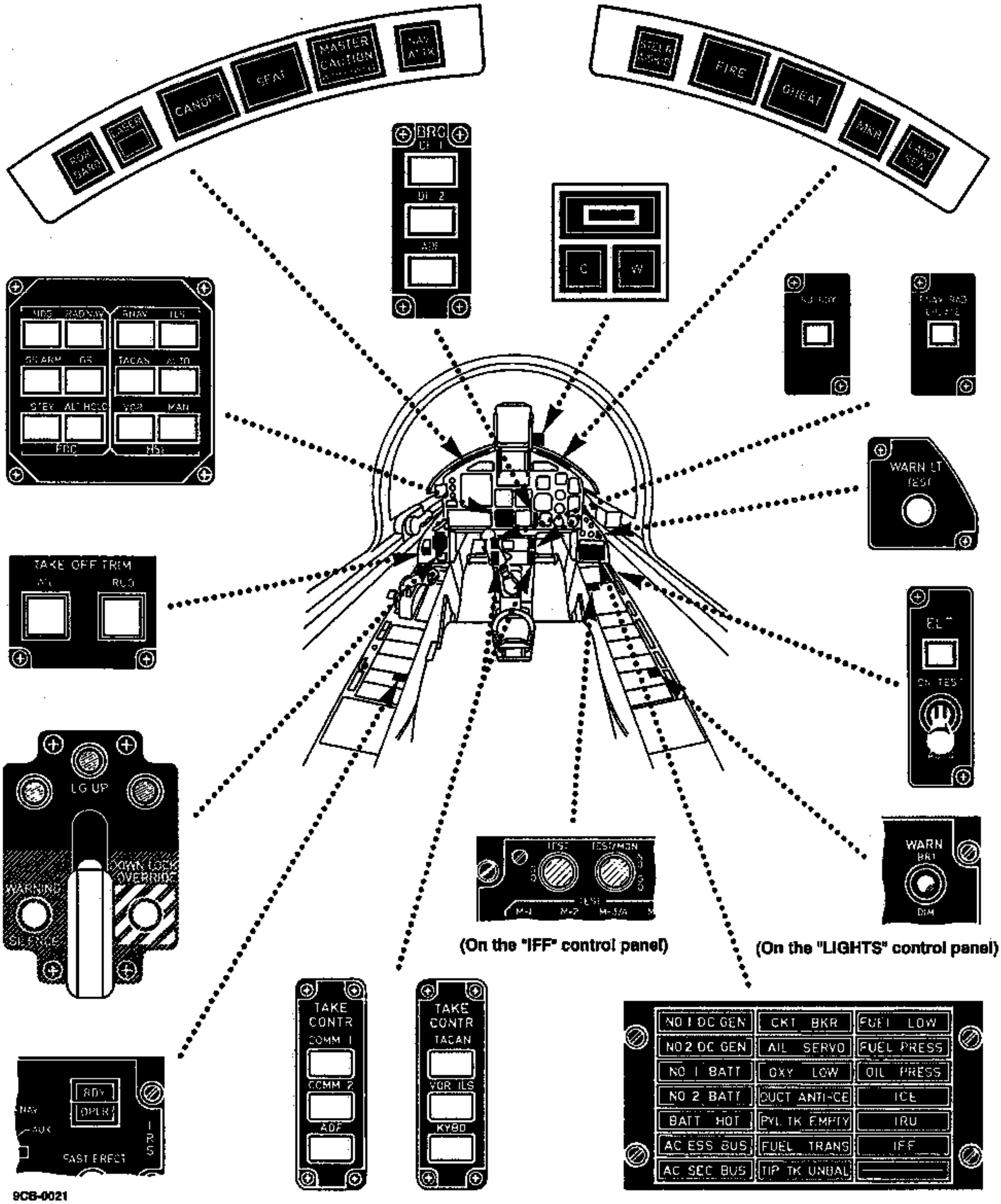
WARNING AND CAUTION LIGHTS SYSTEM

The system (Figure 1-50), consisting of warning, caution and advisory lights, enables the pilot to monitor the condition of the aircraft systems and components. All lights except the lights on the "TAKE CONTR" panels, the "SMS" control panel, the "SMS" monitor panel, the "FDS/HSI" control panels, the "IRS" control panels and the "BRG" control panels can be tested, together with the fire and overheat warning system, by use of the "WARN LT TEST" push-button. The intensity of the lights is controlled by a three-position "WARN" switch with spring-loaded center-off position.

NOTE

> During daylight flight, the "INST" knob on the "LIGHTS" control panel is normally at OFF. Under this condition, the "WARN" switch is inoperative and the lights are selected to maximum brightness.

WARNING, CAUTION AND ADVISORY LIGHTS | FRONT COCKPIT



(On the "IFF" control panel)

(On the "LIGHTS" control panel)

Figure 1-50 (Sheet 1 of 2)

WARNING, CAUTION AND ADVISORY LIGHTS | REAR COCKPIT

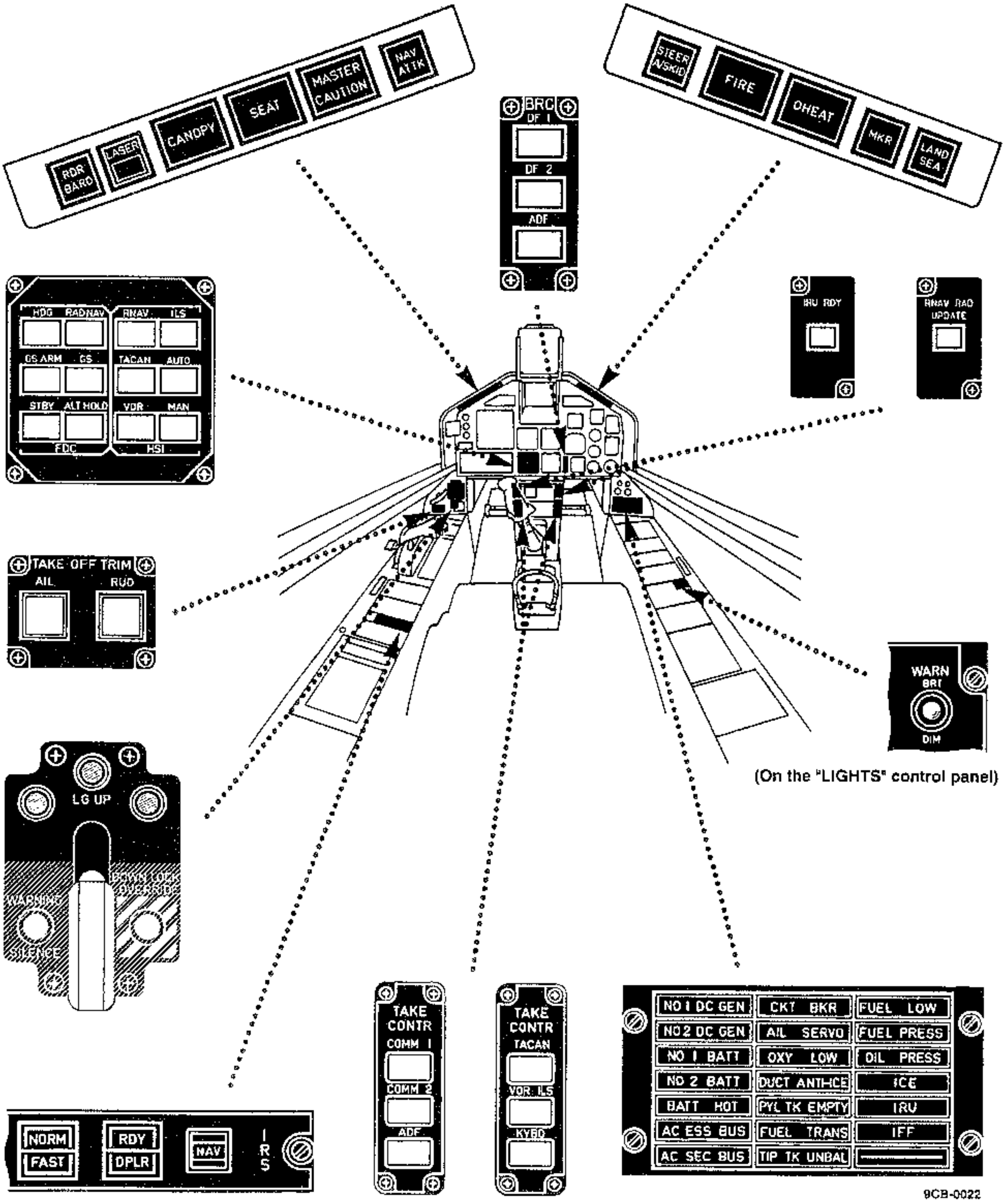


Figure 1-50 (Sheet 2)

Warning Lights

The illumination of a warning light indicates a hazard condition requiring immediate corrective action. The warning lights are: "CANOPY", "SEAT", and "FIRE". These lights are located on the miscellaneous indicator panels under the glareshield. A warning light is also incorporated in the landing gear lever grip. For a fuller explanation of the information provided by these warning lights, refer to the relevant systems.

Caution Lights

The illumination of a yellow caution light indicates a defective condition requiring immediate pilot's attention but not necessarily immediate corrective action. The malfunction indicated by the caution light does not affect the aircraft safety and, in some circumstances, can be remedied in flight by the pilot. The caution light will however remain on until the problem is corrected. The caution lights of the different systems are grouped on the caution lights panel, while the "OHEAT" caution light is located on the miscellaneous indicator panel, under the glareshield, in each cockpit. A "MASTER CAUTION" light (front cockpit) and a "CAUTION" light (rear cockpit) illuminate whenever a caution light on the caution lights panel comes on. The "MASTER CAUTION" and "CAUTION" lights may be extinguished by pressing the cover of the "MASTER CAUTION" light. This rearms the master circuit for a subsequent caution light illumination. An illuminated caution light on the caution light panel will not be turned off by resetting the "MASTER CAUTION" light. For a fuller explanation of the information provided by the caution lights, refer to the relevant systems.

Advisory Lights

Illumination of a green advisory light warns the pilot of a change in the condition of a system. The advisory lights are illustrated in figure 1-50 together with the warning and caution lights.

CENTRAL DISPLAY SYSTEM

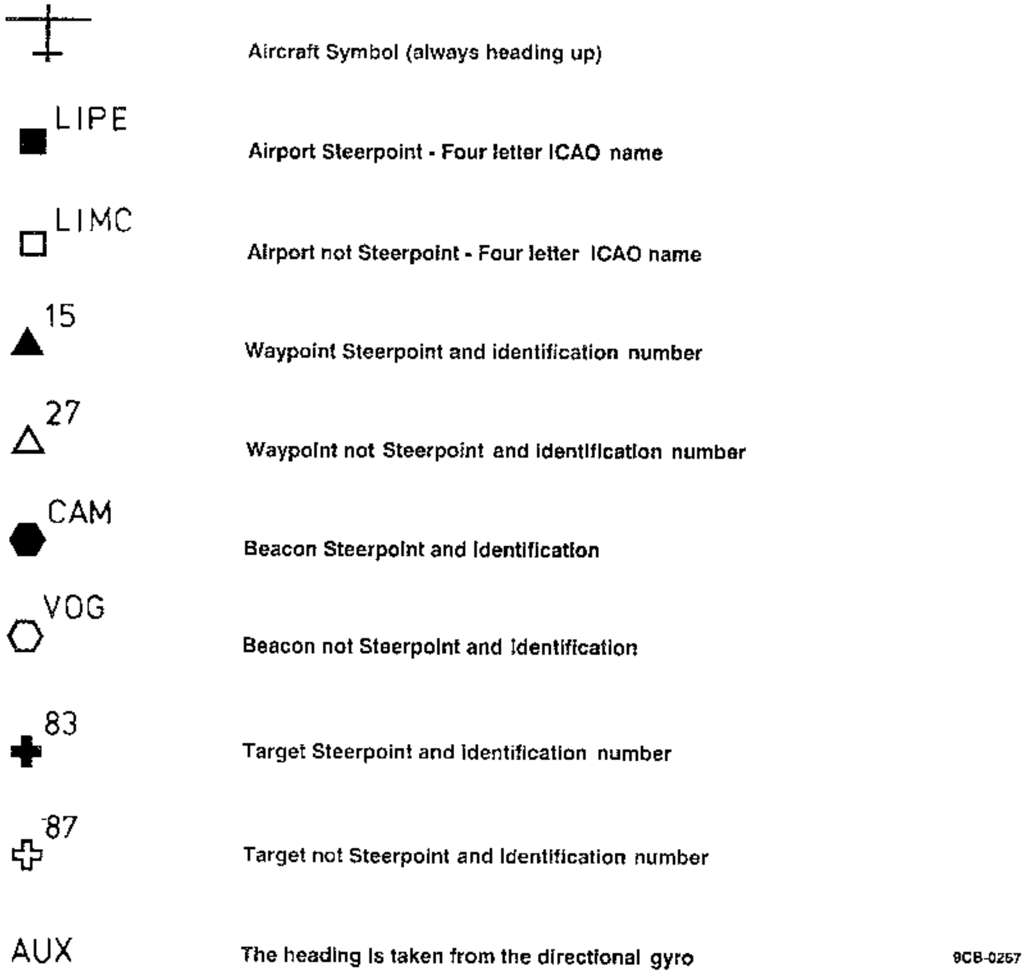
Multifunction Display System (MFD)

The aircraft is fitted with a multifunction display system (Figure 1-51) consisting mainly of two cathode-ray tubes (CRT) (one in each cockpit) with a square presentation. The MFD system provides the pilots with real time display of the navigation and electro-optical weapon (if installed) aiming information through computer-generated symbols. The navigation information is received directly from the TRNAV computer; the aiming information is recived from the electro-optical weapons through the stores management computer (SMC) (if the AGM-65() missile is installed) and from the TRNAV computer. The rear MFD can display, when the "TV CAMERA" switch (rear left console) is set to ON, the images filmed by the video camera (if installed) located on the front PDU, thus providing the rear pilot with the images seen by the front pilot. The multifunction display system is powered from the 28 V dc primary bus. The MFD system controls and indicators are described and illustrated in figure 1-52.

MULTIFUNCTION DISPLAY SYSTEM OPERATION

The system operates in four modes selectable by the pilots through the push-buttons located on the MFD frame:

- MAP Mode
  1. When the "MAP" key is pressed, an aircraft symbol appears at the center of the MFD and a magnetic heading scale is shown against a reference triangle-index, on the upper part of the MFD. The waypoints points stored in the navigation computer (NCU) memory are displayed with a scale of 30, 120, 250 and 500 nm and shown with the following symbols:



2. The aircraft symbol is shown at the center of the MFD, heading up.
3. To decenter the aircraft symbol to the lower end of the MFD, press the "↓" key.
4. To change the scale of the map between 30, 120, 250 and 500 nmi, press the "SC" key:

   scale "30" means: 4 inches = 30 nmi
   scale "120" means: 4 inches = 120 nmi
   scale "250" means: 4 inches = 250 nmi
   scale "500" means: 4 inches = 500 nmi
5. A dotted line going out of the aircraft symbol to the magnetic heading scale represents the magnetic course of the aircraft.

The MAP mode configuration is illustrated in figure 1-54.

- EO Mode (if the AGM-65() missile is installed)
  1. When the "EO" key is pressed, the video camera installed in the search and guidance head of the AGM-65() missile sends images to the MFD through the stores management computer.
  2. The operation is possible only:

MULTIFUNCTION DISPLAY SYSTEM BLOCK DIAGRAM

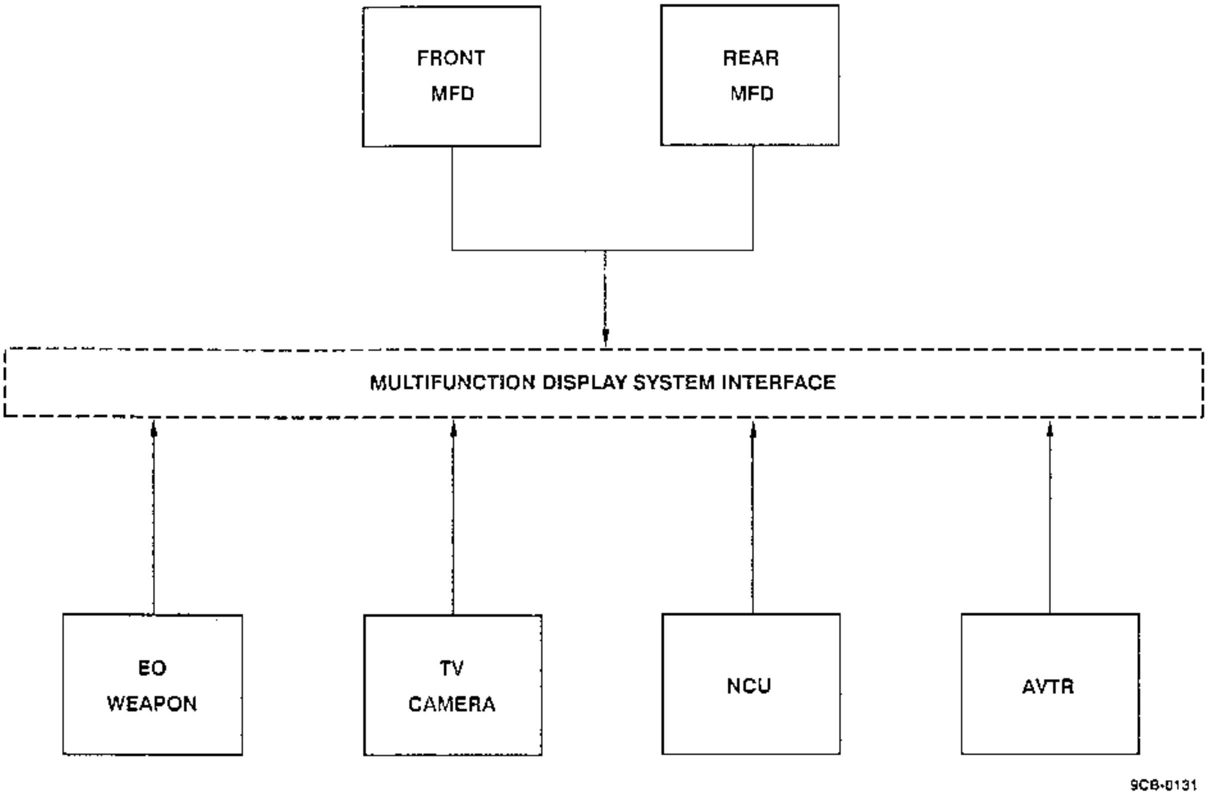


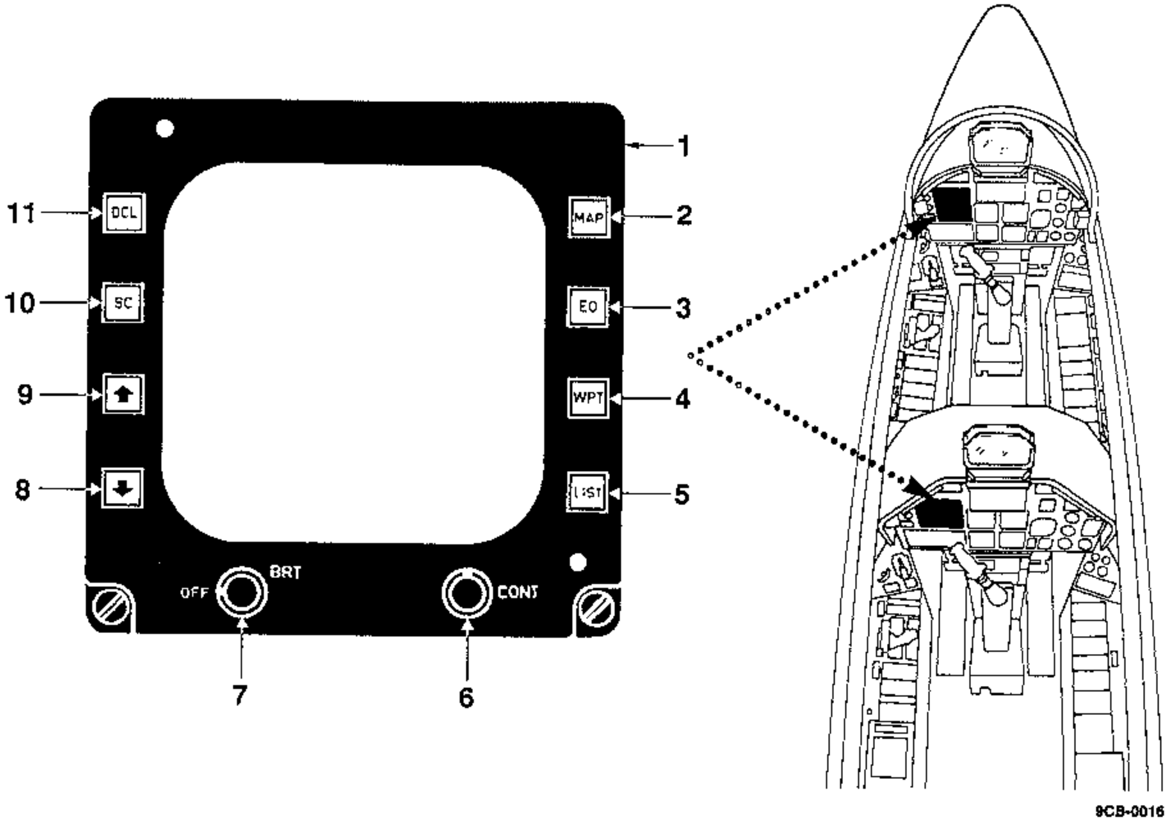
Figure 1-51

- When the AGM-65() missile is installed, and continues after weapon release.
- When the air-to-ground missile (AGM) delivery mode is selected.
- After dome jettison has been operated by pressing the uncage push-button.

3. If the missile used is the AGM-65B or D, the video image can be magnified 4 times by pressing the relevant push-button on the weapon control panel.
4. The video image can be changed from positive (label POS on the weapon control panel) to negative (NEG on the weapon control panel) for better image definition, by pressing the mode push-button on the weapon control panel.

- WPT Mode (Waypoint)
  1. When the "WPT" key is pressed, the list of the waypoints stored in the NCU memory appears on pages of 23 lines each; up to 1000 pieces of information can be displayed.
  2. To change the page, the pilot must press the "↓" key for the next page and "↑ " key for the previous page.

MFD SYSTEM CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. Multifunction display (MFD)	Displays the navigation and weapon aiming information.
2. "MAP" key	Pressed - The aircraft symbol appears at the center of the MFD, the waypoints stored in the NCU memory are displayed and the magnetic scale is shown against a reference triangle- index, on the upper part of the MFD.
3. "EO" key	Pressed - (Operative only if AGM-65() missile installed) - The camera installed in the search and guidance head of the missile sends images to the MFD through the store management computer.

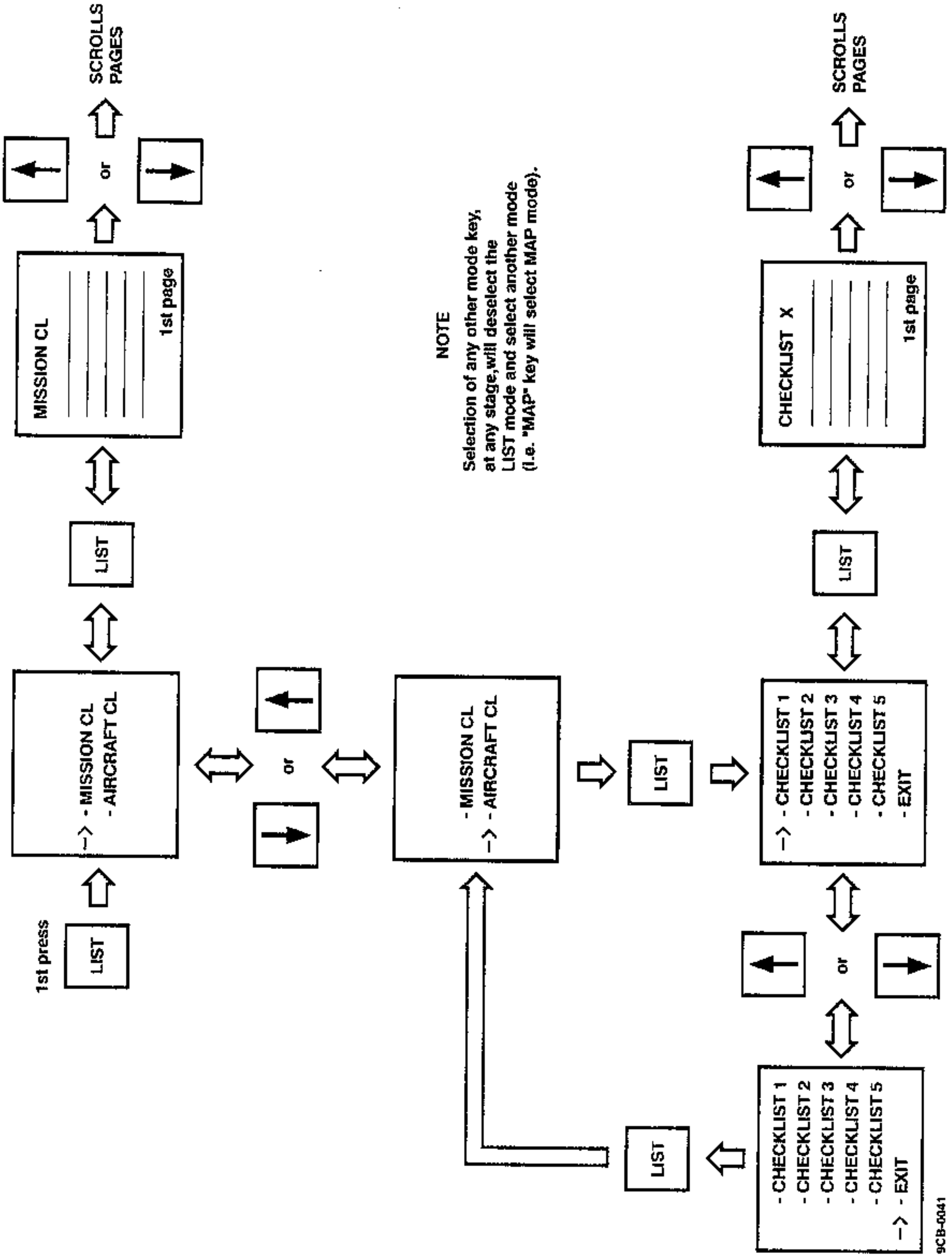
Figure 1-52 (Sheet 1 of 2)

MFD SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
4. "WPT" key	Pressed - The list of the waypoints stored in the NCU memory is displayed.
5. "LIST" key	Pressed - Refer to figure 1-53.
6. "CONT" knob	Rotated clockwise - Controls the contrast of the MFD.
7. "BRT/OFF" knob	Rotated clockwise - Turns on and controls the brightness of the MFD.
8. "↓" key	When pressed, permits the following selections: MAP mode - Decenters the aircraft symbol to the bottom of the MFD. WPT mode - The next page is presented on the MFD. LIST mode - Refer to figure 1-53.
9. "↑" key	When pressed, permits the following selections: MAP mode - Will recenter the aircraft symbol if positioned at the bottom of the MFD. WPT mode - The previous page is presented on the MFD. LIST mode - Refer to figure 1-53.
10. "SC" key	When pressed, changes the scale of the map between 30, 120, 250 and 500 nm.
11. "DCL" key	When pressed, permits three levels of declutter to be obtained, in MAP mode only: First press - The MFD shows only the waypoints, flight plan, and steerpoints, if any. Second press: - The MFD shows only the beacons. Third press - The MFD shows only the airports. Fourth press - No declutter. NOTE The flight plan (if in use) and the steerpoint are always displayed (scale value permitting).

Figure 1-52 (Sheet 2)

MFD LIST MODE



NOTE

Selection of any other mode key, at any stage, will deselect the LIST mode and select another mode (I.e. "MAP" key will select MAP mode).

Figure 1-53

MFD MAP MODE CONFIGURATION

VIDEO DISPLAY SYMBOLS

	IDENT CODE	SYMBOL	STEERPOINT SYMBOL
NORMAL WAYPOINT	01 to 79 90 to 99	△	▲
TARGET WAYPOINT	80 to 89	✙	✚
AIRPORT	AAAA to ZZZZ	□	■
BEACON	AAA to ZZZ	⬡	⬢

RNAV MODE

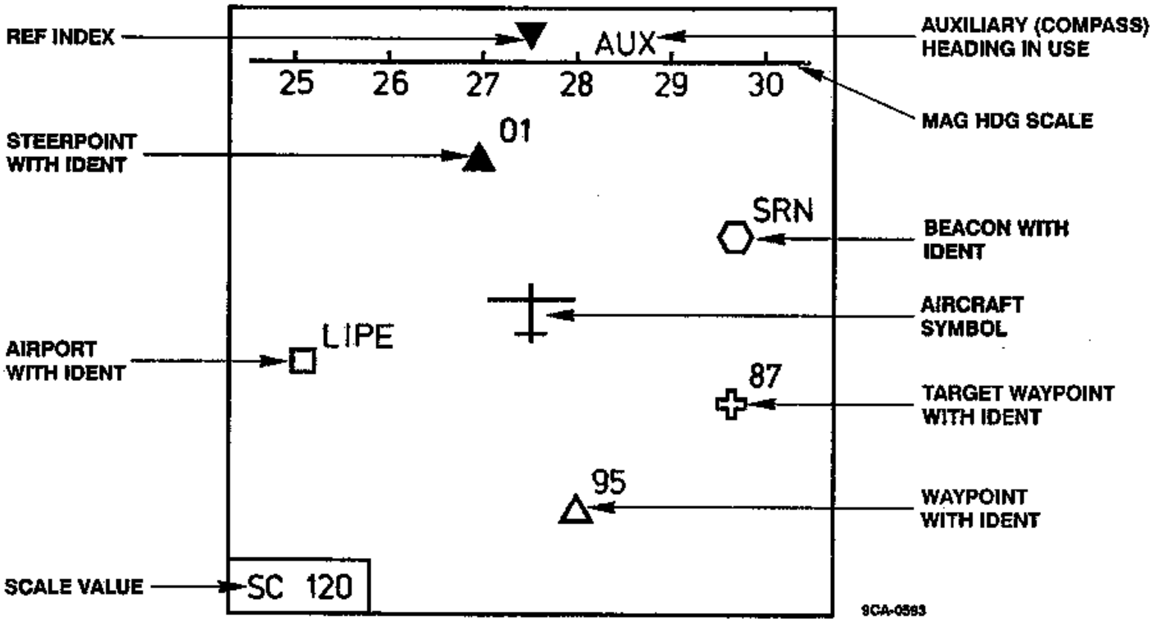
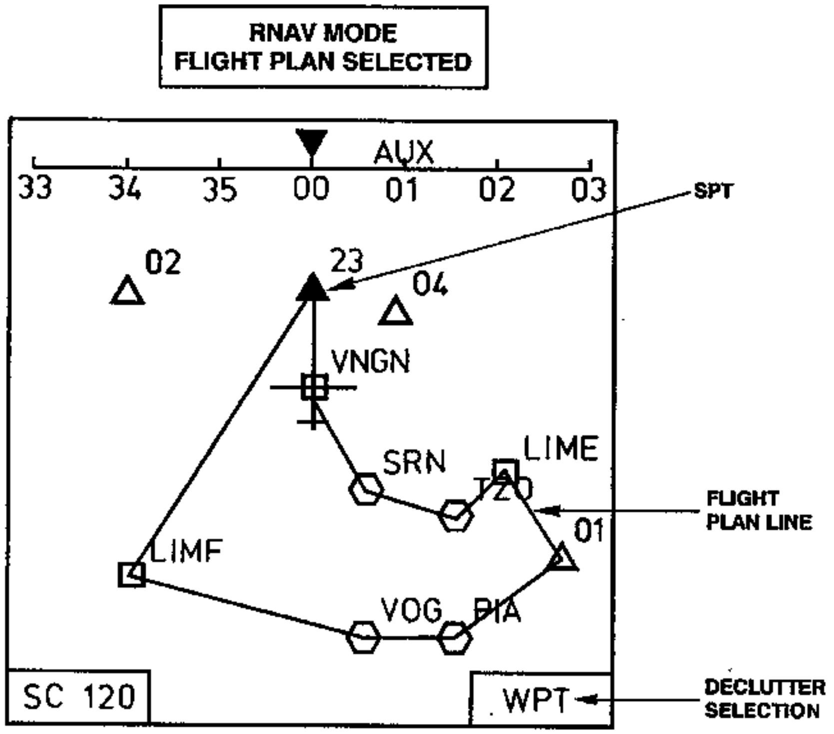


Figure 1-54 (Sheet 1 of 3)

MFD MAP MODE CONFIGURATION



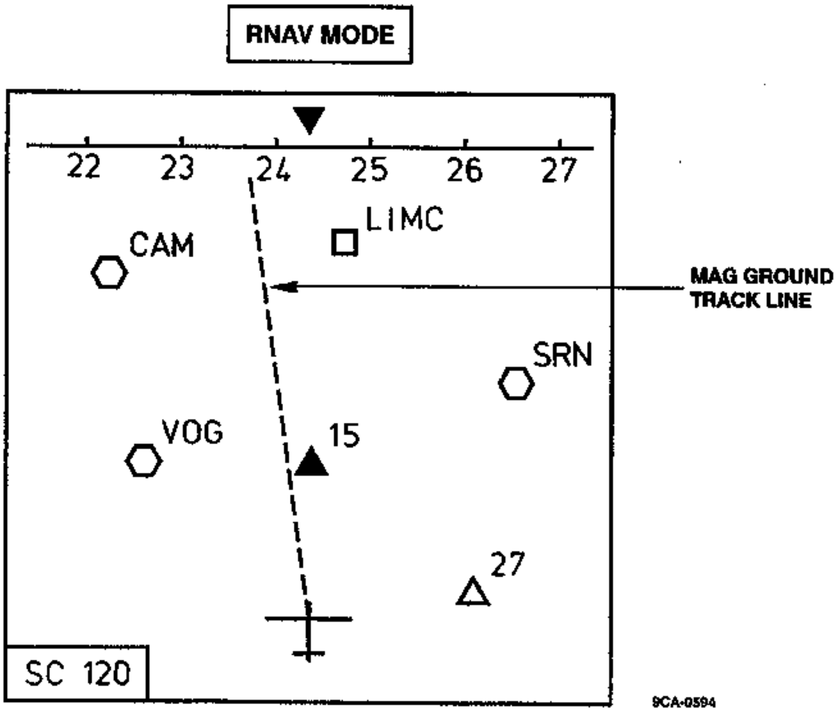
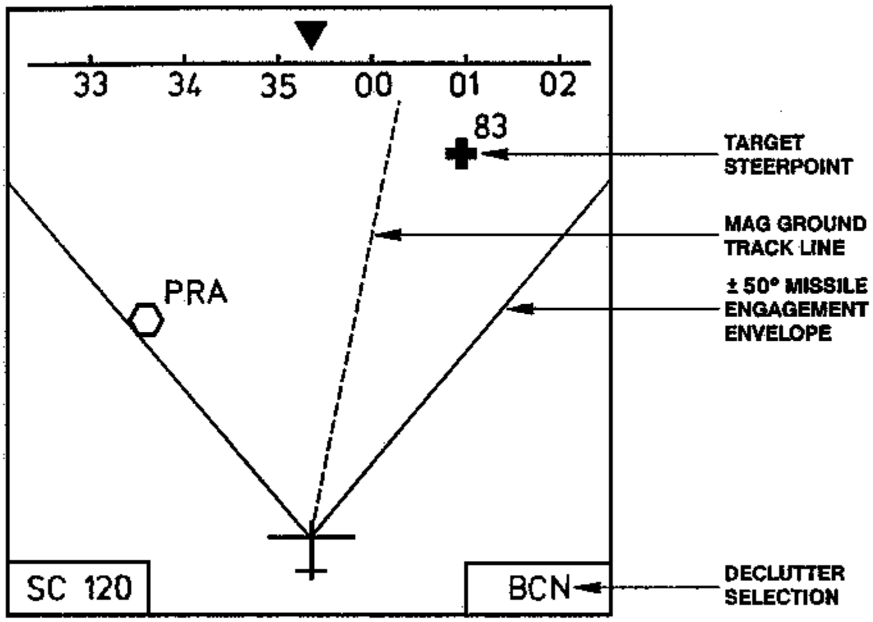


Figure 1-54 (Sheet 2)

MFD MAP MODE CONFIGURATION

**RNAV MODE
TARGET WAYPOINT SELECTED**



TACAN NAVIGATION MODE

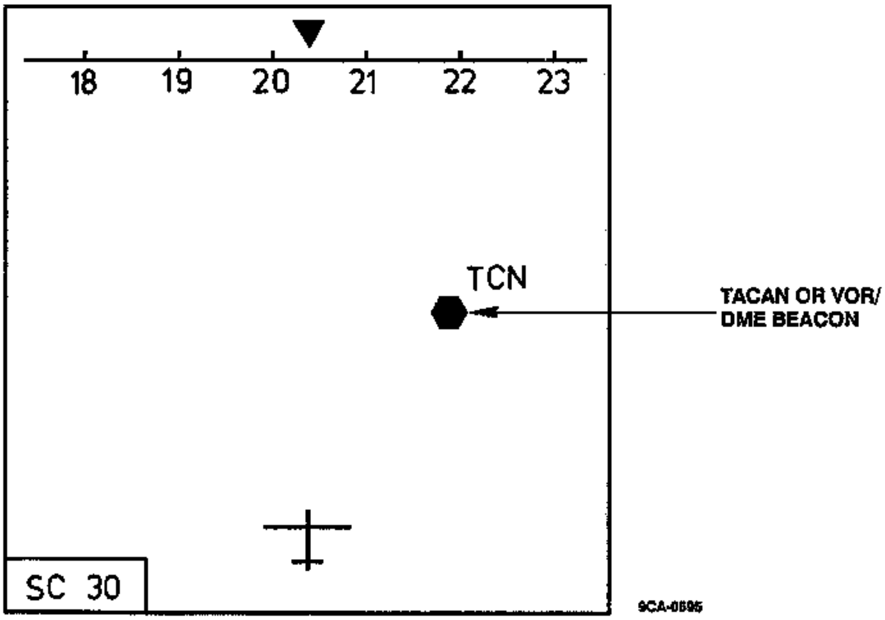


Figure 1-54 (Sheet 3)

3. The waypoints listed are:
   - Numbered waypoints △ from 00 to 99.
   - Labelled airports □ from AAAA to ZZZZ.
   - Labelled TACAN or VOR/DME stations ○ from AAA to ZZZ.

- LIST Mode (Checklist)

  See figure 1-53.

Head Up Display (HUD) System

The aircraft is fitted with two pilot display units (PDU), mounted one in each cockpit. The PDU consists of three groups: optical group, modules, and data entry panel (DEP). Both PDUs are capable of displaying the requested information through the symbols generated by the computer symbol generator (CSG) of the weapon aiming computer (WAC). The PDUs display the data required for flight control and weapon aiming simultaneously with the real world through the dual combiner glass. The PDU is capable of providing the pilot with the data from the CSG within an instantaneous binocular field of view (IFOV) of 14.5° by 14.5° and a total field of view (TFOV) of 20° by 20°. The PDUs are also used as a support for the installation of the video camera or the gun camera. The HUD system controls and indicators are described and illustrated in figure 1-55.

DATA ENTRY PANEL (DEP)

The DEP is a panel at the base of the PDU which groups the control keys of the navigation and weapon aiming computers (NCU and WAC), as well as a 16-alphanumeric-character data display (scratchpad). The function of the DEP is to enable the pilot to enter the data required for navigation and attack into the NCU and WAC without diverting his attention from the outside world. The keyboard includes 28 keys arranged on 4 rows. The keys at center of the panel (3 x 4 keys) permit the entry of alphanumeric data. The keys on the panel sides provide for different computer functions. Some keys have several functions automatically selected by the computers or manually selected by the pilot. The computer usually selects for use the most obvious function or the function connected with the type of data entry in progress (for instance, if the pilot presses the "TA" key, i.e. target altitude, the alphanumeric characters, when depressed, will automatically enter numbers into the computer). Alphabet letters, usually 3 per key, will appear on the scratchpad or display in sequence. For instance, pressing the first key brings letter A in view, but if the key is held depressed, letter B appears after approx 1 second and letter C after another second, then number 1 and again letter A, etc. Keys with two functions usually present the wording on the key as the first option. Further pressing the key provides the second option, etc. However, the operation of each of the function keys is as follow:

- Stopwatch key - When pressed, permits the indication to be read on the PDU (00:00 to 99:59 minutes and seconds). The time is displayed on the left lower quadrant of the PDU, just above the "submode symbol" in submodes NAV, APP, CCIP, RKT, STRF, CCRP, EO.

  Operation: 1st actuation - 00:00 is displayed on the PDU
  2nd actuation - Stopwatch is started
  3rd actuation - Stopwatch is stopped
  4th actuation - Indication disappears from the PDU.

- "RDR/BAR" key - (Radar Altitude/Baro Altitude). When pressed, changes the position of the indications (symbol and number) appearing on the PDU. Data is displayed on the upper right quadrant of the PDU; letter "R" preceding the digital indication indicates radar altitude. In lack of the "R", the displayed altitude is the barometric altitude which is visible in all submodes.

- "FRE/CGE" key - (Flight Path Marker Free or Caged). When pressed, cages the flight path marker (FPM) symbol in azimuth. When caged, the FPM symbol changes its shape from an octagon into an upward pointing caret.

HUD SYSTEM CONTROLS AND INDICATORS

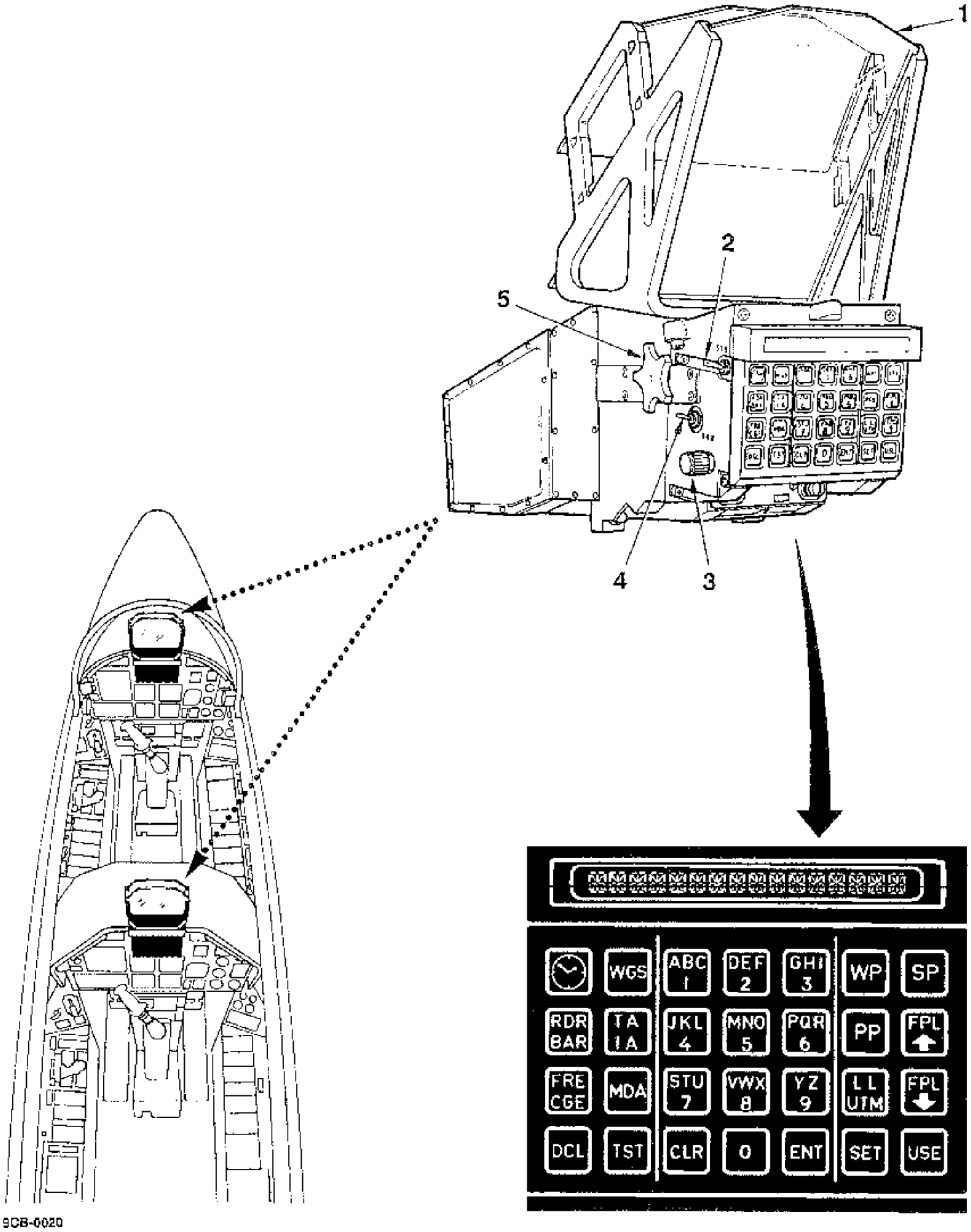


Figure 1-55 (Sheet 1 of 2)

HUD SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Dual combiner glass	Displays the information required for flight control (altitude, speed, heading, attitude and normal acceleration).
2. "STBY" reticle switch	Upper position - The red lighted optical reticle of the sight depression scale is illuminated. Intermediate or lower position - The optical reticle is off.
3. "BRT" knob	Adjusts the brightness of the symbols on the PDU.
4. "PWR" switch	Front PDU - Upper position - Permits energization of the front PDU. Lower position - Both PDUs are de- energized. Rear PDU - Upper position - Permits energization of the rear PDU if the front PDU is on. Lower position - De-energizes the rear PDU.
5. Stand-by reticle depresison knob	Rotated - Illuminates only the portion of the stand-by reticle.

Figure 1-55 (Sheet 2)

- "DCL" key - (Declutter). When pressed, removes from the PDU some symbols which are not essential for use of the selected submodes.
- "TST" key - (Test) When pressed, starts a complete self-test of the HUDWAC system and of the NCU subsystem:

  Operations: Depress "TST" key and hold: all character-forming segments in the DEP and RDU, and on the PDU there appears the test format. Release "TST" key: on the HSI the "RANGE" and "NAV" flags come in view; the deviation bar moves to the left; the bearing pointer moves to 270° (9 o'clock) for about five seconds. Then, automatically, the system starts the second phase of the test while the NCU still processes the navigation data. The "RANGE" and "NAV" flags go off and the "MILES" window on the HSI shows 000. The bearing pointer turns to 180° (6 o'clock). The deviation bar is centered and the "TO/FROM" pointer shows "TO". After about 10 seconds, the windows of both RDUs show the abbreviated names of the sensors associated with the NCU that is failed. The sensors associated with the HUDWAC system show their serviceability status in the DEP windows in the same way.
- "CLR" key - (Clear) When pressed clears the erroneous data from the DEP before the data are entered in the NCU.

  Operation: 1st press - Cancels the last entry.

  2nd press - Cancels the previous character.

3rd press - Cancels all the entered characters to allow the entry sequence to be resumed VAC only.

- "MDA" key - (Minimum Decision Altitude) When pressed shows the minimum decision altitude (MDA) on the PDU. MDA is set at 100 ft by default.
- "TA/IA" key - (Target Altitude/Initialization Altitude) When pressed shows the TA or IA on the PDU, and changes them, if necessary. The value is shown in feet, up to 9999.

NOTE

IA is not an altitude; it is the elevation above sea level of the geographic place chosen to initialize the aiming computer.

- "WGS" key - (Wingspan) When pressed, sets the wingspan data (in feet) on the WAC to solve the stadiametric range equation. The indication appears on the PDU in A/A.
- "WP" key - (Waypoint) When pressed, selects the "WP" mode to enter and/or display the waypoint data. The indication appears on both RDUs:

  Operation: 1st press - Waypoint ident code and waypoint position.

  2nd press - Magnetic bearing and range (nm) from the present position to the waypoint.

  3th press - Time to the waypoint (minutes) and fuel to the waypoint (kg).

  4th press - For target waypoints 80-89 only: target course and target speed.
  - If waypoint is a tuning (freq/channel) and beacon elevation.

  5th press (if waypoint is a beacon) - Beacon type and beacon magnetic variation.

  Next press - Waypoint position, etc.

- "PP" key - (Present Position) Selects the present position mode on the NCU, and displays it on the RDUs.

  Operation: 1st press (LL selected) - Present position (latitude/longitude).

  1st press (UTM selected) - Present position (UTM coordinate).

  2nd press - Wind direction and wind speed.

  3rd press - True heading and magnetic variation.

  4th press - Currently tuned beacon identification channel/frequency and identification of single or dual beacon operation.

  5th press: Present position, etc.

- "LL/UTM" key - (Latitude and Longitude/UTM coordinates) Selects either latitude and longitude or UTM coordinates to use for navigation or attack. The indication appears on the RDUs. Normally, the position is displayed in latitude and longitude; to shift from LL to UTM or viceversa, depress the key.
- "ENT" key - (Entry) When pressed, transfers the data typed in on the DEP into the NCU memory.
- "SET" key - (Set Data) When pressed, informs the navigation system that the new data is to be generated.

  Operation: Press the "SET" key before pressing the alphanumeric keys in order to generate or change the navigation data.

- "USE" key - When pressed, starts the use of the memorized data for navigation.
- "FPL↓" key - (Flight Plan Next Steerpoint)
  "FPL ↑" key - (Flight Plan Previous Steerpoint).

  The sequence of the flight plan waypoints stored may be displayed on both RDUs using the two keys, and without disturbing the steering guidance output to the HSI deviation bar which is present in the current navigation mode. When either of the "FPL" keys is initially pressed, the sequence numbers F0 and F1 and their associated waypoints identification for the first leg of the flight plan are displayed.

Subsequent presses of the "FPL ↓" or "FPL ↑" keys allow the operator to step forward or backward through the flight plan legs. Holding the key depressed will give fast "auto repeat" stepping through the flight plan with each leg displayed for one second.

- "SP" key - (Steer) When pressed, selects the TRNAV display mode or the steer entry. The indication appears on both RDUs and both DEP scratchpads.

Operation: 1st press - Time to steerpoint (minutes) and fuel to steerpoint (kg).
2nd press - Ground speed (kt) and drift angle (degrees left or right).
3rd press - Same as for first press.

NAVIGATION

AIR DATA INSTRUMENTATION SYSTEM

The air data instrumentation system consists of instruments and sensors. The instruments are:

- Altimeter (one in each cockpit)
- Mach-airspeed indicator (one in each cockpit)
- Vertical velocity indicator (one in each cockpit).

The sensors are:

- Pitot-static system
- Total temperature sensor
- AOA tranasmitter
- Sidslip transmitter

Instruments

ALTIMETER

The altimeter (Figures 1-3 and 1-6) provides indication of the aircraft altitude from -1000 to +50 000 feet through a 3-digit counter and a pointer. The instrument is connected to the static pressure system and is fitted with a vibrator which smoothes the pointer movement. A knob in the lower left corner of the instrument is used to set the desired pressure setting between 950 and 1050 mb. The altimeter in the front cockpit also supplies an altitude coded signal for transmission to the ground through the IFF transponder. When the encoder is not supplied with power, a "CODE OFF" flag comes in view on the dial.

MACH-AIRSPEED INDICATOR

The Mach-airspeed indicator (Figures 1-3 and 1-6) provides indication of the indicated airspeed and Mach number. This instrument is operated by the Pitot- static system. A pointer indicates the airspeed on a fixed dial, calibrated from 40 to 650 knots, and the corresponding Mach number on a moving scale calibrated from Mach 0.3 to Mach 1.2. A moving red and black striped pointer indicates, in terms of IAS, the maximum allowable equivalent airspeed (EAS) of the aircraft in the clean configuration. A knob, in the lower right corner of the instrument, may be used to set a triangular shaped visual reference marker, sliding on the dial bezel, to the desired value.

VERTICAL VELOCITY INDICATOR

The vertical velocity indicator (Figures 1-3 and 1-6) is connected to the static pressure system and indicates the value of the vertical component of the aircraft velocity. This value is indicated by a single a single pointer moving on a scale with zero on the horizontal mean line. The instrument scale permits more accurate readings in the vicinity of zero. The limit of indication is 6000 ft/min.

Sensors

PITOT-STATIC SYSTEM

The pitot-static system operates the Mach-airspeed indicator, the altimeter and the vertical velocity indicator. The Pitot heads, mounted on the fuselage immediately forward of the windshield, supply the pressure for operation of the instruments on the two instrument panels: the left Pitot head supplies the instruments on the front instrument panel, the right Pitot head the instruments on the rear instrument panel. The aircraft is also fitted with static/differential pressure ports connected to the Pitot heads. The static ports, fitted to the left and right sides of the fuselage aft section, and the outside air temperature sensor provide the TRNAV and HUDWAC systems with the information needed to compute barometric altitude and true airspeed. The Pitot heads can be electrically heated to prevent ice accretion (see para "Anti-ice System").

Total Temperature Sensor

The total temperature sensor (TTS probe) is located on the left side of the aircraft vertical stabilizer. A temperature sensing element is located inside the probe. The sensing element consists of a platinum wire with a resistance of 100 ohm at 0°C, which is insulated and hermetically sealed inside two concentric tubes. The TTS probe also contains an integral heater which permits accurate temperature measurements even in an enviroment conducive to ice formation.

AOA and Sideslip Transmitters

The AOA (angle-of-attack) transmitter consists of a differential pressure transmitter located on the aircraft nose right side. The indication is displayed on each PDU. The AOA indication is displayed by alternating ticks and dots arranged vertically. The lowest mark represents 0 and the upper mark 1. A square index marker is located at 0.49 to indicate the best approach AOA with flaps and landing gear down. A diamond is located at 0.66 to indicate the best AOA for no-flaps approach. A caret index marker is located at 0.79 to indicate the stall point (Figure 1-56). The angle-of-attack indications during the approach phase are shown in figure 1-57. The angle-of-attack and sideslip transmitters are fitted with a heating element to prevent ice formation or accretion (see para "Anti-ice System"). The sideslip transmitter is installed in a central position on the upper part of the aircraft nose. This transmitter measures the aircraft sideslip angle during flight.

ATTITUDE AND DIRECTION SYSTEMS

Directional Reference System

The aircraft is fitted with an Aeritalia/Sperry directional reference system type AN/ASN-75, composed of a Sperry CN-1141 directional gyroscope, a C-2 flux valve and an AM-4606A amplifier/transformer. The AN/ASN-75 directional reference system continuously provides the aircraft magnetic heading over 360°.
The data provided by the system is used by the doppler/inertial reference system (DIRS) to obtain a fast alignment of the IRU with North. It is also automatically used by the TRNAV and HUDWAC systems in the event of failure of the DIRS heading information. In this case the HSI can be supplied by the directional reference system by selecting "AUX" on the IRS control panel. The directional gyro is installed in the dorsal electronic compartment; the flux valve is installed in a special bay located at the root of the vertical stabilizer and accessible through a screw-mounted door.

Attitude Reference System

The aircraft is fitted with a VG-204L Jet Industries attitude gyro reference system. This system provides roll information (continuous over 360) and pitch information (within 82), valid for all headings. The data provided by this system is used by the HUDWAC and TRNAV systems in the event of failure of the DIRS attitude information. In this case the HSI can be supplied by the attitude reference system by selecting

ANGLE OF ATTACK MARKERS

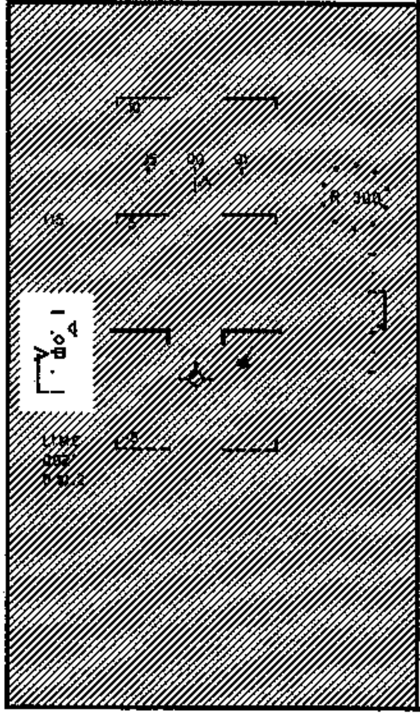
ANGLE-OF-ATTACK INDICATION ON PDU	MARKER	AOA	CONDITION
	◁	.79	STALL WARNING WITH FLAPS AND L.G. DOWN
	◇	.66	LANDING APPROACH WITH FLAPS UP AND L.G. DOWN
	□	.49	LANDING APPROACH WITH FLAPS AND L.G. DOWN
	.23 MAXIMUM RANGE .27 AIRFIELD TRAFFIC PATTERN AT 200 KIAS .33 ● ATTITUDE FOR LANDING GEAR EXTENSION ● MAXIMUM ENDURANCE .42 GLIDING AT 150 KIAS FOR A FLAME-OUT OR LANDING CIRCUIT .60 FINAL APPROACH WITH FLAPS UP T/O AT 125 KIAS .60 TURNS OR MAXIMUM PERFORMANCE MANEUVERS AT LOW ALTITUDE/HIGH G-LOADS .82 STALL WARNING WITH FLAPS UP AND CLEAN AIRCRAFT AT 106 KIAS .90 STALL AT LOW ALTITUDE IN ANY CONFIGURATION		

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Figure 1-56

"AUX" on the IRS control panel. The attitude gyroscope is installed in the aircraft electronic compartment.

Flight Director and Indicator System

The flight director and indicator system consists of a flight director computer, a flight director repeater controller, a horizontal situation indicator (HSI) and an attitude director indicator (ADI).

The flight director computer provides the pilot with steering commands through the horizontal and vertical steering bar of the ADI (as required to fly consistently with the selections made on the FDC panel).

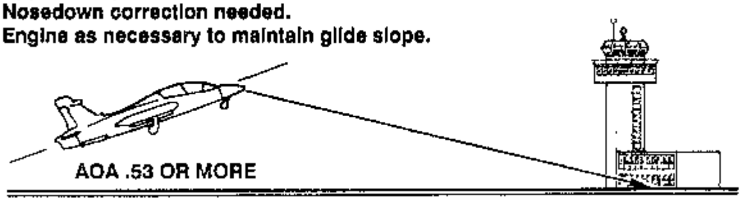
The HSI is an integrated instrument which provides with the following information:

- Heading
- Bearing and distance to the selected navigation aid
- Selected course, TO/FROM and lateral deviation.

ANGLE OF ATTACK INDICATOR

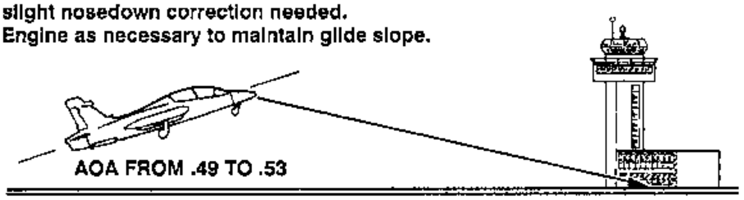
Pointer at or above upper edge of approach index marker

Approach speed more 5 knots slow.
Nosedown correction needed.
Engine as necessary to maintain glide slope.



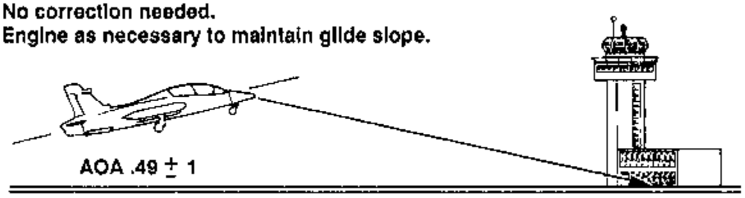
Pointer just above center of approach index marker

Approach speed 3 to 5 knots slow.
slight nosedown correction needed.
Engine as necessary to maintain glide slope.



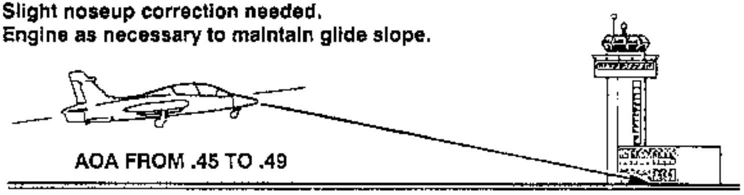
Pointer near center of approach index marker

Angle of attack and approach speed at optimum.
No correction needed.
Engine as necessary to maintain glide slope.



Pointer at or below lower edge of approach index marker

Approach speed 3 to 5 knots fast.
Slight noseup correction needed.
Engine as necessary to maintain glide slope.



Pointer at or below lower edge of approach index marker

Approach speed more than 5 knots fast.
Noseup correction needed.
Engine as necessary to maintain glide slope.

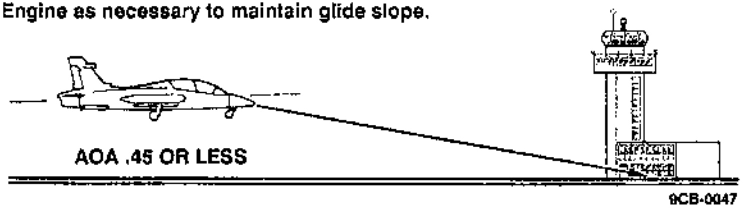


Figure 1-57

The ADI is an integrated instrument which provides the following information:

- Aircraft attitude
- Flight director steering command
- Rate of turn
- Slip
- Glide slope.

The flight director and indicator system block diagram is illustrated in figure 1-58.
The flight director and indicator system controls and indicators are described and illustrated in figure 1-59.

FLIGHT DIRECTOR COMPUTER (FDC)

The Flight Director Computer (FDC) processes navigation and attitude data and displays them to the pilot on the ADI, HSI and PDU. It comprises the navigation flight director control panel (NFDCP) which is a two-section control panel labelled "FDC" and "HSI". The flight director computer receives selected information from the VOR/ILS, TACAN and TRNAV systems, attitude information from the IRS or the attitude reference system, and air data from the air data sensors. The NFDCP comprises 12 push-buttons which, when pressed and illuminated, activate the corresponding function of the flight director and indicator system. The FDC is powered from the 115 V ac and 28 V dc primary busses.

OPERATION OF FLIGHT DIRECTOR AND INDICATOR SYSTEM

The FDC moves the vertical and horizontal steering bars of the ADI and the flight director symbol on the PDU. The vertical steering bar indicates the roll maneuvers required, depending on the bar displacement (following the bar). The horizontal bar indicates the pitch maneuvers required, depending on the bar displacement (following the bar). When the FDC is not operating, the two ADI steering bars are out of the pilot's sight. The FDC is designed such that, the use of incompatible modes (such as "ALT HOLD" and "GLIDE SLOPE"), is prevented. The navigation/flight director functions selectable on the NFDCP in both cockpits are:

A. "FDC" section on the NFDCP.

- HDG (Heading) - Through the vertical steering bar of the ADI and the flight director symbol on the PDU, provides information on the sequence of inputs to be applied to the aileron control to reach the specific heading set on the HSI by means of the "HDG" knob.
- RAD NAV (Radionavigation) - Through the vertical steering bar of the ADI and the flight director symbol on the PDU, provides information about the sequence of inputs to be applied to the aileron to achieve an intercept of a VOR or TACAN radial or an ILS localizer or RNAV steerpoint, and to keep the aircraft on the attained radial. The radial is selected by use of the "CRS" knob of the HSI (and appears in the "COURSE" window). The VOR or TACAN equipment must be switched on and set to the desired frequency or channel. When an ILS approach is flown, it is recommended that the course to the runway be set in the HSI "COURSE" window and the appropriate ILS frequency selected.

NOTE

> During an ILS approach with the Flight Director in the "RAD NAV" mode, the vertical steering bar of the ADI may provide incorrect initial intercept commands if the selected course ("COURSE" window on the HSI) is the same as the runway heading. After a few minutes of flight, these commands are however corrected by the FDC which assumes the difference between the aircraft heading and the course as drift angle.

- GS ARM (Glide Slope Arm) - The Flight Director is set to operate in the GS (Glide Slope) mode as soon as the Glide Slope of a specific ILS station selected on the VOR/ILS is intercepted. Information

FLIGHT DIRECTOR AND INDICATOR SYSTEM BLOCK DIAGRAM

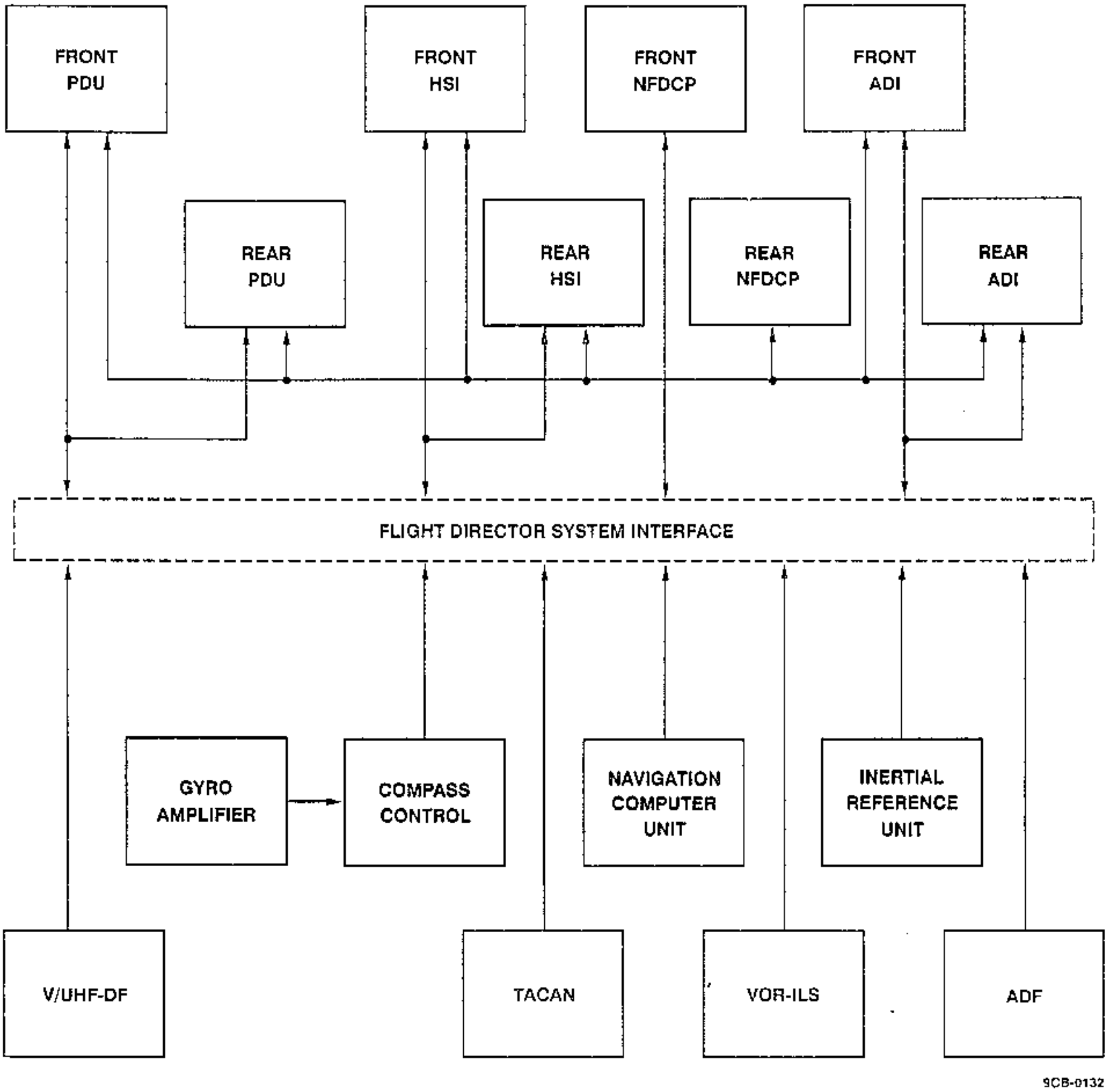


Figure 1-58

FLIGHT DIRECTOR AND INDICATOR SYSTEM CONTROLS AND INDICATORS

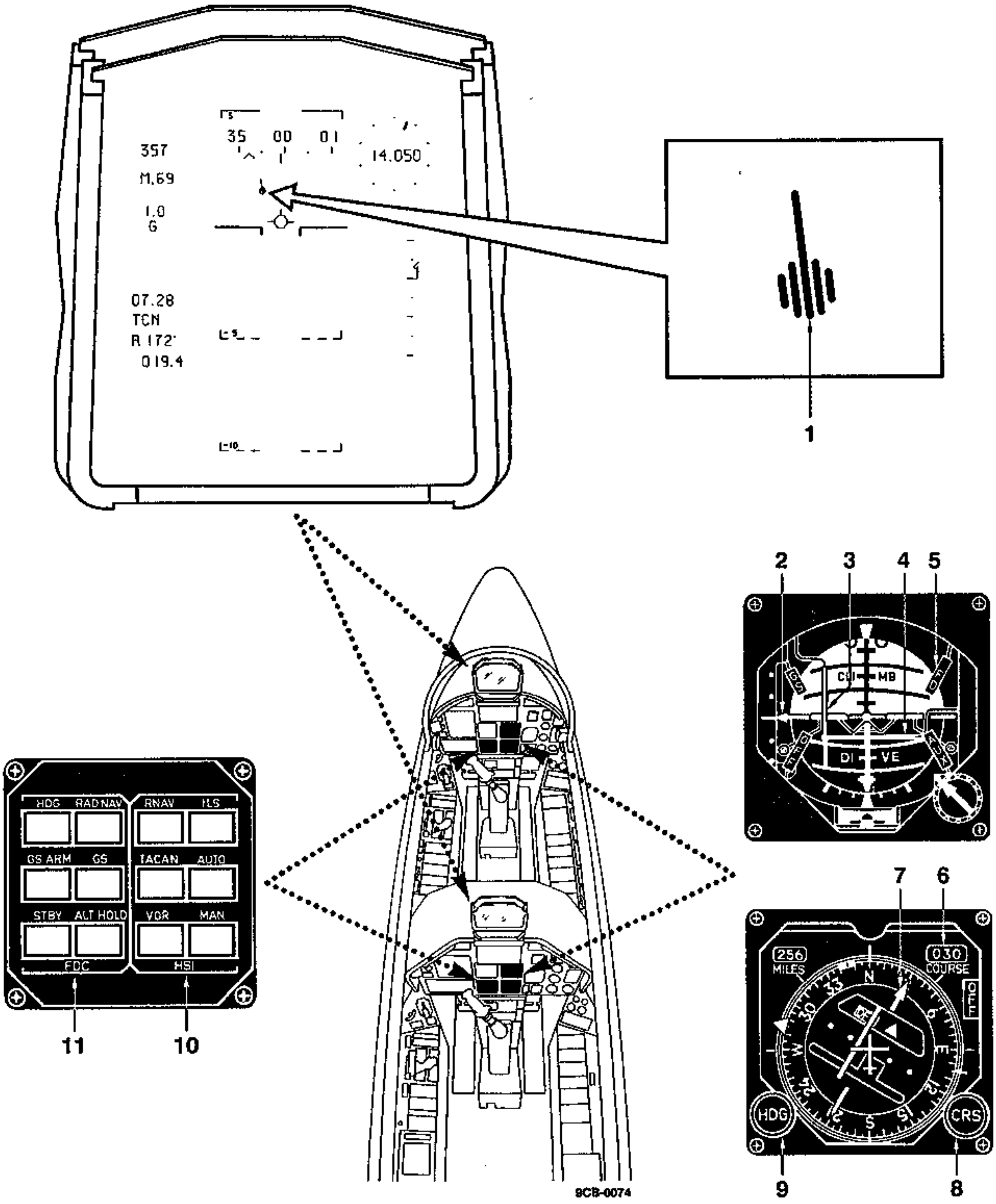


Figure 1-59 (Sheet 1 of 2)

FLIGHT DIRECTOR AND INDICATOR SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Flight director symbol on PDU	Indicates the desired aircraft flight path related to the flight path marker. The position of the symbol is determined by the vertical and horizontal steering bars. The symbol points to the bearing of the selected beacon or waypoint.
2. Glideslope indicator	Indicates, on the relevant scale, the glideslope position with respect to the aircraft represented by the miniature aircraft.
3. Vertical steering bar	Displays the steering information to fly to or maintain the flight path selected on the HSI and on the "FDC" control panel.
4. Horizontal steering bar	Displays the pitch attitude needed to acquire and maintain the glideslope or to hold altitude.
5. "FD" flag	In view - Indicates that the indications of the steering bars are unreliable.
6. "COURSE" window	The value of the course selected with the "CRS" knob appears in the window.
7. Course arrow	Indicates the course selected with the "CRS" knob.
8. "CRS" knob	Sets the desired course. The relevant information appears in the "COURSE" window and is indicated by the course arrow.
9. "HDG" knob	Sets the heading reference.
10. "HSI" control panel	Mode push-button lights illuminated with green light - The arrow shafts and deviation bar of the HSI provide visual information consistent with the selections made through the push-button light.
11. "FDC" control panel	Mode push-button lights illuminated with green light - The steering bars of the ADI and the flight director symbol on the PDU provide visual information consistent with the selections made through the push-button light.

Figure 1-59 (Sheet 2)

is supplied through the ADI horizontal bar and the flight director symbol on the PDU, which gives indications to maintain the attitude as required to remain on the Glide Slope. When the glideslope is intercepted, the GS ARM light extinguishes and the GS (Glide Slope) light comes on automatically, activating the relevant function.

- GS (Glide Slope) - The flight director and indicator system is actuated by pressing the push-button, or operates automatically in sequence at the moment of Glide Slope interception when in the "GS ARM" mode. Information is supplied through the ADI horizontal bar and flight director symbol on the PDU, which indicates the sequence of inputs to be applied to the elevator to maintain the aircraft on the Glide Slope. The GS mode operates only after selection of the appropriate ILS frequency and after pressing the "ILS" push-button on the NFDCP.
- STBY (Stand By) - All modes of the FDC are off. Both ADI steering bars are at full scale out of the pilot's sight.
- ALT HOLD (Altitude Hold) - When this push-button is pressed and illuminated, the FD computer memorizes the flight altitude, cuts out the GS mode (if on) and supplies information through the ADI horizontal bar and flight director symbol on the PDU, which indicates the sequence of inputs to be applied to the elevator to maintain the aircraft at the selected altitude.

NOTE

If the aircraft altitude is changed by an amount greater than 12 mbar of pressure, the "ALT HOLD" function will automatically disengage.

B. "HSI" section on the NFDCP.

- RNAV - The HSI and PDU (and steering bar/steering symbol if the "RAD NAV" push-button is selected) receive information from the NCU concerning: distance, course, deviation from course, and bearing to the next steerpoint. If the "SP" push-button on the DEP is selected, the RDU shows time to go, and fuel to go to the next steerpoint.
- ILS - Information concerning the selected ILS station is sent to the HSI, ADI and the flight director symbol on the PDU. If the "RNAV" push-button on NFDCP is pressed and the steerpoint fixed at the touch-down point, it is possible to have concurrently ILS and RNAV distance to the touch-down point.
- TACAN - If the "RAD NAV" push-button on the "FDC/HSI" control panel is pressed, information concerning the selected TACAN station is sent to the HSI and PDU (distance, bearing) and to the vertical steering bar of the ADI.
- AUTO - In this mode, with the RNAV mode selected, the NCU operates automatically the course arrow on the HSI to select a new planned course to the next steerpoint of the flight plan when a steerpoint is reached. When TACAN mode or VOR mode is selected, the momentary activation of the "AUTO" push-button provides the HSI with the direct course to the selected beacon.

NOTE

The automatic change over will only occur when the aircraft has passed the flight plan steerpoint as sensed by the NCU. Therefore if a turn greater than 90° is made prior to the sensed turnpoint, the next planned course will not be selected automatically.

- VOR - If the "RAD NAV" push-button on the NFDCP is selected, information concerning the selected VOR/DME station is sent to the HSI and PDU (distance, bearing) and to the vertical steering bar of the ADI.
- MAN - Permits the manual selection of the required course by means of the "CRS" knob on the HSI.

HORIZONTAL SITUATION INDICATOR

The HSI (figure 1-60) is powered from the 115 V ac essential and 26 V ac primary busses via the "HSI" circuit breaker. This instrument permits the pilot to define the aircraft position in relation to the selected

HORIZONTAL SITUATION INDICATOR CONTROLS AND INDICATORS

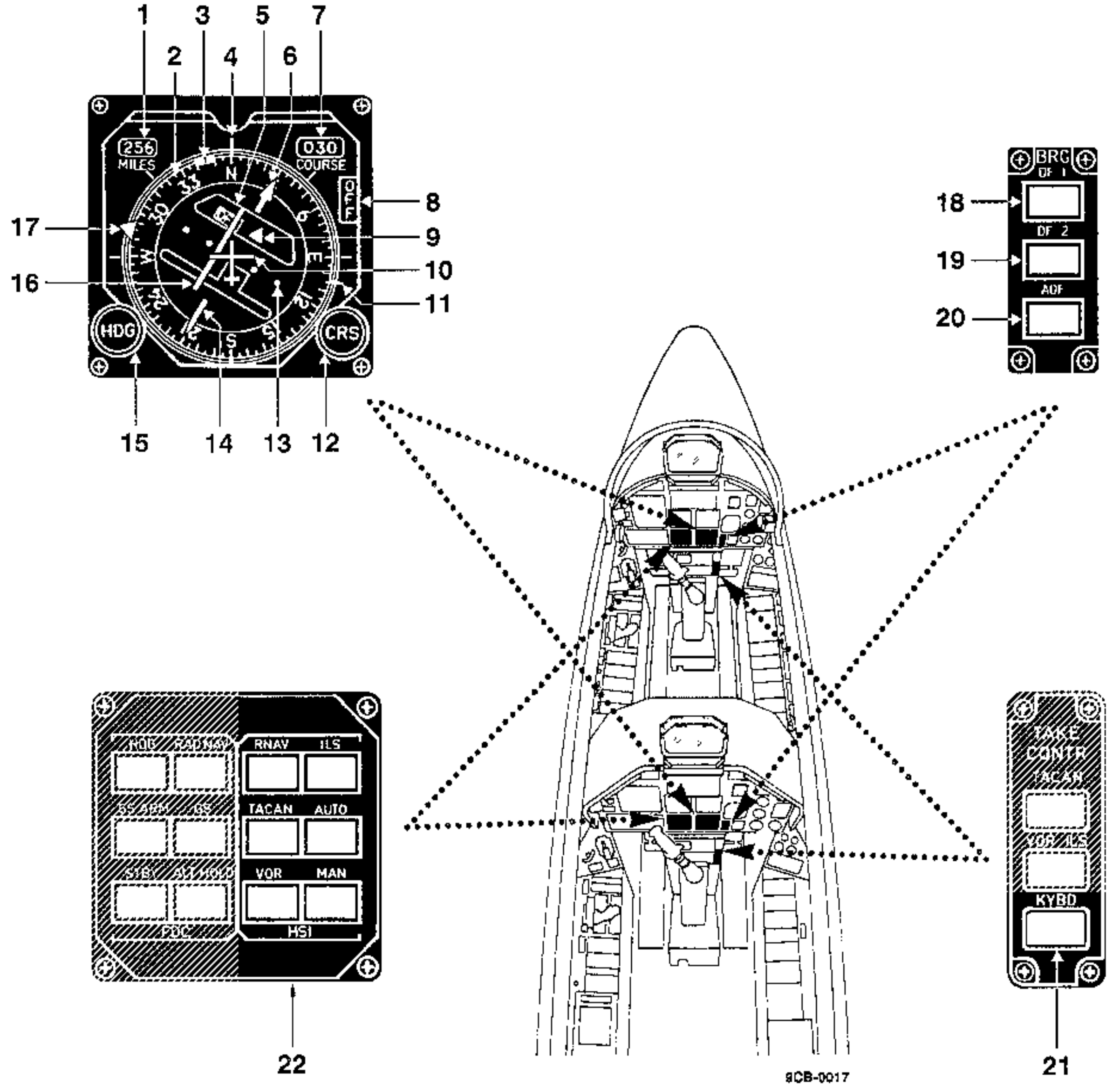


Figure 1-60 (Sheet 1 of 4)

HORIZONTAL SITUATION INDICATOR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "MILES" range indicator	Indicates the distance in nautical miles (slant range) to the selected VOR/DME or TACAN station, or the horizontal distance to a RNAV waypoint, depending upon the selected navigation set.
2. Compass card	Indicates the aircraft heading in degrees at the fixed lubber line.
3. Heading marker	Is set by the "HDG" knob.
4. Fixed lubber line	Permits reading of the aircraft magnetic heading.
5. Deviation bar flag (red flag)	In view - Indicates that the indications of the course deviation bar and the TO/FROM indicator are unreliable.
5. "DF" flag	In view - Indicates that the ADF or DF mode is displayed.
6. Course arrow	Indicates the course selected with the "CRS" knob.
7. "COURSE" window	The course selected by the "CRS" knob appears in the window.
8. "OFF" flag	In view - Indicates that no power is supplied to the instrument or that heading information is erroneus.
9. "TO-FROM" indicator	Indicates whether the aircraft is flying TO or FROM the ground station.
10. Miniature aircraft	Reference to compare the HSI readings with the aircraft heading.
11. Bearing pointer (tail)	Indicates the reciprocal of the bearing pointer head (radial).
12. "CRS" knob	Sets the desired course. The relevant information appears in the "COURSE" window and is indicated by the course arrow.

Figure 1-60 (Sheet 2)

HORIZONTAL SITUATION INDICATOR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
13. Course deviation scale	Allows the deviation bar to indicate the amount of deviation from the course. The two internal dots represent a 5-degree deviation from the VOR, TACAN or RNAV radial. The two external dots represent a 10-degree deviation. When ILS is selected on the "HSI" control panel, the two internal dots represent a 1 1/4 degree deviation from the LOC and the two external dots represent a 2 1/2 degree deviation.
14. Course arrow	Indicates the course selected with the "CRS" knob.
15. "HDG" knob	Sets the heading marker.
16. Course deviation bar	Lateral displacement of this bar indicates the amount and direction of the deviation from the selected VOR/TACAN/RNAV radial or LOC.
17. Bearing pointer	Indicates the magnetic bearing to the selected VOR or TACAN or DF1, DF2 or ADF station or to the TRNAV steerpoint.
18. "BRG/DF1" push-button	Pressed and illuminated - The bearing light information from the COMM1 receiver is displayed through the HSI bearing pointer.
19. "BRG/DF2" push-button light	Pressed and illuminated - The bearing information from the COMM2 receiver is displayed through the HSI bearing pointer.
20. "BRG/ADF" push-button light	Pressed and illuminated - The bearing information from the LF--ADF receiver is displayed on the HSI.
21. "TAKE CONTR/KYBD" push-button light	Pressed and illuminated - Takes control of the DEP keys and the "HDG" and "CRS" knobs on the HSI. **NOTE** Control cannot be shifted back to the other pilot (by pressing the same button again). It is necessary that the pilot who wants control presses the button.

Figure 1-60 (Sheet 2)

HORIZONTAL SITUATION INDICATOR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
22. Navigation flight director control panel (NFDCP)	Sets the HSI to display the information selected through the push-button light.

Figure 1-60 (Sheet 3)

VOR/DME, TACAN, NDB station, waypoint and DF station. The magnetic heading is indicated by a rotating compass card read against a fixed lubber line on the instrument dial face. The compass card is operated by the Inertial Reference System (IRS) if the IRU is in "NAV" mode or by the directional gyro if the IRU is in other than "NAV" mode. The "HDG" knob, in the lower left corner of the instrument, permits a double heading marker to be set to the desired heading. This marker rotates on the compass card outer periphery. The selected heading is read against the compass card. The selected course is set by means of the "CRS" knob mounted in the lower right corner of the instrument, and is indicated by the arrow located in the center of the dial face. This value is read against the compass card. The course is also indicated by a three-digit indicator ("COURSE" window) located in the upper right corner of the instrument dial. A lateral displacement to the right or to the left of the center portion of the course arrow, defined as deviation from the selected course, indicates an opposite deviation of the aircraft from the selected course. The inner dot indicates a 5-degree deviation from the selected course, the outer dot a ten-degree deviation. When used with the ILS, each dot indicates a 1 1/4 degree deviation from the "Localizer". A red alarm flag, which appears in a display window under the head of the arrow, indicates an invalid deviation reading. The distance from the VOR/DME, TACAN station, or from the RNAV waypoint, depending on which navigation set has been selected, is indicated by a three-digit indicator (MILES) in the upper left corner of the dial face. If the system is not operating or is in a search condition, or a station not equipped with DME is selected, a black and white striped flag drops across the numerals of this indicator. A triangular-shaped small pointer (TO-FROM) appears under the head or the tail of the course arrow. When the "TO-FROM" indicator appears under the head of the course arrow, this means that the course selected, if properly intercepted and flown, will take the aircraft to the station, and vice versa. The magnetic bearing to the VOR/DME, NDB, TACAN, DF station and RNAV waypoint is indicated by a pointer head, located on the outer periphery of the compass card. A red warning flag marked OFF appears in a display window to indicate lack of ac power to the HSI or that there is no valid heading information. A "DF" flag appears on the HSI in the ADF or DF mode. The "HSI" control panel permits the selection, by push-button lights, of the navigation aid from which information is to be displayed on the HSI. The visual information displayed on the HSI and ADI as resulting from the selections made on the NFDCP and associated radio-navigation equipment, is shown in the tables at figure 1-61. In the RNAV mode only, the "MILES" distance read on the HSI is the "horizontal" distance and not the slant range. When no push-button is depressed or only the "ILS" push-button is selected, the bearing pointer is parked at 3 o'clock.

NOTES ON HSI USE

A few examples on the use of the HSI, to determine the aircraft position or to intercept a course to or from a TACAN station, using the information shown on the PDU, are given in figure 1-62. Depending upon the navigation equipment used, and the selection made on the NFDCP, the HSI provides the information indicated in the tables of figure 1-79. If the heading information provided by the IRS is wrong or unreliable, the pilot can select the auxiliary mode by setting the mode selector knob of the "IRS" control panel to AUX. Information will thus be provided by the directional gyro. To obtain the correct

TABLE OF INFORMATION DISPLAYED ON HSI AND ADI

NAVIGATION MODE	HSI									ADI	
							COURSE DISPLAY				
	BEARING	DF FLAG	TO-FROM	RANGE	DEVIATION	DEVN FLAG	MAN	AUTO	HDG SET	GLIDESLOPE DEVIATION	GLIDESLOPE FLAG
TACAN	TACAN BEARING	OUT OF VIEW	TO-FROM TACAN BEACON	TACAN SLANT RANGE	COURSE DEVIATION	RESPOND TO TACAN VALID	PILOT SELECTED DESIRED COURSE	DIRECT COURSE TO TACAN TUNED BEACON (MOMENTARY)	SET BY PILOT	OUT OF VIEW	OUT OF VIEW
TACAN + ILS	TACAN BEARING	OUT OF VIEW	OUT OF VIEW	TACAN SLANT RANGE	ILS-LOC	RESPOND TO LOC VALID	PILOT SELECTED RUNWAY HDG	NOT AVAILABLE	SET BY PILOT	ILS GLIDESLOPE	RESPOND TO GLIDESLOPE VALID
RNAV	RNAV BEARING	OUT OF VIEW	TO-FROM STEERPOINT	STEERPOINT HORIZONTAL RANGE	COURSE DEVIATION	RESPOND TO RNAV VALID	PILOT SELECTED DESIRED COURSE	RNAV COMPUTED COURSE	SET BY PILOT	OUT OF VIEW	OUT OF VIEW
RNAV + ILS	RNAV BEARING	OUT OF VIEW	OUT OF VIEW	STEERPOINT HORIZONTAL RANGE	ILS-LOC	RESPOND TO LOC VALID	PILOT SELECTED RUNWAY HDG	NOT AVAILABLE	SET BY PILOT	ILS GLIDESLOPE	RESPOND TO GLIDESLOPE VALID
ILS	PARKING	OUT OF VIEW	OUT OF VIEW	DME SLANT RANGE PAIRED WITH ILS	ILS-LOC	RESPOND TO LOC VALID	PILOT SELECTED RUNWAY HDG	NOT AVAILABLE	SET BY PILOT	ILS GLIDESLOPE	RESPOND TO GLIDESLOPE VALID
VOR	VOR BEARING	OUT OF VIEW	TO-FROM VOR BEACON	DME SLANT RANGE PAIRED WITH VOR	COURSE DEVIATION	RESPOND TO VOR VALID	PILOT SELECTED DESIRED COURSE	DIRECT COURSE TO VOR TUNED BEACON (MOMENTARY)	SET BY PILOT	OUT OF VIEW	OUT OF VIEW

BEARING SUBMODE	HSI								
							COURSE DISPLAY		
	BEARING	DF FLAG	TO-FROM	RANGE	DEVIATION	DEVN FLAG	MAN	AUTO	HDG SET
DF1	COMM1 STATION BEARING	IN VIEW	**DEPENDING ON NAV MODE SELECTED AS ABOVE**						
DF2	COMM2 STATION BEARING	IN VIEW							
ADF	LF-ADF BEARING	IN VIEW							

IRU CONT PNL SEL MODE	HSI COMPASS CARD	ADI	
		ROLL & PITCH	AUX FLAG
NAV	CONNECTED TO INERTIAL REFERENCE UNIT MAGNETIC HEADING	PROVIDED BY INERTIAL REFERENCE UNIT	OUT OF VIEW
HDG-SET FAST NORM AUX	CONNECTED TO DIRECTIONAL GYRO MAGNETIC HEADING	PROVIDED BY VERTICAL GYRO	IN VIEW

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Figure 1-61

USE OF HSI

NOTE

When a VOR station not equipped with DME is tuned, the "MILES" distance indicator does not operate and the numerals of this indicator are covered by a flag.

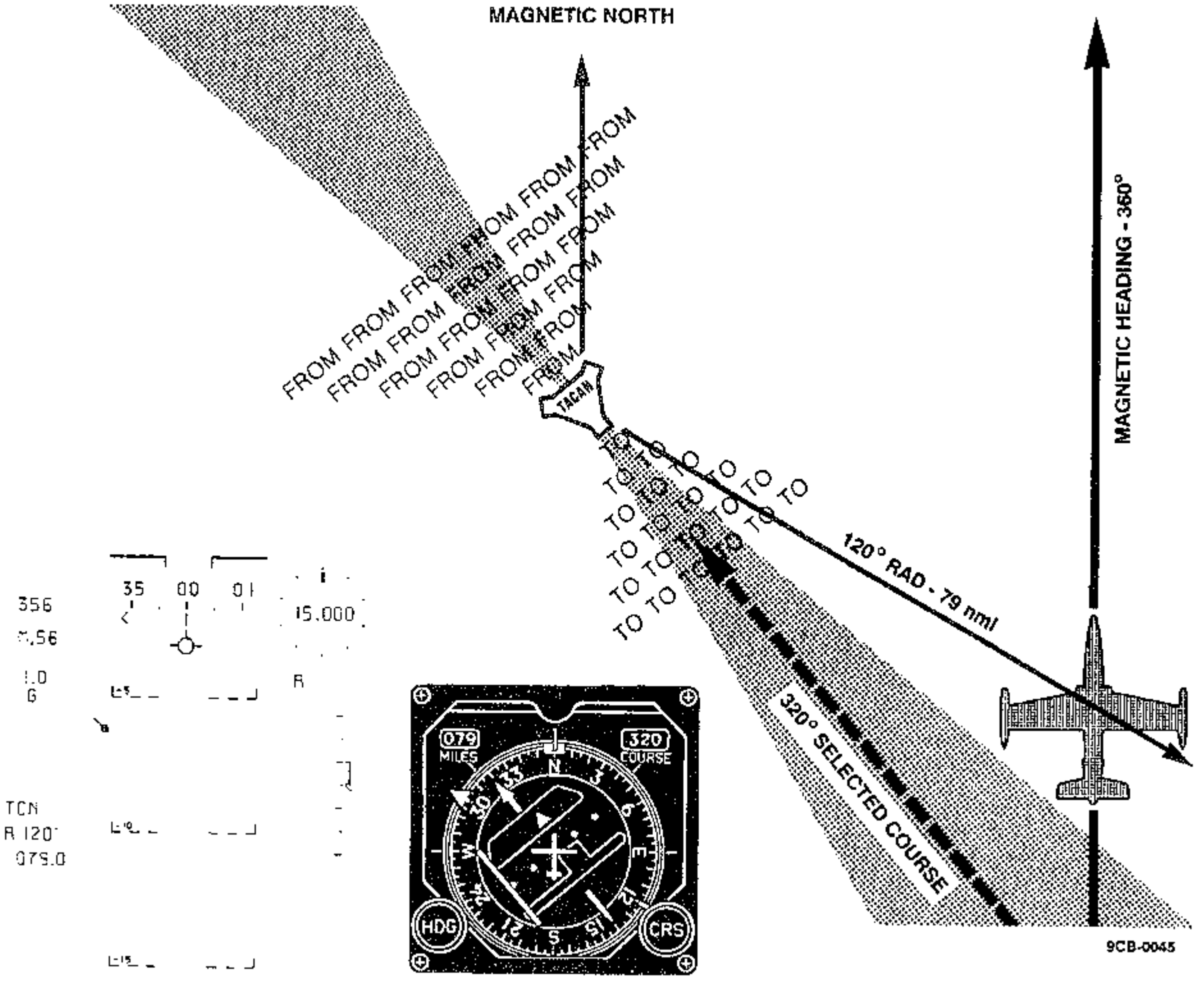
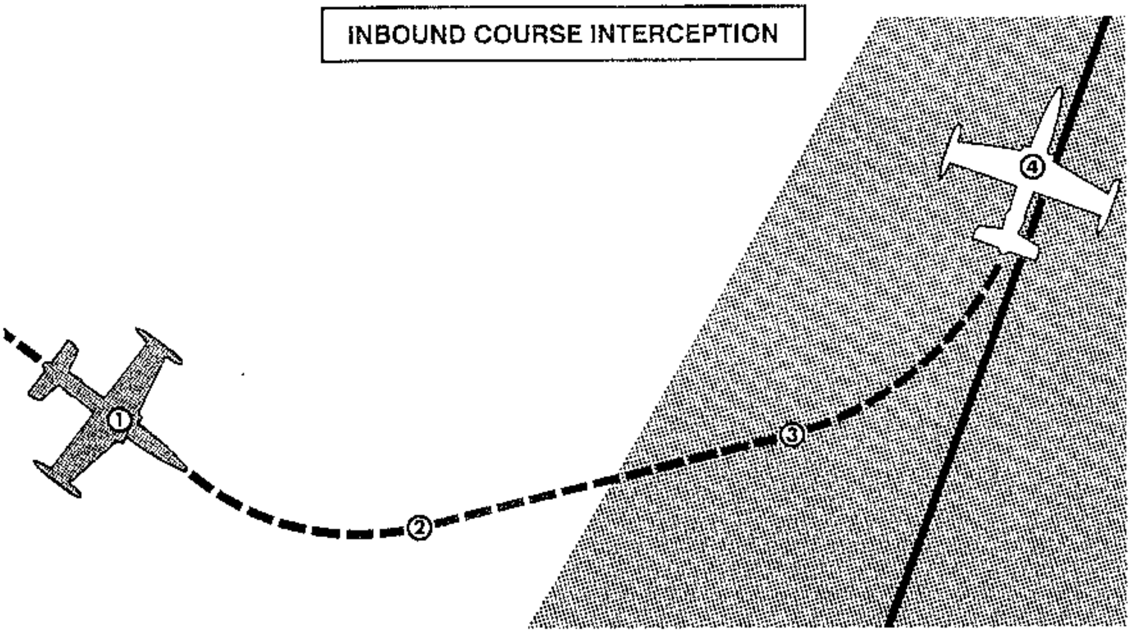


Figure 1-62 (Sheet 1 of 4)

USE OF HSI



① Set the desired course in the "COURSE" window by means of the "CRS" knob and check the TO-FROM indicator. Turn to "fly" the aircraft symbol towards the course deviation bar.

② Roll out when the bearing pointer is between the fixed lubber line and the course arrow. Make sure that the course arrow is in the top half of the HSI.

③ Plan proper lead point by judging the time required to complete the intercept compared to the time required to turn to course.

④ Gradually level the wings aligning the aircraft symbol with the deviation bar.

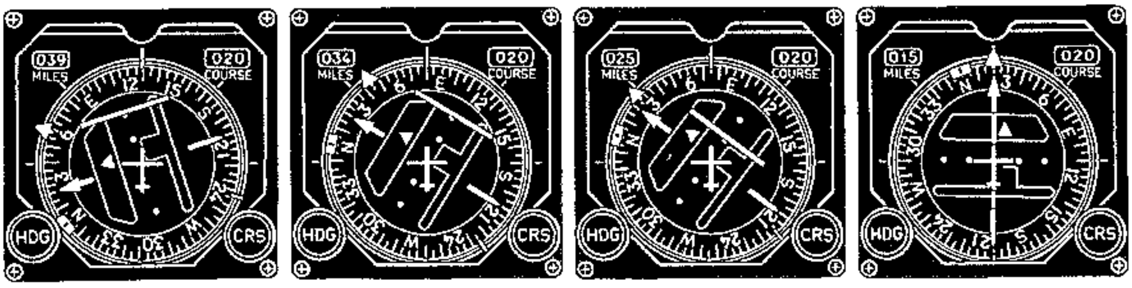
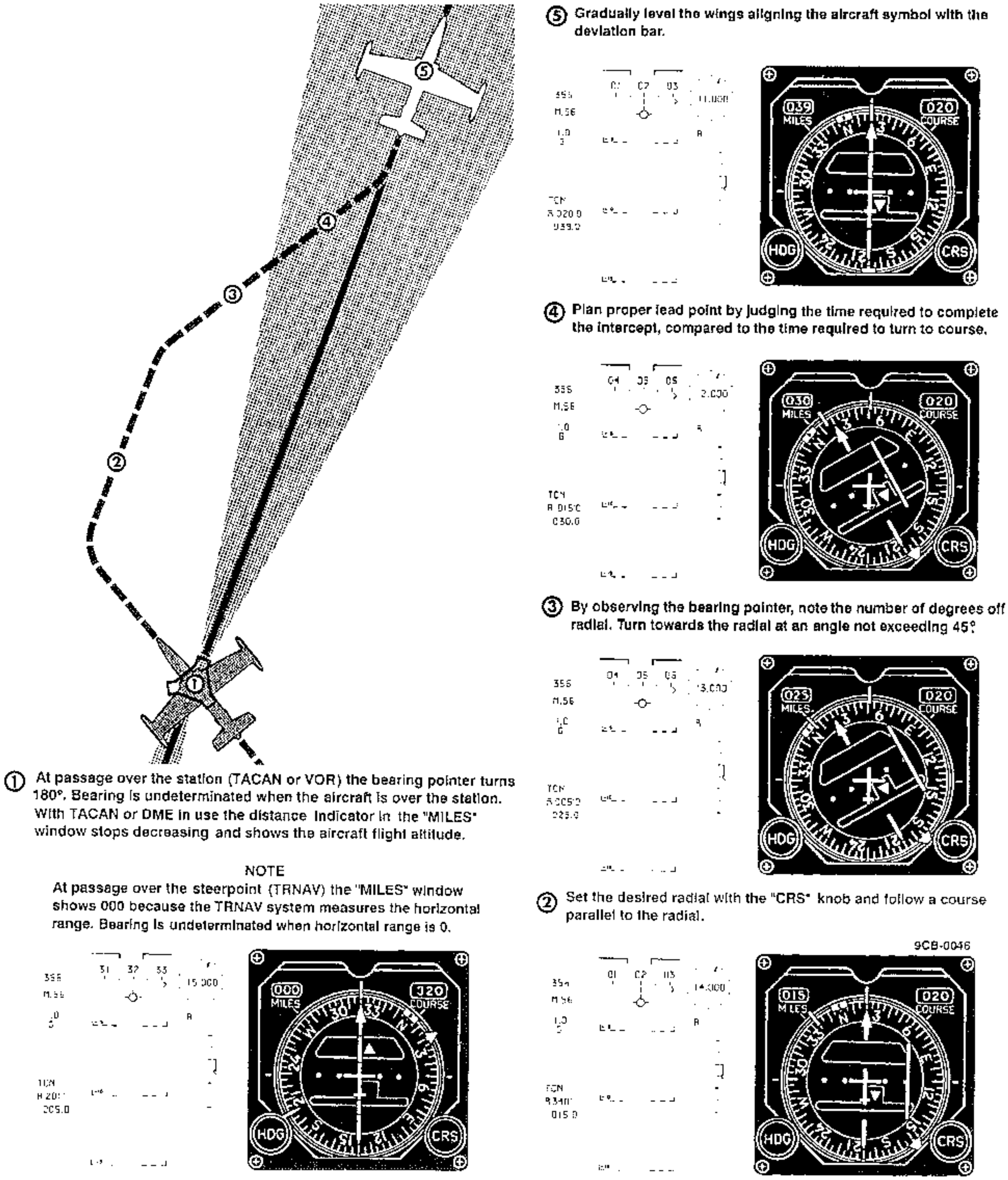


Figure 1-62 (Sheet 2)

USE OF HSI

COURSE INTERCEPTION IMMEDIATELY AFTER STATION PASSAGE



① At passage over the station (TACAN or VOR) the bearing pointer turns 180°. Bearing is undetermined when the aircraft is over the station. With TACAN or DME in use the distance indicator in the "MILES" window stops decreasing and shows the aircraft flight altitude.

NOTE

At passage over the steerpoint (TRNAV) the "MILES" window shows 000 because the TRNAV system measures the horizontal range. Bearing is undetermined when horizontal range is 0.

② Set the desired radial with the "CRS" knob and follow a course parallel to the radial.

③ By observing the bearing pointer, note the number of degrees off radial. Turn towards the radial at an angle not exceeding 45°.

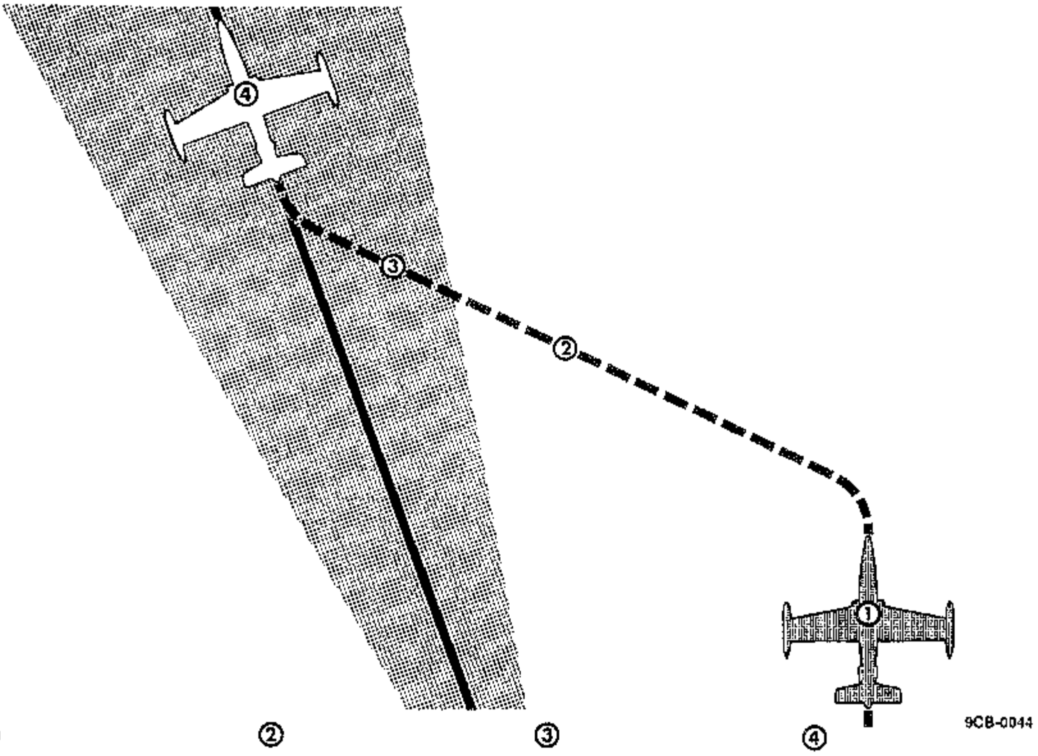
④ Plan proper lead point by judging the time required to complete the intercept, compared to the time required to turn to course.

⑤ Gradually level the wings aligning the aircraft symbol with the deviation bar.

Figure 1-62 (Sheet 3)

USE OF HSI

OUTBOUND COURSE INTERCEPTION



① Set the desired course in the "COURSE" window and check that the TO-FROM indicator is positioning to the tail of the course arrow.

② Turn to "fly" the aircraft symbol towards the deviation bar. Roll out with the course arrow in the upper half of the HSI.

③ Plan proper lead point by judging the time required to complete the intercept compared to the time required to turn to course.

④ Gradually level the wings aligning the aircraft symbol with the deviation bar.

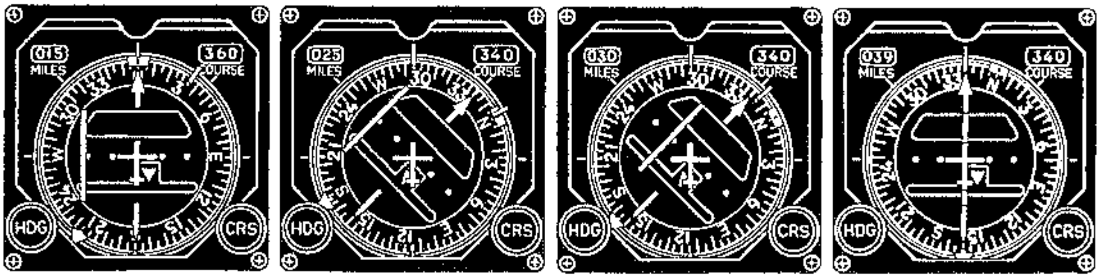


Figure 1-62 (Sheet 4)

value of the aircraft radial, it is necessary to turn the "CRS" knob until the deviation bar is centered and a "FROM" indication is obtained. The value read on the "COURSE" window will be the correct aircraft radial. During an ILS approach, the HSI deviation bar provides the lateral deviation from the localizer even if the selected course value (CRS) is wrong. It must also be noted that, still in an ILS approach, information on deviation (to the right or left) with respect to the localizer is obtained by setting the magnetic bearing of the course to be flown in the "COURSE" window. Should this bearing be 180° displaced, the deviation bar information (to right or left) will be inverted.

ATTITUDE DIRECTOR INDICATOR (ADI)

This instrument (Figure 1-63) consists of an attitude indicator, turn and slip indicator, glide slope indicator and vertical and horizontal steering bars. It provides aircraft attitude indications, turn rate information, slip information, ILS glide slope position relative to the aircraft, and pitch and roll commands. The two steering bars are controlled by the FDC (flight director computer) (see para "Flight Director System" in this Section), and provide pitch and roll steering information required to attain and maintain the flight conditions selected on the NFDCP. A red warning flag appears below the glide slope indicator if the indication is unreliable. If power fails to the ADI or the information is unreliable or the IRS or vertical gyro is at fault, an "OFF" flag comes in view. If the attitude information provided by the IRS is wrong or unreliable, the pilot can shift to the auxiliary mode by setting the mode selector knob on the IRS control panel to AUX. Information will thus be supplied by the vertical gyro. The roll and pitch information is also presented on the PDU.
Aircraft slip is indicated by a slip ball located in the lower portion of the instrument, with a range of ± 10°.
The attitude director indicator is powered from the 115 V ac essential bus via the "ADI" circuit breaker.

OPERATION OF ATTITUDE INDICATOR

The attitude indicator in the ADI is operated by the IRS or a separate vertical gyro. The aircraft attitude is shown accurately through 360° of roll and pitch in NAV mode, and 360° in roll and ± 82° in pitch in the auxiliary mode. Pitch and roll attitudes of the aircraft are shown by the circular motion of a sphere displayed as the background for a miniature reference aircraft. The miniature reference aircraft is always in proper physical relationship to the simulated earth, horizon and sky of the background sphere. The horizon is represented on the sphere by a solid line, the sky by a light gray area and the earth by a dull black area. Horizontal markings in 5-degree increments on the face of the sphere show accurate aircraft attitudes. Bank angles are read on a semicircular bank scale on the lower half of the instrument. The pitch trim knob, on the lower right side of the instrument, permits displacement of the horizon line in relation to the fixed miniature reference aircraft to correct for pitch attitude changes. The window in the lower left corner of the instrument shows "OFF" whenever the instrument is not operating or the vertical gyro is off or the IRS is faulty.

STAND-BY ATTITUDE INDICATOR

The AI-803BH standby attitude indicator (Figure 1-63), is used to provide a standby indication of lateral and longitudinal attitude. Attitude indication is given by the position of a miniature reference aircraft fastened to the instrument bezel, against a drum divided in an upper gray area and a lower black area separated by a white line representing the horizon. The upper gray area represents the sky, the lower black area the earth. When climbing or diving, the horizon line moves down and up respectively.
The two areas have a graduated scale with 10° increments up to 70° in dive and 80° in climb. The instrument provides roll indications through 360° and pitch indications through a minimum of 75° of dive and 95° of climb. The roll angle is displayed by the position of a pointer with respect to a fixed scale marked on the instrument bezel. The attitude indicator is provided with a fluorescent red and black striped warning flag appearing on the dial of the instrument when power to the instrument is interrupted or when the manual gyro caging knob is pulled. The attitude indicator consists mainly of a gyro slaved to the true vertical through an erection mechanism. The gyro manual caging knob, when rotated, aligns the miniature aircraft with the horizon line (max adjustment 5° up and 5° down); when

ATTITUDE DIRECTOR INDICATOR CONTROLS AND INDICATORS

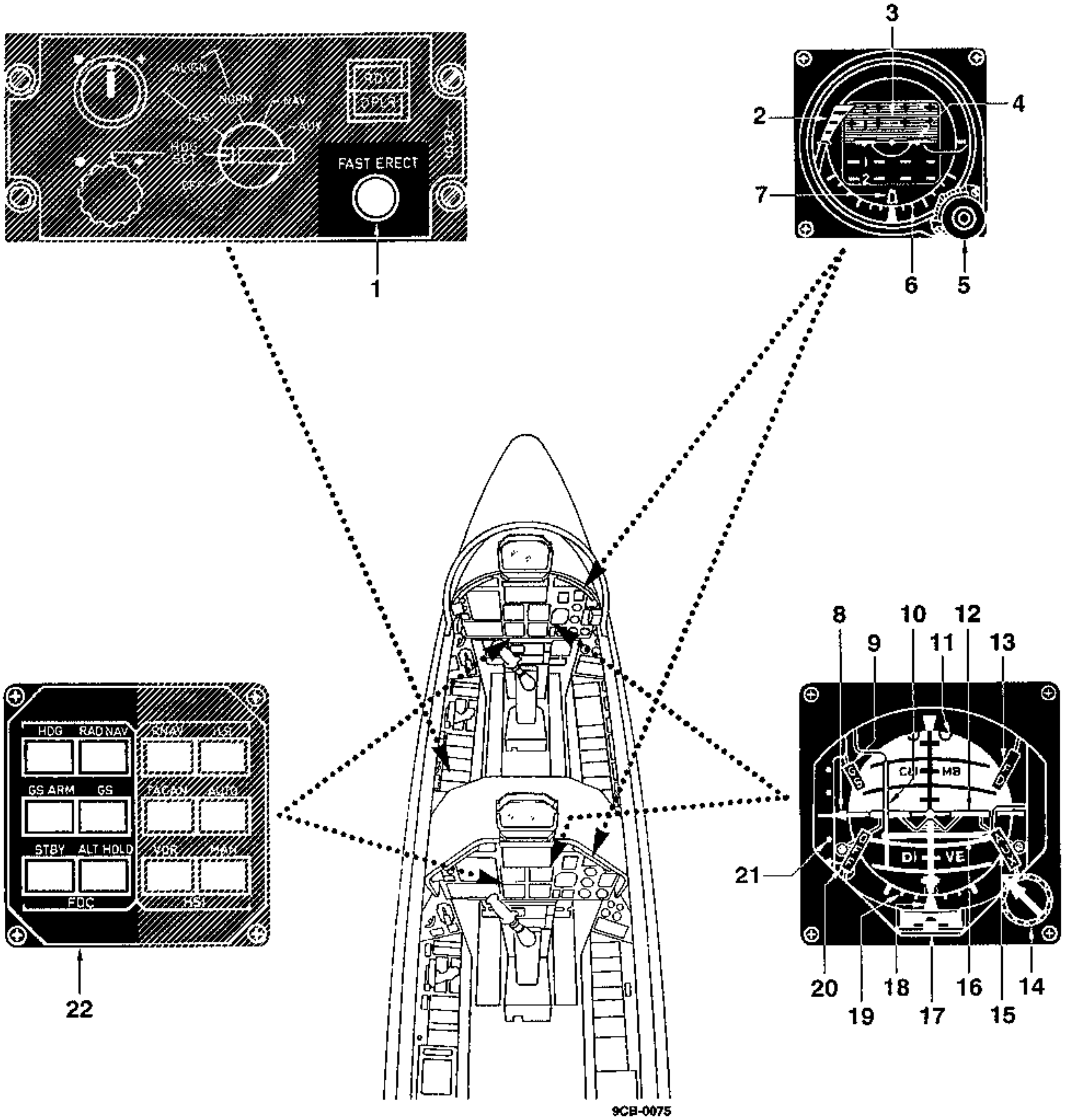


Figure 1-63 (Sheet 1 of 3)

ATTITUDE DIRECTION INDICATOR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "FAST ERECT" push-button	Pressed - Allows fast erection of the vertical gyro
2. Power warning indicator	In view - Indicates that the stand-by attitude indicator is unreliable due to failure or lack of power, or the instrument is locked.
3. Drum	Used together with the miniature aircraft to indicate the aircraft attitude with respect to the horizon.
4. Miniature aircraft	Used together with the drum to indicate the aircraft attitude with respect to the horizon.
5. "PULL TO CAGE" knob	Rotated - Adjusts the position of the miniature aircraft in pitch with respect to the horizon line. Pulled - Permits fast erection of the gyro; the aircraft must be in level flight. Pulled and rotated clockwise - Maintains the knob in the pulled position, viz. with the gyro caged.
6. Bank scale	The bank index provides indication of the aircraft bank angle.
7. Bank index	Indicates the bank angle on the bank scale.
8. Glide slope indicator	Indicates the glide slope position relative to the aircraft.
9. "GS" warning flag	In view - Indicates that the signal from the glide slope receiver is weak or unreliable.
10. Vertical steering bar	Displays the amount of bank necessary for the aircraft to reach and maintain the flight conditions set on the HSI and the NFDCP.
11. Sphere	Used together with the miniature aircraft to indicate the aircraft attitude with respect to the horizon.
12. Miniature aircraft	Used together with the sphere to indicate the aircraft attitude with respect to the horizon.

Figure 1-63 (Sheet 2)

ATTITUDE DIRECTION INDICATOR CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
13. "FD" flag	In view - Indicates that the indications of the steering bars are unreliable.
14. Pitch trim knob	Adjusts in pitch the position of the horizon line on the instrument to correct for pitch attitude changes resulting in level flight attitude of the aircraft from mass and speed variations.
15. "AUX" flag	In view - Indicates that the "NAV" mode is not selected on the IRS control panel.
16. Horizontal steering bar	Displays the pitch attitude change required for the aircraft to reach and maintain the selected altitude or glide slope depending on the selected flight director mode.
17. Slip indicator	Indicates the aircraft slip.
18. Bank index	Indicates the bank angle on the bank scale (19).
20. "OFF" flag	In view - Indicates that the indicator is unreliable due to failure or, momentarily, because a "FAST ERECT" cycle is in progress or the vertical gyro or IRS pitch attitude is invalid.
21. Glide slope scale	Permits the glide slope indicator to indicate the amount of deviation from the glide slope beam. Each dot represents approximately 1/4 degree.
22. Navigation flight director control panel (NFDCP)	Permits the flight director computer modes to be selected, the output commands of which will be displayed through the horizontal and vertical steering bars of the ADI.

Figure 1-63 (Sheet 3)

pulled, it quickly returns the gyro axis to the vertical position. When pulled and rotated fully clockwise, the caging knob cages the gyro and is locked in the pulled position. The knob also carries a pointer which is aligned with the zero on the adjustment scale when the miniature aircraft is aligned with the horizon line. The stand-by attitude indicator is installed 10° down with respect to the aircraft longitudinal axis. With this installation, an inter-gimbal error occurs in pitch which represents a "false climb" indication which is a function of aircraft roll. This pitch error is listed in the following table:

AIRCRAFT ROLL ANGLE	PITCH ERROR IN DEGREES
10°	0.15°
20°	0.60°
30°	1.34°
45°	2.93°
60°	5.00°
90°	10.00°

MARKER BEACON (MKR)

The Rockwell Collins Italiana MKI-3 Marker Beacon system consists of a receiver, a control panel and an antenna installed on the fuselage underside. The system, tuned to 75 MHz, provides the pilot with an aural and visual indication when the aircraft overflies a Marker Beacon. Display of the received signals is through a "MKR" indicator light, which illuminates when the aircraft overflies the outer marker, the inner marker and the airway marker. The aural indication in the headsets is a signal modulated at 400 Hz for the outer marker, 1300 Hz for the inner marker and 3000 Hz for the airway marker. The audio signals are received in Morse code and consist of continuous dashes for the outer marker, alternated dots and dashes for the inner marker and continuous dots for the airway marker. The "MKR" control panel is fitted with a "HI/LO/TEST" switch. The system can operate with low or high sensitivity. In the TEST position, this switch perform receiver self-test. The Marker Beacon system is powered from the 28 V dc bus via the "VOR/ILS" circuit breaker if the VOR/ILS is on. The controls and indicators of the Marker Beacon system are described and illustrated in figure 1-64.

Marker Beacon Operation

1. Make sure that the "VOR/ILS" push-button light on the "TAKE CONTR" control panel is illuminated to indicate availability of control; otherwise, press this push-button.
2. Move the function selector switch on the "VOR/ILS/DME" control panel to VOR/ILS.
3. Move the sensitivity switch to HI (high sensitivity) or to LO (low sensitivity).
4. Pullout and rotate the "MKR" receive switch (on the audio control panel) to the intermediate position.

Marker Beacon Self-Test

1. Move the "HI/LO/TEST" sensitivity switch to TEST.
2. Make sure that the overflight indicator light flashes and a low frequency signal is heard in the headset.

INDEPENDENT POSITION DETERMINING SYSTEM

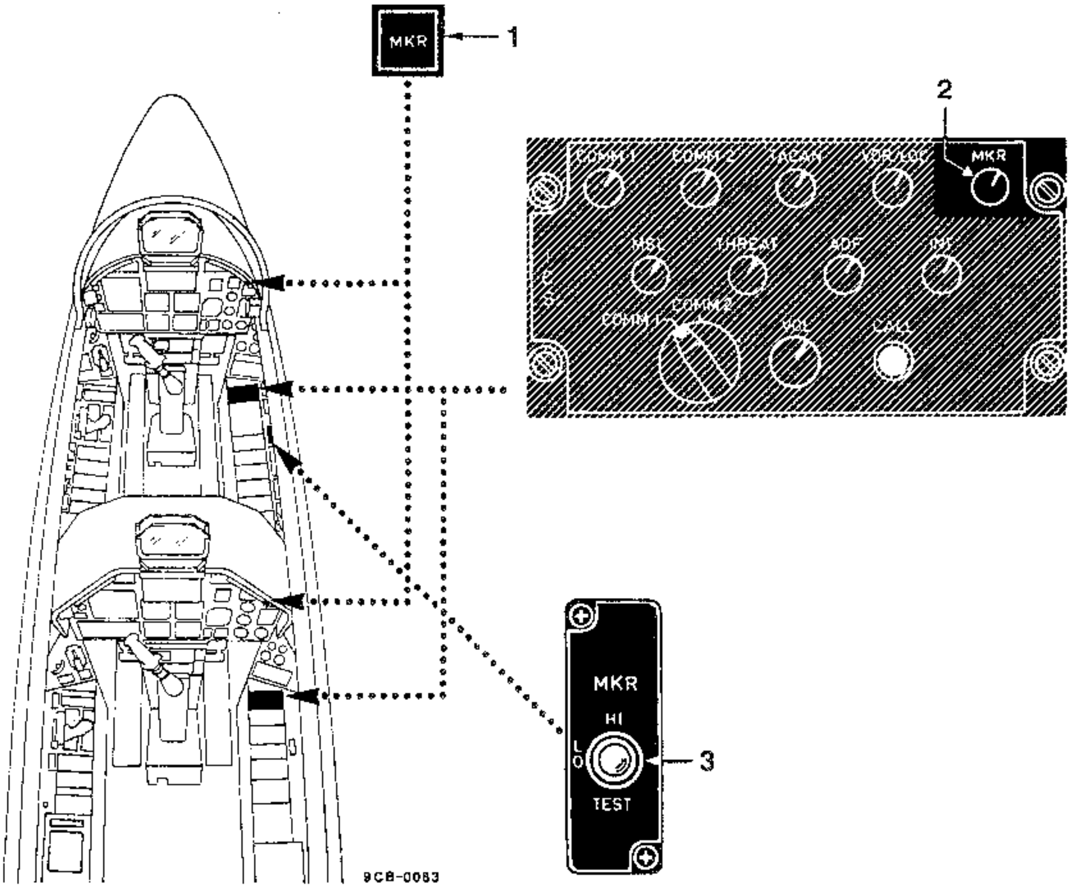
Radar Altimeter System

The aircraft is fitted with a Honeywell radar altimeter HG8505. The radar altimeter system measures the vertical distance between the aircraft and the ground, and transmits the relevant information to the head-up display and weapon aiming computer (HUDWAC) system. The system operates between 0 and 5000 ft and provides reliable information up to ± 45° in pitch and roll. The transmitter/receiver of the radar altimeter system is located in a bay in proximity of the root of the vertical stabilizer. The antennas are positioned on the fuselage underside skin. The radar altimeter system is powered from the 28 V dc primary bus.

Doppler/Inertial Reference System

The aircraft is fitted with a Doppler/Inertial Reference System (DIRS) (figure 1-65), composed of a Litton Guidance LR-80 Inertial Reference Unit (IRU) and a GEC Avionics AD-660 Doppler Velocity Sensor

MARKER BEACON CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. "MKR" indicator light	Illuminates to indicate passage over the Marker Beacon.
2. "MKR" receive switch	Pulled out - Permits reception of the signal indicating passage over the Marker Beacon. Rotated - Adjusts the set volume.
3. Sensitivity switch	HI - Sets the Marker Beacon receiver for high sensitivity operation. LO - Sets the Marker Beacon receiver for low sensitivity operation. TEST - Performs Marker Beacon self-test (in accordance with the described procedure)

Figure 1-64

DOPPLER/INERTIAL REFERENCE SYSTEM BLOCK DIAGRAM

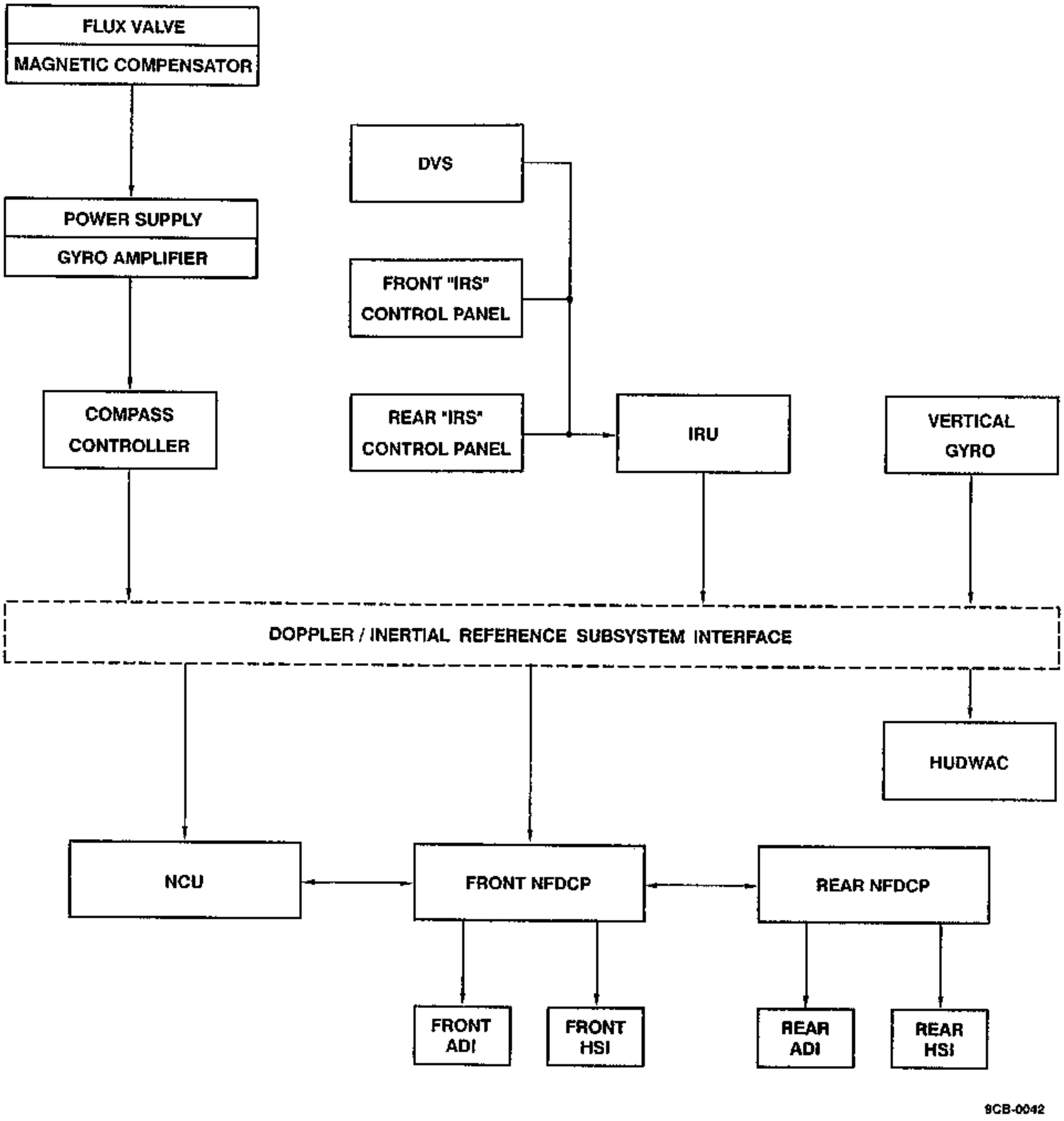


Figure 1-65

(DVS). The DIRS is capable of providing the HUDWAC and tactical area navigation (TRNAV) systems and the integrated instruments system with the following information for any aircraft attitude: roll and pitch angles and rates, turn rates, true heading, normal acceleration, aircraft velocities (Vx, Vy, Vz, north-south, east-west and vertical), aircraft inertial/baro altitude, aircraft present position (longitude/latitude). The DIRS operates in the Doppler/inertial mode and in the free inertial mode. In the Doppler/inertial mode, the DVS delivers velocity data along the three aircraft axes to the IRU; this data is combined with the velocities derived from the IRU through a Kalman filter, and allow the DIRS to provide the above outputs (velocities and angles) with the required accuracy. The DVS gives correct velocity information when flying over land ("LAND" push- button selected) and over water ("SEA" push-button selected). The two operating modes are selected by the pilot as a function of the overflown surface, through a "LAND/SEA" push-button/advisory light located on the right glareshield in each cockpit. The Doppler/inertial mode is the primary operating mode: when no velocity information from the DVS is available, the DIRS automatically operates in the free inertial mode, furnishing the same information as computed in the Doppler/inertial mode, though with degraded accuracy. In case of failure of the inertial reference unit, the DIRS still furnishes the velocity data along the three aircraft axes as measured by the DVS. The DIRS provides this performance two minutes after switching on in the fast alignment mode and eight minutes after switching on in the normal alignment mode. The alignment mode is selected by the front pilot through the "IRS" control panel, located on the left console of the front cockpit. When the selector knob is at FAST ALIGN, alignment can be performed in the following ways:

- Stored Heading (using the data stored in the Mission Data Memory of the inertial platform)
- Manual Heading (using the heading value manually entered through the DEP keyboard)
- Compass Heading (using the heading output by the directional gyro, after validation).

With the selector knob at NORMAL ALIGN, the platform computes the heading independently with the "two position gyro-compass alignment" procedure. The "IRS" repeater panel is located on the left console of the rear cockpit. The Doppler/inertial reference system control panel is also used to control the directional gyro and the vertical gyro.

ALIGNMENT PROCEDURE OF IRU

- IRU Alignment in Stored Heading Mode

  This alignment is possible only under the dollowing conditions:

  - Last alignment was made in Normal mode
  - The aircraft was not moved after the last IRU switching off.

  For IRU alignment in this mode, accomplish the following operations:

1. On the "IRS" control panel, move the mode selector knob to HDG SET.
2. Align the slave indicator by turning the "HDG SET" knob.
3. Check that the heading on the HSI is consistent with the heading on the standby compass.
4. On the Data Entry Panel (DEP) scratchpad, check that the heading digital indication is correct.
5. On the DEP, press the "ENT" key.
6. By use of the DEP keyboard, enter the Present Position, or recall a weypoint number or an airport ident from the Navigation Computer Unit (NCU) data base, the position of which is the present aircraft position (carry out the "SET" ... "ENT" sequence).
7. On the "IRS" control panel, move the mode selector knob to FAST.

NOTE

This operation energizes the IRU, which is then capable of checking whether the aircraft was moved after the last IRU switching off.

- IRU Alignment in Manual Heading Mode

This alignment is carried out when the directional gyro is failed or unreliable (e.g. when the aircraft is located close to large metallic masses, such as shelters, etc.).
To accomplish this alignment, proceed as follow:

NOTE

The procedures described in steps 1 thru 4 are the same as those described in the same steps in the Stored Heading alignment paragraph.

1. On the "IRS" control panel, set the mode selector knob to HDG SET.
2. Align the slave indicator by turning the "HDG SET" knob.
3. Check that the heading on the HSI is consistent with the heading on the standby compass.
4. On the DEP scratchpad, check that the heading digital indication is correct.
5. Through the DEP keyboard, enter the present magnetic heading. Heading (for example HDG 134) will appear on the DEP scratchpad.
6. On the DEP, press the "SET" key. Heading will disappear from the DEP scratchpad (HDG ---).
7. Through the DEP keyboard, enter the magnetic heading, and press the "ENT" key.

NOTE

The procedures described in steps 8 and 9 are the same as those described in steps 6 and 7 in the Stored Heading alignment paragraph.

8. By use of the DEP keyboard, enter the Present Position, or recall a waypoint number or an airport ident from the NCU data base, the position of which is the present aircraft position (carry out the "SET" ... "ENT" sequence).
9. On the "IRS" control panel, move the mode selector knob to FAST.

NOTE

This operation energizes the IRU, which is then capable of checking whether the aircraft was moved after the last IRU switching off.

- IRU Alignment in Compass Heading Mode

This alignment is carried out by following the same procedures as used for the alignment in the Stored Heading mode (see the paragraph covering the latter mode). The only difference is that the IRU, when it recognizes that the aircraft was moved since the last switching off, automatically accomplishes an alignment in the Compass mode.
Carry out one of the three FAST alignments described in the preceding points. When the "RDY" advisory light illuminates, set the mode selector knob to NAV, and chack that:

- The HSI, ADI and PDU display the information provided by the IRU.
- The MFD displays the information provided by the directional gyro (AUX legend).

NOTE

After take-off, the "AUX" legend remains in view on the MFD because the IRU is operating in In-flight Restart mode. During the first 6 minutes of flight, the Doppler Velocity Sensor (DVS) updates the alignment of the IRU which passes from In-flight Restart mode to normal navigation mode. Before the IRU starts operating in normal navigation mode, the Remote Display Unit (RDU) will display "A" or "R".

- IRU Alignment in Normal Mode

  This alignment is carried out by using any of the procedures described in the preceding paragraphs. The only condition to perform this alignment is that the mode selector knob must be rotated to NORMAL ALIGN upon completion of all operation described in the previous points. This operation energizes the IRU, and initiates the two-position gyro-compass alignment. When the "RDY" advisory light is illuminated, move the mode selector knob to NAV and check that:

  - The HSI, ADI, PDU and MFD display the information provided by the IRU.
  - The RDU displays mode "I" or is blank (normal navigation mode).

- AUX Mode

  If, after completion of one of the above alignments and selection of the NAV mode, it is suspected that the IRU does not operate correctly, a cross check can be performed by rotating the mode selector knob from NAV to AUX, and checking that the following takes place: - The "AUX" flag appears on the ADI (pitch and roll information is provided from the vertical gyro)

  - The "AUX" legend (magnetic heading scale) appears on the MFD (heading information is provided from the directional gyro)
  - The normal acceleration information ("G" indication) disappears from the PDU (pitch and roll information is provided from the vertical gyro while heading information is provided from the directional gyro)
  - The mode displayed on the RDU is "A" or "R". Return the mode selector knob to NAV.

NOTE

Selection of the AUX mode in no way impairs IRU performance.

Independent Position Determining System Controls and Indicators

The independent position determining system controls and indicators are illustrated in figure 1-66.

DEPENDENT POSITION DETERMINING SYSTEM

The dependent position determining systems block diagram is illustrated in figure 1-67.

IFF System

The AN/APX-100 transponder system consists of a transceiver, a control panel and two antennas: an upper antenna located on the aircraft nose and a lower antenna located on the fuselage mid-section underside. The receiver operates on a frequency of 1030 MHz and the transmitter operates on 1090 MHz. The system permits automatic identification of the aircraft when interrogated by a radar system (IFF) and provides selective identification (SIF) in the different modes. The system provides a coded reply to a proper interrogation code. The correct reply to the interrogation enables the radar operator to identify the aircraft. In case of seat ejection the IFF transponder automatically transmits emergency replies provided the "MASTER" selector is not at OFF. The system is supplied from the 28 V dc essential bus via the "IFF" circuit breakers. The IFF system controls and indicators are described and illustrated in figure 1-68.

IFF SYSTEM OPERATION

Operation of the system is obtained by moving the "MASTER" selector switch to any position (except OFF). The STBY position is used to warm the set and to maintain the system ready for operation. Transmission takes place only when the "MASTER" selector is in the NORM and EMER positions. When

INDEPENDENT POSITION DETERMINING SYSTEM CONTROLS AND INDICATORS

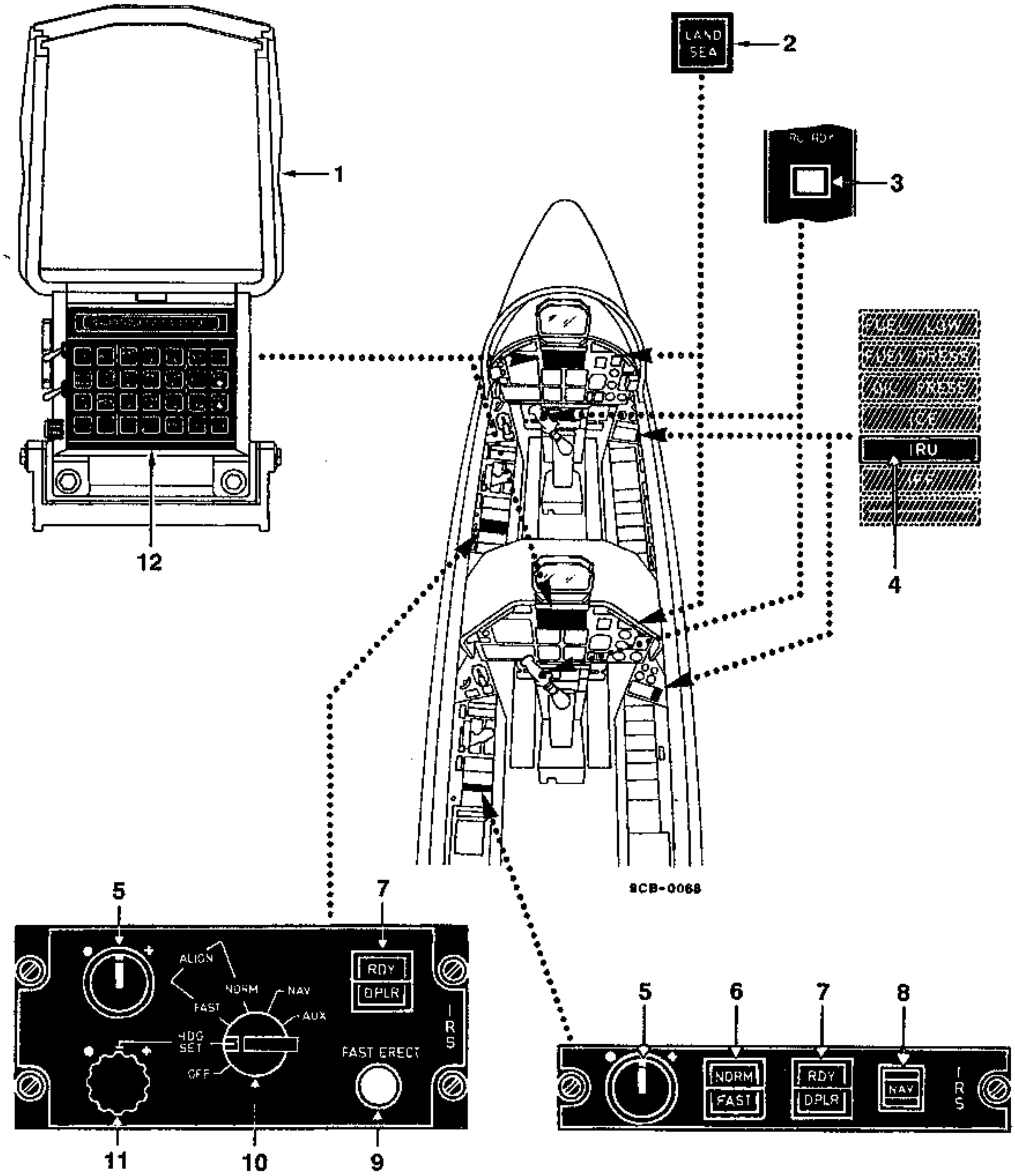


Figure 1-66 (Sheet 1 of 4)

INDEPENDENT POSITION DETERMINING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. PDU	Displays all data received from the independent navigation sensor system.
2. "LAND/SEA" push-button/ /advisory light	Permits the selection of the two navigation operating modes as a function of the overflown surface. It must be pushed to change the doppler velocity sensor rate from land operation ("LAND" green sector illuminated) to water operation ("SEA" green sector illuminated). **NOTE** If both advisory lights are off, it indicates a failure of the doppler velocity sensor.
3. "IRU RDY" advisory light	Illuminated - The inertial gyros are aligned and the mode selector switch can be moved to the NAV position.
4. "IRU" caution light	Illuminated - Indicates a failure of the inertial reference unit or that the "AUX" mode has been selected.
5. Slave indicator	When the slave indicator index is aligned with the lubber line, the heading information sent by the directional reference system is consistent with the actual heading of the aircraft. When the marker moves toward the dot (.) or the cross (+), the instrument indicates a misalignment between the directional gyro and the compass transmitter. The pilot must rotate the "HDG SET" knob to zero the error.
6. "NORM/FAST" advisory light	NORM - Indicates that the front pilot has set the mode selector knob to the NORM ALIGN position. FAST - Indicates that the front pilot has set the mode selector knob to the FAST ALIGN position.
7. "RDY/DPLR" advisory light	RDY - The inertial gyros are aligned and the mode selector switch can be moved to the NAV position. DPLR - Indicates a failure of the doppler velocity sensor or that it is switched off.

Figure 1-66 (Sheet 2)

INDEPENDENT POSITION DETERMINING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "NAV/AUX" indicator	Indicates the mode selected on the front "IRS" control panel, except for NORM ALIGN, FAST ALIGN and OFF.
9. "FAST ERECT" push-button	Pressed - Causes fast alignment of the vertical gyro, with the mode selector knob in any position except OFF.
10. Mode selector knob	OFF - All the systems controlled by the "IRS" control panel are switched off. HDG SET - Changing the selector knob position from OFF to HDG SET applies power to the directional gyro and the vertical gyro only, and sends information to the PDU, HSI, ADI and MFD. **NOTE** The selector knob shall not be moved back to HDG SET (from other modes) without reaching the OFF position. FAST ALIGN - Switch on the IRU. This position is to be used for scramble purposes only. In the case of fast alignment, the inertial system has no time to sense the rotation of the earth and search for the direction of North. The computer can align the inertial sensor with the compass or with a preset heading reference; in this case alignment is less accurate. NORM ALIGN - This position permits normal alignment to be performed. The pitch, roll and heading information are provided from the vertical gyro and directional gyro to the PDU, ADI, HSI and MFD. NAV - This position corresponds to normal navigation when alignment is completed. **CAUTION** The mode selector knob must be moved to NAV position before moving the aircraft. When selected, the "RDY" advisory lights go off. The pitch, roll and heading information are provided from the IRU to the PDU, ADI, HSI and MFD.

Figure 1-66 (Sheet 3)

INDEPENDENT POSITION DETERMINING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
	AUX - This position of the mode selector knob enables the pilots to use the directional gyro and the vertical gyro to obtain the heading and attitude information to use on the HSI/ADI and TRNAV/Flight Director. The pitch, roll and heading information is provided from the vertical gyro and directional gyro to the PDU, ADI, HSI and MFD.
11. "HDG SET" knob	Pressed and rotated in the appropriate direction - Starts fast alignment of the directional gyro with the compass transmitter, if the mode selector knob is in any position other than OFF.
12. Data entry panel (DEP)	Permits the entry of the navigation and weapon aiming data into the navigation computer (NCU) and the weapon aiming computer (WAC)

Figure 1-66 (Sheet 4)

the "MASTER" selector is moved to EMER, the IFF transponder transmits emergency replies in modes 1, 2 and 3/A, regardless of the position of the mode switches (modes C and 4 do not have emergency replies, therefore they operate as if the "MASTER" selector were at NORM). The same operation takes place automatically after ejection if the "MASTER" selector is at STBY or NORM.

OPERATION OF MODES 1, 2 AND 3/A

Modes 1, 2 and 3/A may be used independently or in combination. Mode 1 provides 32 possible code combinations, each selectable in flight by means of the two "MODE 1" code selectors on the control panel. Mode 2 provides one of the 4096 possible code combinations which can be selected on the ground through transponder "MODE 2" code selectors. Mode 3/A provides 4096 possible code combinations which may be selected by the pilot in flight by means of the four "MODE 3/A" code selectors on the control panel.

OPERATION OF MODE C

Mode C can only be enabled if mode 3/A is enabled as well. When Mode C is selected and correctly interrogated, the aircraft pressure altitude (four digits) is automatically reported to the air traffic control on the ground in 100-foot increments. To provide this information, the system uses the data supplied by the encoder altimeter installed in the front cockpit.

NOTE

> The altitude recorded by the ground station is referred to 1013.25 mbar altimeter setting and is the same altitude as indicated by the encoder altimeter if QNE is set through the altimeter baro pressure setting knob.

DEPENDENT POSITION DETERMINING SYSTEM BLOCK DIAGRAM

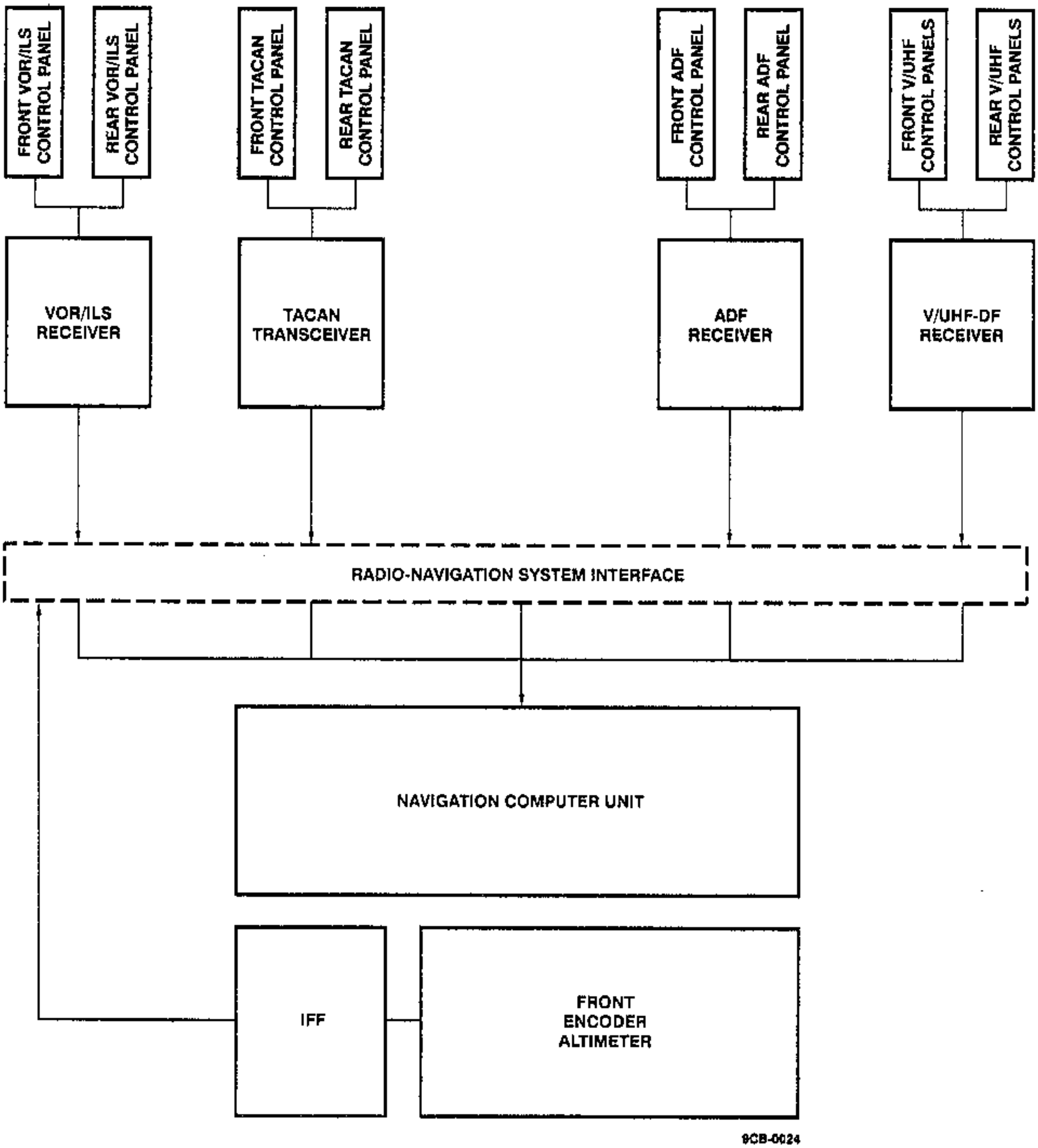


Figure 1-67

IFF SYSTEM CONTROLS AND INDICATORS

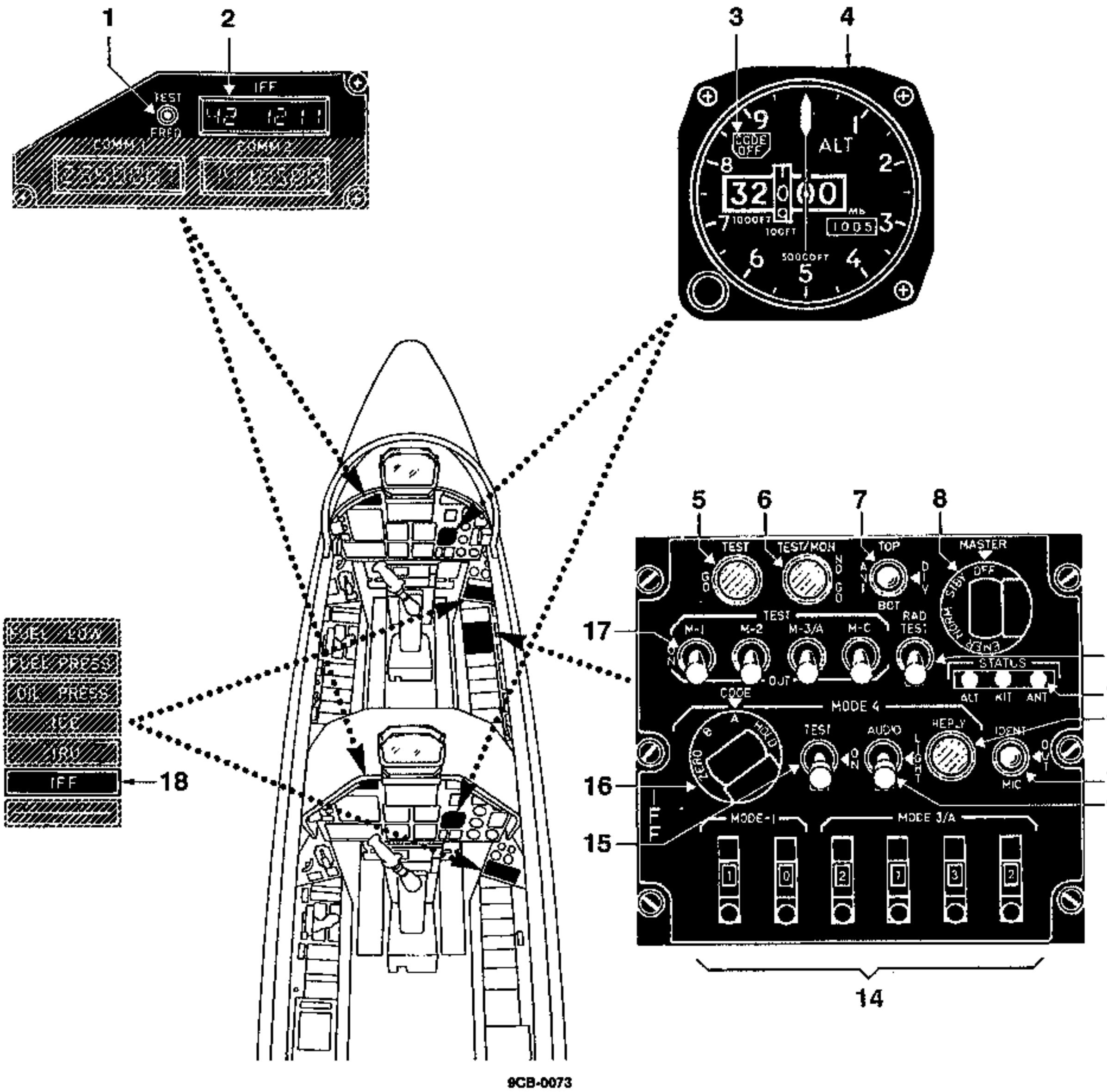


Figure 1-68 (Sheet 1 of 3)

IFF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "TEST/FREQ" switch	TEST - Momentarily shows 88 8888 on the "IFF" display to indicate correct operation. Center position - Indicates the identification code corresponding to the code of mode 1 and 3/A selected on the "IFF" control panel. FREQ - Inoperative.
2. "IFF" display	Indicates the identification code selected in modes 1 and 3/A only.
3. "CODE OFF" flag	In view - Indicates that power is not supplied to the encoder or the encoder does not operate correctly.
4. Encoder altimeter	Provides the IFF system with coded signals of aircraft altitude.
5. "TEST-GO" light	On - Indicates that the set replies correctly to modes 1, 2, 3/A or C test interrogations made with the mode switches at TEST (self- test) or the "RAD TEST/OUT" switch at RAD TEST (test with ground equipment).
6. "TEST/MON NO-GO" light	On - Indicates that the set does not reply correctly to tests of modes 1, 2, 3/A or C. The mode switches must be at TEST (self- test) or the "RAD TEST/OUT" switch must be at RAD TEST (test with ground equipment).
7. "ANT" switch	TOP - The set operates through the top antenna. DIV - (Diversity) - The system automatically selects the antenna to be used for transmission and reception. BOT - (Bottom) - The set operates through the bottom antenna.
8. "MASTER" selector	OFF - De-energized position. STBY - The equipment is selected for immediate operation when the selector is moved to NORM or EMER. NORM - The set is operating. EMER - All modes are excluded except TEST; the set transmits emergency reply signals when interrogated.

Figure 1-68 (Sheet 2)

IFF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
9. "RAD TEST-OUT" switch	OUT - De-energized position (Self-test is still possible). RAD TEST - Momentary position - Permits reception of interrogation signals transmitted by appropriate ground test equipment. **NOTE** Positions OUT and RAD TEST operate the test set only when the "MASTER" switch is at NORM or EMER.
10. Status lights	ALT - Illuminated - Indicates that the encoder altimeter data is not received by the IFF set. KIT - (Inoperative). ANT - Illuminated - Indicates failure of one of the two antennas or that the standing wave ratio is too high.
11. "REPLY" light (Mode 4)	(Inoperative).
12. "IDENT-MIC" switch	OUT - De-energized position. IDENT - Momentary position - Enables an identification reply for approx 20 seconds. MIC - Enables an identification reply for approx 20 seconds every time the transmission push-button on the engine throttle is pressed.
13. "AUDIO LIGHT" switch (inoperative in this aircraft)	OUT - De-energized position. AUDIO - A signal indicating validity of mode 4 interrogations is heard in the headset. aircraft)The "REPLY" and "IFF MODE 4" lights illuminate. LIGHT - The "REPLY" light illuminates.
14. "MODE 1" and "MODE 3/A" code selectors	Select the mode 1 (2- digit) and mode 3/A (4-digit) reply code number.
15. "MODE 4 - TEST" switch (inoperative in this aircraft)	TEST - Momentary position - Permits IFF self- test in Mode 4. OUT - Mode 4 is de-energized. This position is indicated by the illumination of the "IFF" light. ON - Enables the set to reply to Mode 4 interrogations.

Figure 1-68 (Sheet 3)

IFF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
16. "CODE" switch (inoperative in the aircraft)	Determines Mode 4 operation. ZERO - Erases the code from the computer. A or B - Enables computer operation in Mode A or B. HOLD - Prevents the computer from being automatically zeroed.
17. "M1", "M2", "M3/A" and "M-C" Mode switches	OUT - Disable the reply in the corresponding mode ON - Enable the reply in the corresponding mode. TEST - Momentary position - Perform self-test of the set in the corresponding mode (the "TEST GO" or "TEST/MON NO-GO" light will illuminate) provided the "MASTER" selector switch is at NORM or EMER. **NOTE** Mode "M-C" can be used only if mode "M-3/A" is operating.
18. "IFF" caution light (inoperative in this aircraft)	On - Indicates unsatisfactory operation of the set in Mode 4, or that the "MODE 4-TEST" switch is at OUT, or the "AUDIO-LIGHT" switch is at LIGHT or AUDIO.

Figure 1-68 (Sheet 4)

OPERATION OF MODE 4

Mode 4 (identification code reserved for military use) is inoperative in this aircraft.

SYSTEM STARTING

1. "MASTER" selector switch - STBY for 1 minute under standard temperature conditions (5 minutes under extreme cold temperature conditions), then NORM.
2. Code selectors - Set.
3. Mode switches - As desired.
4. IDENT/MIC switch - OUT.

IDENTIFICATION-OF-POSITION OPERATION

When the "Ident/MIC switch is selected, the system transmits the position identification signal to all interrogating stations in Modes 1, 2 and 3/A. Trsnsmission of the identification-of position signal occurs along with the normal reply in these modes only, and therefore is independent on the selections made. Identification-of-position signals can be transmitted using two different procedures:

1. Momentarily hold the "IDENT/MIC" switch in the IDENT position, then release. This action causes the identification-of-position signal to be transmitted for a period of 20 seconds to all interrogating stations in Modes 1, 2 and 3/A. Repeat as required.
2. Set the "IDENT/MIC" switch to the MIC position. Identification-of-position signals are transmitted by pressing the radio transmit push-button on the engine throttle. When the need for identification signals has ended, return the "IDENT/MIC" switch to the OUT position.

EMERGENCY OPERATION

During an emergency or distress condition, the system is used to transmit specially coded signals in modes 1, 2 and 3/A to all interrogating stations. These emergency signals are transmitted as long as the "MASTER" selector switch remains in the EMER position. For emergency operation, proceed as follows:

1. Pull and rotate the "MASTER" selector switch to the EMER position.
2. Leave the "MASTER" selector switch at EMER for the duration of the emergency.
3. When the emergency has ended, return the "MASTER" selector switch to the NORM position.

NOTE

When the seat is ejected, the emergency signal is automatically transmitted if the "MASTER" selector is not in OFF position.

IFF SYSTEM SELF-TEST

Self-test is possible for modes 1, 2, 3/A and C. With the "MASTER" selector switch in the NORM position, self-test is commenced by moving one of the mode switches to TEST. A signal generated for the selected mode of operation arrives at the set and is processed as a normal interrogation signal. Normal operation of the mode being tested is indicated by the illumination of the "GO" light (green light). The "RAD TEST/OUT" switch provides a further method to check the system. A special test mode is obtained when the switch is momentarily moved to the RAD TEST position. In the test mode, the "GO" light illuminates when the system replies to the interrogations sent by an external test set. The test mode is independent and does not affect the operating modes. In the OUT position, the self-test set monitor circuits are activated and the "GO" light illuminates whenever valid replies both to external and internal interrogations are transmitted.

Automatic Direction Finder (ADF) System

The Collins ADF-60A system consists of a radio receiver operating in the frequency range of 190.0 to 1749.5 kHz, two control panels, an integrated loop sense antenna located on the fuselage underside. Information is visually displayed by the bearing pointer of the HSI. The ADF system provides a continuous indication of the bearing of the selected ground station. The system can also be used as a simple radio receiver, the bearing function being disabled, for the reception of radio range stations. The control panel permits preselection of two frequencies which give, in quick sequence, the reading of two NDB stations when the "TFR" (transfer) switch is operated. The ADF system is powered from the 28 V dc and 26 V ac primary busses via the "ADF" circuit breakers. The ADF controls are described and illustrated in figure 1-69.

ADF SYSTEM OPERATION

1. Make sure that the "ADF" push-button light, on the "TAKE CONTR" control panel, is illuminated to indicate availability of the control panel and instrument controls; otherwise, press the push-button.

ADF SYSTEM CONTROLS AND INDICATORS

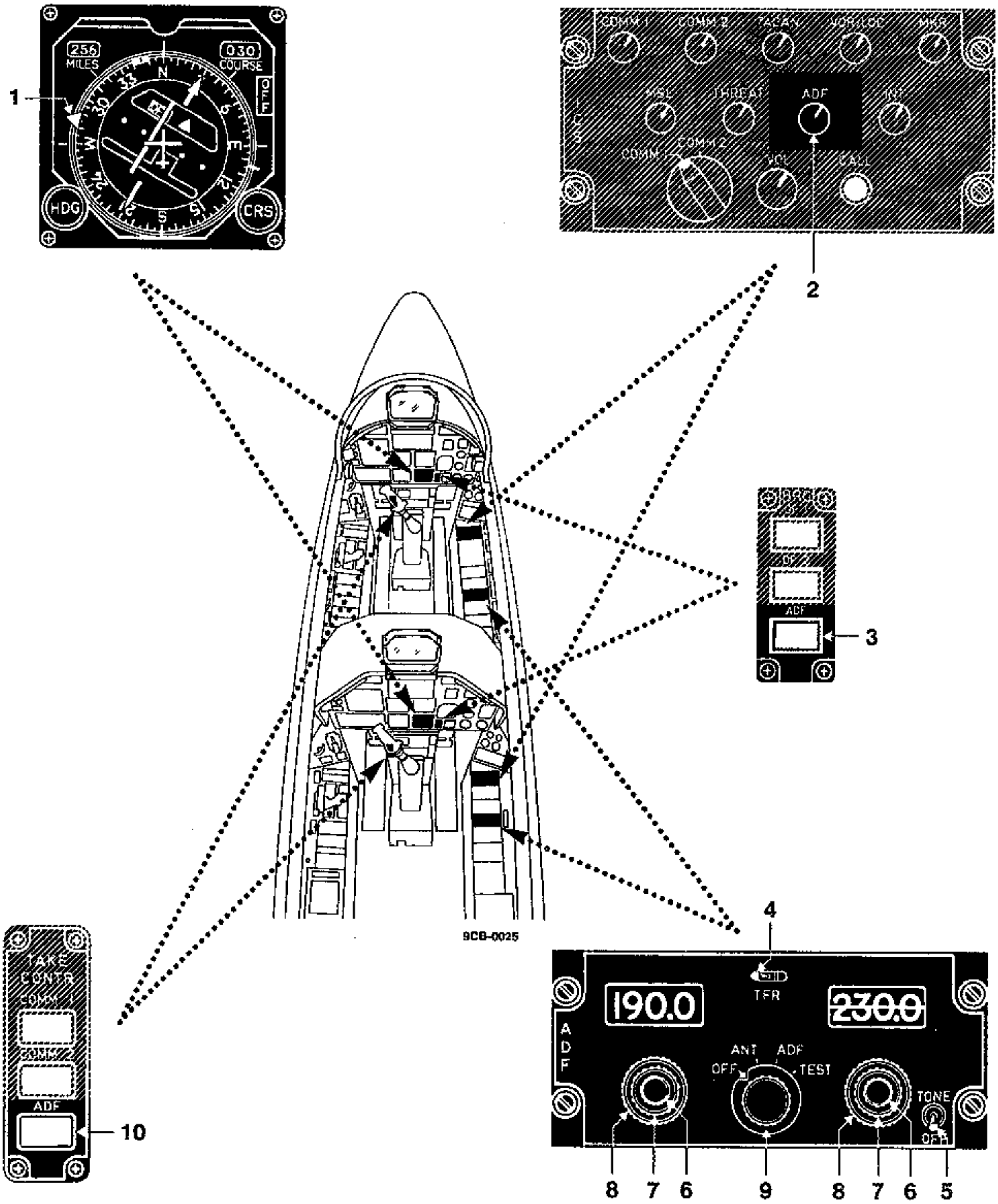


Figure 1-69 (Sheet 1 of 3)

ADF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Bearing pointer	Displays the bearing of the selected NDB station.
2. "ADF" receive switch	Pulled out - Permits ADF signals to reach the headset. Rotated - Adjusts the set volume.
3. "BRG/ADF" push-button advisory light	Pressed and illuminated - Permits the bearing (bearing pointer) to be displayed on the HSI. **NOTE** The push-button is energized only when the ADF system is on (mode selector at ADF or ANT).
4. "TFR" switch	Selects one of the two preset frequencies. A white bar appears in the window of the frequency not in use. Only the frequency in use is illuminated.
5. "TONE" switch	TONE - The Beat-Frequency Oscillator (BFO) in the receiver is operating, thus allowing the reception of continuous wave (CW) radio stations.
6. Frequency selector	Selects the frequencies in 1 kHz and 0.5 kHz increments (third and fourth digits).
7. Frequency selector	Selects the frequencies in 10 kHz increments (second digit).
8. Frequency selector	Selects the frequencies in 100 kHz increments (first digit).
9. Mode selector	OFF - De-energized position. ANT - Allows operation of the set as a general radio receiver or for the reception of Radio Range stations. Reception is through the sense antenna and no bearing of the selected station is provided. ADF - The receiver automatically displays the bearing of the selected station through the HSI bearing pointer. TEST - Momentary position - Permits the ADF system to be tested for correct operation in flight. The pointer on the HSI moves to 315° polar bearing. A continuous 1020 Hz signal is heard in the headset.

Figure 1-69 (Sheet 2)

ADF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
10. "TAKE CONTR/ADF" push-button light	Pressed and illuminated - Provides control of the ADF system. **NOTE** Control cannot be shifted back to the other cockpit (by operating the same push-button again). It is necessary that the pilot who wants control presses the push-button.

Figure 1-69 (Sheet 3)

2. Select the desired frequencies and move the "TFR" switch to set the arrow to the frequency to be used.
3. Turn the mode selector switch to ANT. The receiver tunes immediately to the selected frequency.
4. Press the "ADF" push-button light located on the "BRG" control panel.
5. Pull and rotate the "ADF" receive switch on the audio control panel to the intermediate position.
6. Listen for the station identity tone.
7. Move the mode selector switch to ADF and read the bearing to the selected station indicated by the bearing pointer on the HSI.
8. To turn the set off, return the mode selector switch to OFF.

V/UHF-DF System

The V/UHF-DF system uses the VHF and UHF radio sets and an integrated Collins DF301-E type antenna. The Direction Finder DF-301E provides, through the bearing pointer of the HSI, the bearing of a station transmitting on VHF or UHF (in a frequency range from 100 to 400 MHz). The V/UHF-DF system is designed to ensure automatic switching of the UHF and VHF receiver-transmitters to the respective communication antennas, when they are selected for transmission through the "MIC" push-button located on the engine throttle. Transmission on UHF and VHF is thus possible also when operating in the DF mode. Audio reception is from antenna DF-301E. The V/UHF-DF system is powered from the 26 V ac and 28 V dc essential busses. The system controls are described and illustrated in figure 1-70.

V/UHF-DF SYSTEM OPERATION

Accomplish all the operations required to tune the system to the UHF or VHF ground station.

- VHF-DF Operation Mode
  1. Make sure that the "COMM2" push-button light on the "TAKE CONTR" control panel is illuminated; otherwise press the push-button.
  2. Press the "DF2" push-button light on the "BRG" control panel. The push- button is energized only when the VHF system is on.
  3. Move the mode selector switch on the "VHF" control panel to DF.

V/UHF-DF SYSTEM CONTROLS AND INDICATORS

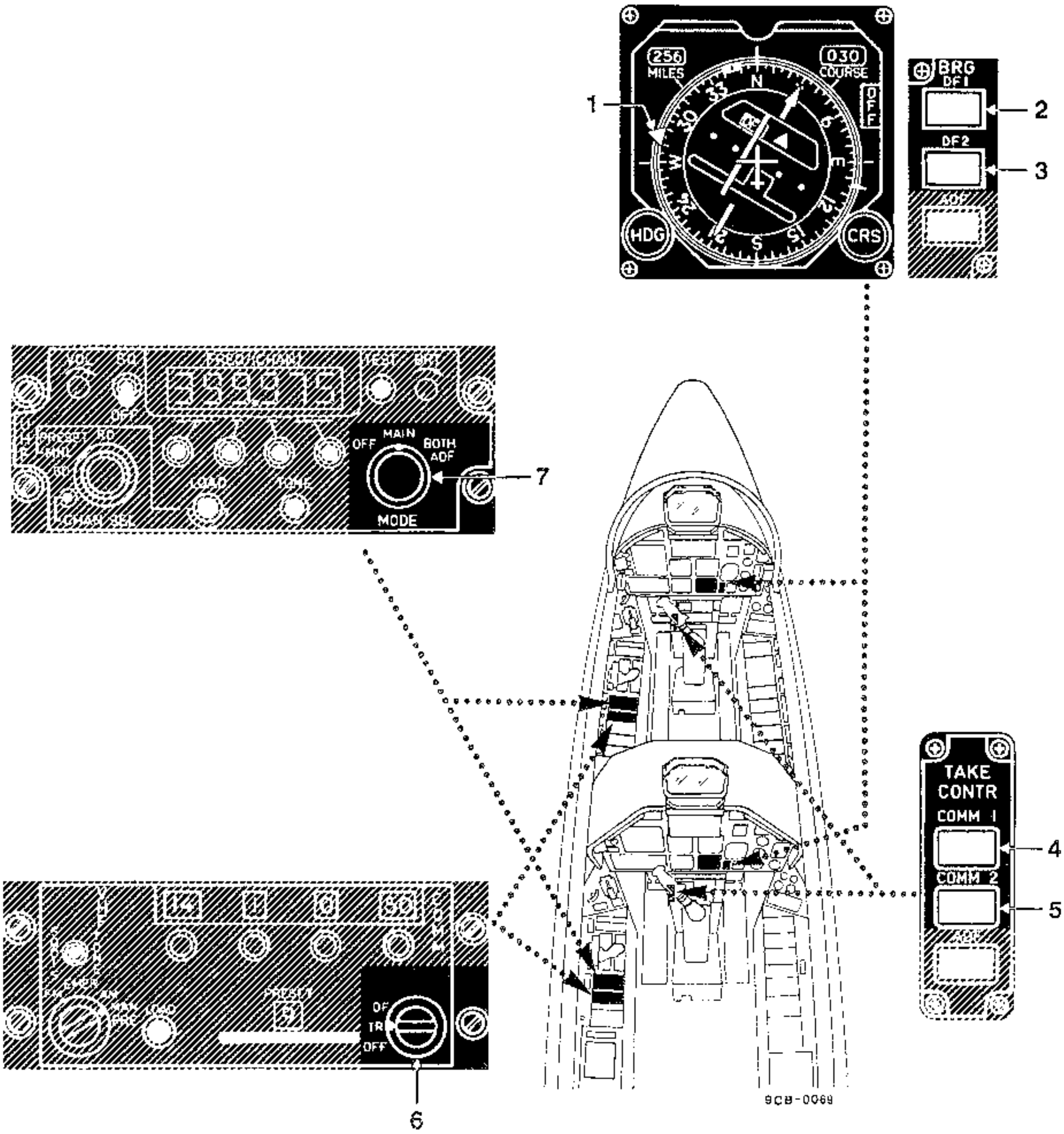


Figure 1-70 (Sheet 1 of 2)

V/UHF-DF SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Bearing pointer (head)	Indicates the bearing to the selected VHF or UHF station.
2. "BRG/DF1" push-button light	Pressed and illuminated - Permits display of the bearing to the selected UHF station on the HSI (bearing pointer). (The push- button is energized only when the UHF system is on.)
3. "BRG/DF2" push-button light	Pressed and illuminated - Permits display of the bearing to the selected VHF station on the HSI (bearing pointer). (The push- button is energized only when the VHF system is on.
4. "TAKE CONTR/COMM1" push-button ight.	Pressed and illuminated - Provides control of the UHF set
5. "TAKE CONTR/COMM2" push-button light	Pressed and illuminated - Provides control of the VHF set.
6. Mode selector on the "VHF" control panel	OFF - De-energized position. TR - Permits transmission and reception on the selected channel and frequency. DF - Permits selection of the DF function in the VHF-DF system.
7. Mode selector on the "UHF" control panel	OFF - De-energized position. MAIN - Permits transmission or reception on the selected channel and frequency. BOTH - Same as for position MAIN, but the guard receiver is also set to operation. ADF - Permits selection of the DF function in the UHF-DF system.

Figure 1-70 (Sheet 2)

4. Read the bearing to the selected VHF station through the bearing pointer on the HSI, when the VHF station transmits.

- UHF-DF Operation Mode

1. Make sure that the "COMM1" push-button light on the "TAKE CONTR" control panel is illuminated; otherwise press the push-button.

2. Press the "DF1" push-button light on the "BRG" control panel. (The push-button is energized only when the UHF system is on).
3. Move the function selector switch on the "UHF" control panel to ADF.
4. Read the bearing to the selected UHF station through the bearing pointer on the HSI when the UHF station transmits.

VOR/ILS System

The Rockwell-Collins 51RV-4B VOR/ILS system consists of a receiver, two "VOR/ILS/DME" control panels and two VOR/LOC/GS antennas mounted on the vertical stabilizer. The system receives and processes VOR and localizer signals in the frequency range of 108.000 to 117.950 MHz, and glideslope signals in the frequency range of 329.150 to 335.000 MHz. These are used to provide bearing information to the VOR station, course deviation and to-from signals, localizer and glideslope deviation signals, and VOR and localizer audio signals. The VOR/ILS system may be connected, either directly to the integrated instrument system for operation on VOR or localizer frequencies, or to the TRNAV system for the best position determination. The signals are displayed on the HSI and PDU, and the glideslope indicator of the ADI. In addition, the ADI steering bars provide the course intercept and follow information, according to the selections made on the HSI and consistent with the operating mode selected on the NFDCP. The VOR/ILS system supplies the following data to the integrated instrument system:

- relative bearing to a selected VOR station
- aircraft course deviation from a VOR radial selected on the HSI
- aircraft deviation from the localizer station, when a localizer frequency is selected
- aircraft deviation from the glide slope, when a localizer frequency is selected
- discrete "TO" or "FROM" signals, when a VOR frequency is selected, and information validity signal.

To the TRNAV system, the VOR/ILS system provides information, as follows:

- magnetic bearing (omni-bearing) to a selected VOR station
- digital signal of information validity.

The tuning control facilities are provided on a "VOR/ILS/DME" control panel, located on the right console; the control function is transferable from the front control panel to the rear, and viceversa, by means of the "VOR ILS" and "KYBD" push-button lights, located on the centerstand. The VOR/ILS system is powered from the 28 V dc and 26 V ac primary busses via the "VOR/ILS" circuit breakers. The controls and indicators of the VOR/ILS system are described and illustrated in figure 1-71.

VOR/ILS SYSTEM OPERATION

1. Make sure that the "VOR ILS" and "KYBD" push-button lights on the "TAKE CONTR" control panel are illuminated to indicate availability of the control panel and instrument controls; otherwise, press the push-button lights.
2. Pull and rotate the "VOR/LOC" receive switch (on the audio control panel) to the intermediate position.
3. Make the following selections on the "VOR/ILS/DME" control panel:

- Bearing to VOR Station
  1. Move the function selector switch to VOR/ILS.
  2. Press the "VOR" push-button light on the NFDCP.
  3. Select the VOR frequency by rotating the two selector knobs.
  4. Check that the received signals correspond to the identification code of the selected station.
  5. Read the bearing to the VOR station on the HSI.
  6. Move the "CRS" knob of the HSI until the selected course appears in the "COURSE" window.

VOR/ILS SYSTEM CONTROLS AND INDICATORS

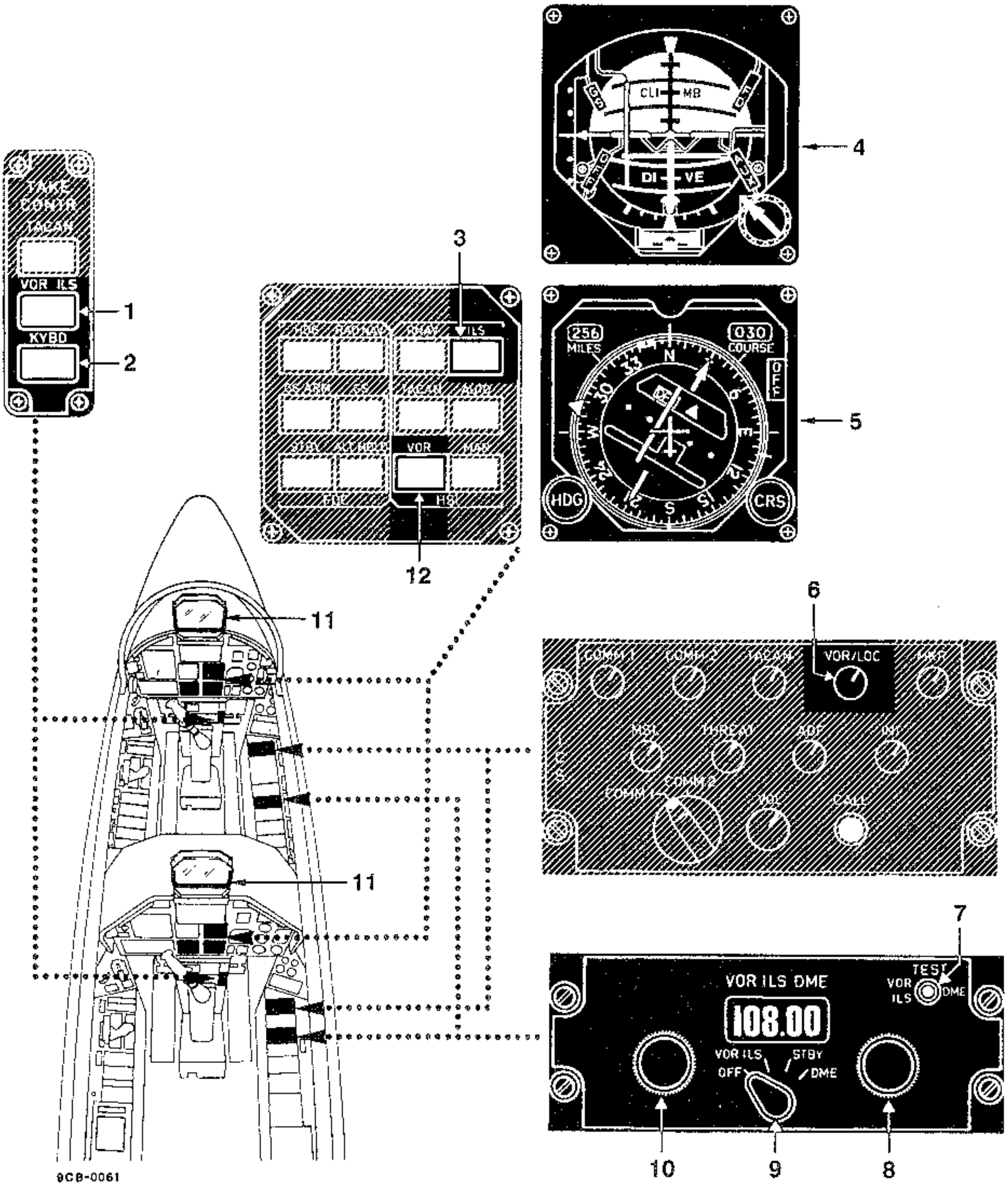


Figure 1-71 (Sheet 1 of 3)

VOR/ILS SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "TAKE CONTR/VOR ILS"	Pressed and illuminated - Provides control of push-button light the VOR/ILS system. **NOTE** Control cannot be shifted back to the other cockpit (by operating again the same push-button again). It is necessary that the pilot who wants control presses the push-button.
2. "TAKE CONTR/KYBD" push-button light	Pressed and illuminated - Provides control of the HSI ("HDG" and "CRS" knobs).
3. "HSI/ILS" push-button light	Pressed and illuminated - Permits the ILS information provided by the Flight Director Computer to be displayed on the ADI.
4. ADI	- The vertical steering bar provides the commands to intercept and maintain the selected VOR radial. - The horizontal steering bar provides the commands to intercept and maintain the glide slope. - The glide slope deviation pointer indicates the aircraft position with respect to the glide slope.
5. HSI	- The bearing pointer displays the bearing to the VOR station. - The deviation bar indicates the amount and direction of deviation from the selected VOR radial or from the LOC. - The "TO-FROM" indicator indicates whether the aircraft is moving TO or away FROM the VOR station.
6. "VOR/LOC" receive switch	Pulled out - Permits VOR/LOC signals to reach the headset. Rotated - Adjusts the set volume.
7. "TEST" switch	VOR/ILS - Performs VOR and ILS self-testing. DME - Inoperative.
8. Frequency selector knob	Selects the frequencies in 50 KHz increments (two digits in the right window).

Figure 1-71 (Sheet 2)

VOR/ILS SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
9. Function selector switch	OFF - Disconnects electrical power to the VOR/ILS set. VOR/ILS - The VOR/ILS set is powered and is operating. STBY - The VOR/ILS set is powered and is operating. DME - Both the VOR/ILS and the distance measuring section of the TACAN sets are powered and are operating. **NOTE** The TACAN is powered also when the function selector on the TACAN control panel is in OFF position.
10. Frequency selector knob	Selects the frequencies in 1 MHz increments (three digits in the left window).
11. PDU	Indicates that the VOR/ILS navigation mode is selected.
12. "HSI/VOR" push-button light	Pressed and illuminated - Permits the bearing information and all other data provided by the VOR system to be displayed on the HSI. **NOTE** The push-button is energized only when the VOR system is on.

Figure 1-71 (Sheet 3)

7. Check the deviation on the HSI and maneuver to maintain the aircraft on the selected course.
8. Check the TO-FROM indicator to ascertain whether the aircraft is flying to or from the VOR station.
9. To switch the set off, move the function selector switch to OFF.

- ILS Approach
  1. Move the function selector switch to VOR/ILS.
  2. Press the "VOR" and "ILS" push-button lights on the "FDC/HSI" control panel.
  3. Select the LOC frequency by rotating the two selector knobs.
  4. Carry out an ILS approach on the HSI, ADI, PDU and Marker Beacon.
  5. To switch the set off, move the function selector switch to OFF.

VOR SELF-TEST

1. Select a VOR frequency.
2. Rotate the "CRS" knob of the HSI until 180 degrees is read in the COURSE window.
3. Move the "TEST" switch to VOR/ILS and hold.
4. On the HSI check that:
   a. The deviation bar flag remains in view for 5 seconds.
   b. The deviation bar remains centered when the deviation bar flag is out-of-view.
   c. The bearing pointer (head) indicates 0 or 180 degrees.
   d. The deviation bar flag comes in view again after approx 20 seconds.
5. Release the "TEST" switch.

ILS SELF-TEST

1. Select an ILS frequency.
2. Check that the glide slope pointer appears on the ADI.

NOTE

The glide slope flag appears when the signal is not valid.

3. By using the "CRS" knob, move the course arrow on the HSI under the upper lubber line.
4. Move the "TEST" switch to VOR/ILS and hold.
5. On the ADI check that the glide slope flag remains in view for 5 seconds.
6. On the HSI check that:
   a. The deviation bar flag remains in view for approx. 5 seconds on the HSI.
   b. When both flags disappear, the glide slope pointer moves up and the deviation bar deflects to the left.
   c. The bearing pointer moves to the rest position (3 o'clock).
   d. The flags come back in view after approx 20 seconds.
7. Release the "TEST" switch.

TACAN System

The AN/ARN-118(V) TACAN system consists of a transceiver, two control panels and two antennas (one located on the fuselage upper side and one in an aft position on the fuselage underside). The system permits selection, in either X or Y mode, of any of the 126 channels available in the frequency range from 1025 to 1150 MHz. Channels are spaced 1 MHz apart. The system provides indications of station bearing, range to the selected TACAN station, deviation from the selected radial and the indication whether the aircraft is flying the selected radial to or from the station. In addition, this system permits measurement of air-to-air distance. This function is used when operating with similarly equipped aircraft, in air-to-air operations, rendez-vouzing and in any operation where it is desired to determine the distance to the co-operating aircraft. The received signals are visually displayed on the horizontal situation indicator (HSI) through the bearing pointer, the deviation bar and the range indicator, while the vertical steering bar on the ADI provides the indication to attain and maintain the flight conditions set on the HSI and consistent with the operating mode selected on the NFDCP. The TACAN system can provide distance information also with function selector on the TACAN control panel at OFF, by moving the selector switch on the "VOR/ILS/DME" control panel to DME. The TACAN system may be connected either directly to the integrated instrument system or to the RNAV system for best position integration. The system is supplied from the 26 V ac primary bus via the "TACAN" circuit breaker. The TACAN system controls are described and illustrated in figure 1-72.

NOTES ON X AND Y MODES

Earlier TACAN stations had available only 126 channels. As a means of obtaining a larger number of ground stations the number of channels has been doubled, and a letter X or Y was added to the channel number. The old 126 channels were assigned letter X, the new 126 channels letter Y. See the example in the following table:

SELECTED CHANNEL	FREQUENCY TRANSMITTED FROM THE STATION	FREQUENCY TRANSMITTED FROM THE AIRCRAFT
1X	962 MHz	1025 MHz
1Y	1088 MHz	1025 MHz
109X	1196 MHz	1133 MHz
109Y	1070 MHz	1133 MHz

In order to avoid interferences, the pairs of interrogating pulses of the airborne set are spaced 12 μ sec on channels X, and 36 μ sec on channels Y.

TACAN SYSTEM OPERATION

1. Ensure that the "TACAN" and "KYBD" push-button lights, on the "TAKE CONTR" panel, are illuminated to indicate availability of the control panel and instrument controls; otherwise, press the push-buttons.
2. Pull and rotate the "TACAN" receive switch (on the audio control panel) to the intermediate position.
3. Make the following selections on the "TCN" control panel, as required:

BEARING TO TACAN STATION

1. Function selector to REC. Operation is instantaneous.
2. Press the "TACAN" push-button light on the NFDCP and make sure that it illuminates.
3. Rotate the selectors to obtain the selected channel.
4. Check that the received signals correspond to the identification of the selected station.
5. The bearing pointer on the HSI will indicate the bearing to the selected station. The deviation bar indicates the deviation from the selected course. The TO/FROM indicator indicates that if the selected course is flown, the aircraft will reach the station (TO) or will fly outbound (FROM) it.

BEARING AND DISTANCE TO TACAN STATION

1. Function selector to T/R.
2. Press the "TACAN" push-button light on the NFDCP and make sure that it illuminates.
3. Rotate the selectors to obtain the selected channel.
4. Check that the received signals correspond to the identification of the selected station.
5. On the HSI, the "MILES" indicator flag will lift showing the slant range, while the bearing pointer will indicate bearing to the selected station.

BEARING AND LINE-OF-SIGHT DISTANCE TO AN AIRCRAFT

If it is desired to know the bearing and the line-of-sight distance to another aircraft, it is necessary that operation be pre-arranged with the other aircraft (co-operating aircraft), and the co-operating aircraft be

TACAN SYSTEM CONTROLS AND INDICATORS

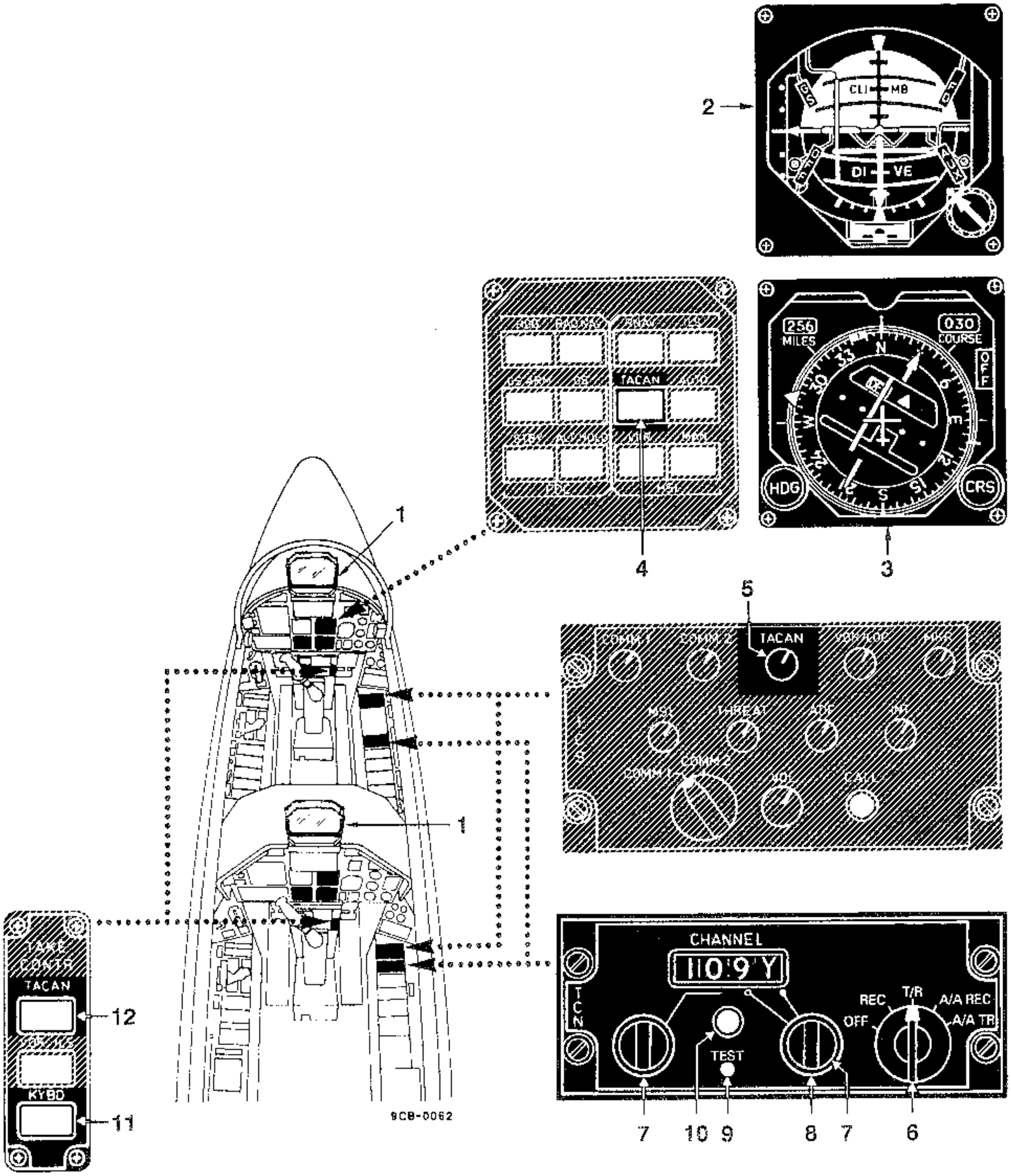


Figure 1-72 (Sheet 1 of 3)

TACAN SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. PDU	Indicates that the TACAN navigation mode is selected.
2. ADI (vertical steering bar)	The vertical steering bar receives the steering command from the Flight Director to maintain the selected TACAN radial.
3. HSI	With the function selector at T/R, provides bearing to station, line-of-sight distance to station and deviation from the selected radial.
4. "HSI/TACAN" push-button light	Pressed and illuminated - Permits display of the information provided by the TACAN system on the HSI (bearing pointer), on the ADI (vertical steering bar), and on the PDU. **NOTE** The push-button is energized only when the TACAN system is on.
5. "TACAN" receive switch	Pulled out - Permits TACAN signals to reach the headset. Rotated - Adjusts the set volume.
6. Function selector	OFF - De-energized position. REC - Permits display of continuous bearing information from the selected surface station. The bearing value is indicated by bearing pointer (head) on the HSI. T/R - Permits display on the HSI of continuous slant range information in nautical miles from the selected surface station (in addition to providing bearing information as in the "REC" position). A/A REC - Permits display on the HSI of continuous bearing information from a cooperating aircraft equipped with a system capable of transmitting bearing information. A/A TR - Permits display of continuous distance and bearing information on the HSI from a properly equipped co-operating aircraft.

Figure 1-72 (Sheet 2)

TACAN SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
7. Channel selectors	Rotated - Permit selection of one of the 126 desired channels, which is displayed in the "CHANNEL" window. The left selector operates the tenths, the right selector the units.
8. Mode selector	Rotated - Displays letter X or Y in the "CHANNEL" window for operation with x or y type surface stations.
9. "TEST" push-button	Pressed - Performs system self-test.
10. "TEST" caution light	On - In case of system failure and during self- test.
11. "TAKE CONTR/KYBD" push-button light	Pressed and illuminated - Provides control of the HSI ("HDG" and "CRS" knobs).
12. "TAKE CONTR/TACAN" push-button light	Pressed and illuminated - Provides control of the TACAN set. **NOTE** Control cannot be shifted back to the other pilot (by pressing the same push-button again). It is necessary that the pilot who wants control presses the push-button.

Figure 1-72 (Sheet 3)

fitted with a TACAN set operating in the A/A (air-to-air) mode on a channel 63 channels apart from that of your aircraft.

NOTE

Only line-of-sight distance will be provided if the co-operating aircraft is not equipped with a system configured to receive or transmit bearing information.

1. Function selector to A/A REC (bearing only) or A/A TR (bearing and line-of- -sight distance).
2. Rotate the selectors to the chosen channel.
3. After a short search period, the HSI bearing pointers indicate the bearing and the "MILES" indicator flag on the HSI will lift, showing the line-of- sight distance to the co-operating aircraft.

TACAN SELF-TEST

1. Set the function selector switch to T/R.
2. Rotate the "CRS" knob of the HSI until a 180° reading appears in the "COURSE" window.

3. Temporarily press the "TEST" push-button.
4. Check that:
   a. The "TEST" light flashes on the control panel for a short time to indicate light serviceability.

CAUTION

If the light stays on, a malfunction is present, and the indications of the HSI may be wrong.

   b. The deviation bar flag and the distance flag come in view on the HSI, if not already in view.
   c. The bearing pointer of the HSI moves to 270° and remains there for approx 7 seconds.
   d. The deviation bar flag and the distance flag disappear.
   e. The bearing pointer moves to 180 ± 4°, and 000 ± 0.2 nmi is show in the "MILES" window.

NOTE

As the full scale deviation of the "MILES" indicator is 389, a reading of 300 (first digit not tripping to 0) is not an evidence of malfunction.

   f. The deviation bar of the HSI is centered (± ½ scale spacing = 2° 30') and the "TO-FROM" indicator reads "TO".
   g. After 15 seconds from the beginning of the test cycle, the deviation bar flag and the range flag come back in view.

TACTICAL AREA NAVIGATION SYSTEM (TRNAV)

The aircraft is fitted with a GEC (Marconi) Avionics tactical area navigation system (TRNAV) AD-620K, composed of the navigation computer unit (NCU), and of the front and rear remote display units (RDU). The TRNAV system (Figure 1-73) computes and displays the aircraft present position in geographic or UTM coordinates (as selected by the pilot), the bearing and horizontal distance to any geographic point (in the system memory) arbitrarily selected by the pilot. The system also continuously processes the deviation with respect to a preselected course to any waypoint selected as steerpoint, the time and fuel required to reach the steerpoint or any of the stored waypoints, and the wind direction and speed. The navigation calculations are made on great circle legs, each defined by two waypoints or by one waypoint and the aircraft present position. The system also provides the information required to follow a flight plan, defined as the succession of 10 waypoints. The navigation system is also capable of retaining in a non-volatile memory, the data applicable to 99 waypoints (numbered from 01 to 99), defined by the ground crew and entered in the system in geographic or UTM coordinates through the DEP. Control functions are transferable from one DEP to the other by means of the "KYBD" push-button lights located on the "TAKE CONTR" control panel installed in each cockpit. The system also stores in non-volatile memory the data applicable to 600 beacons and to 300 airports. It is possible to automatically select a preplanned sequence of 10 waypoints (flight plan) among the thousand available, through on the DEP. The pilot can also select any of the 1000 available waypoints by manually setting the relevant identification code on the DEP. The calculations made by the area navigation system are then referred to the new waypoint selected as steerpoint. For position determining the system uses the information of distance and magnetic bearing from VOR/DME, TACAN, DME or VOR/TAC stations furnished by the radio-aided navigation sensor system, the information of position, speed and heading furnished by the independent navigation sensor system, the information of static pressure, total pressure and total temperature delivered by the relevant sensors, for the calculation of true altitude and speed (air data), and the information of fuel consumption furnished by the fuel flow transmitter. The area navigation system automatically tunes the usable radio navigation system, in accordance with a program based on memorized geographic information of beacons availability (beacons scan). The navigation computer unit (NCU) is also a video display generator for the multifunction display system (MFD). The video display generator generates the symbols and alpha-nume-

TRNAV SYSTEM BLOCK DIAGRAM

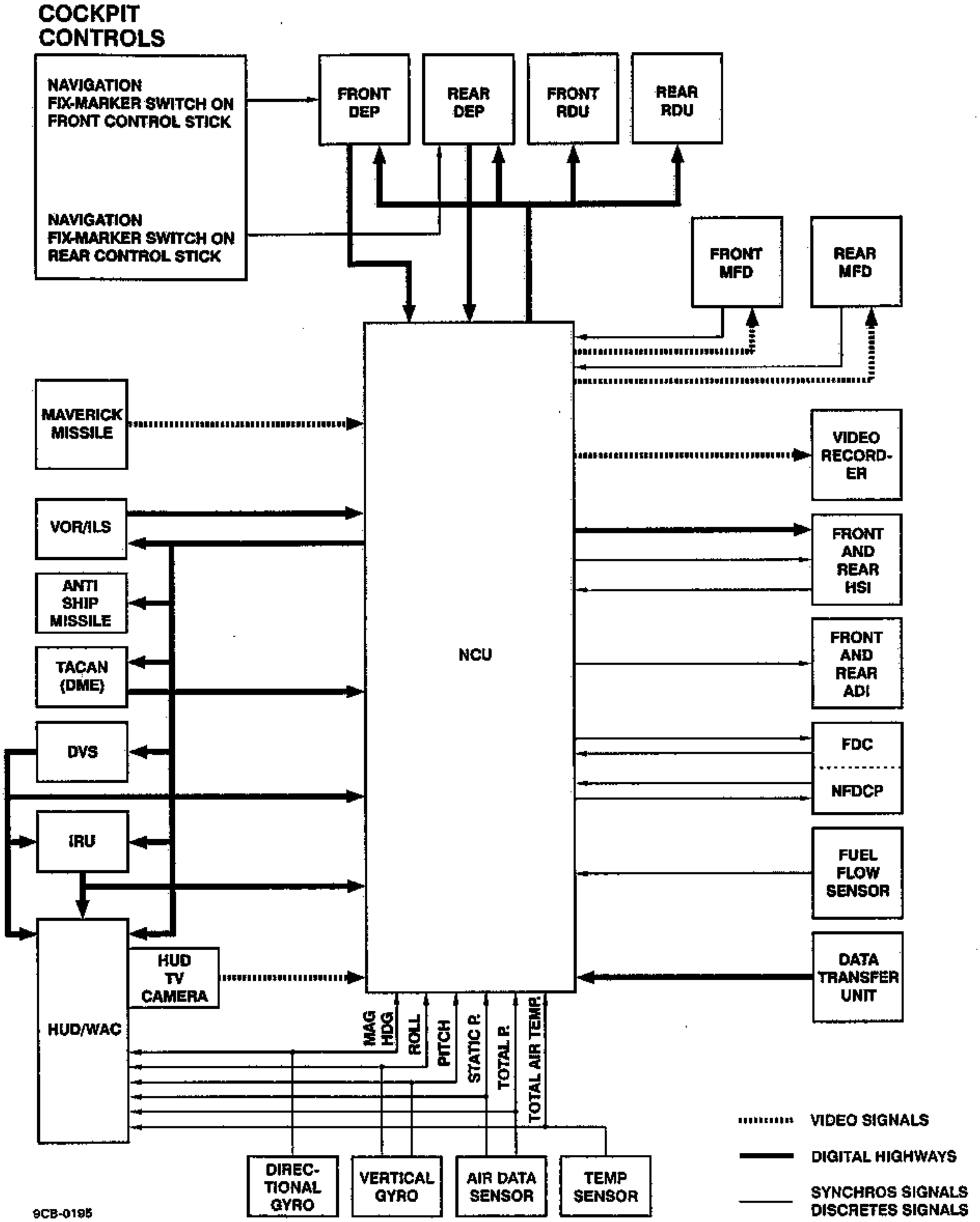


Figure 1-73

numerical characters required to display the information on the MFD system. The TRNAV system is powered from the 28 V dc, 26 V ac and 115 V ac primary busses.

TRNAV System Controls and Indicators

The TRNAV system controls and indicators are illustrated in figure 1-74.

REMOTE DISPLAY UNIT (RDU)

The RDUs are two identical panels, installed in the upper-right corner of the instrument panel in each cockpit, which display the same information to the front and rear pilot. The information must be selected through the DEP. The RDU has a top row of 10 alphanumeric characters and a bottom row of 16 alphanumeric characters.

The top row is divided into four displays which provide the following information:

- "F" display - (Flight plan) Shows the number (from 0 to 9) assigned to the current steerpoint in the flight plan. The indication is shown only when a flight plan navigation mode is selected.
- Mode display - Shows a maximum of 3 characters (letters and numbers) annunciating the currently selected mode for the data displayed on the display. Legends available are:

  TCN - (TACAN) When the "TCN" push-button only, or the "TCN" and "ILS" push- buttons are selected on the NFDCP.

  VOR - When the "VOR" push-button is selected on the NFDCP.

  ILS - When the "ILS" push-button only is selected on the NFDCP.

  POS - (Present Position) When the "NAV" push-button is selected on the NFDCP, and the "PP" key is pressed on the DEP.

  WP - (Waypoint) When the "NAV" push-button is selected on the NFDCP, and the "WP" key is pressed on the DEP.

  SP - (Steerpoint) When the "RNAV" push-button is selected on the NFDCP, and the "SP" key is pressed on the DEP.

  TST - When the "RNAV" push-button is selected on the NFDCP, and the "TST" key is pressed on the DEP.

  FPL - (Flight plan) When the "NAV" push-button is selected on the NFDCP, and the "FPL ↑" or "FPL ↓" key is pressed on the DEP.
- Identity display - Shows two numbers or three or four letters to identify the waypoint which is currently the steerpoint. The identification will start flashing when the aircraft is within 30 seconds from the steerpoint. The indication is shown in all navigation modes if a memorized steerpoint is selected. For all other modes, the field is blank.
- Status display - Indicates the status of the navigation system as follows:

- Blank	- Normal inertial/radio navigation mode in use.
- R	- Radio navigation in use.
- I	- Inertial navigation in use.
- D	- Doppler navigation in use.
- A	- Air data navigation in use.
- F	- TRNAV failure.

- Data Display - Shows the data related to the display mode selected on the DEP, and shown in the mode window on the 10-character upper display.

TRNAV SYSTEM CONTROLS AND INDICATORS

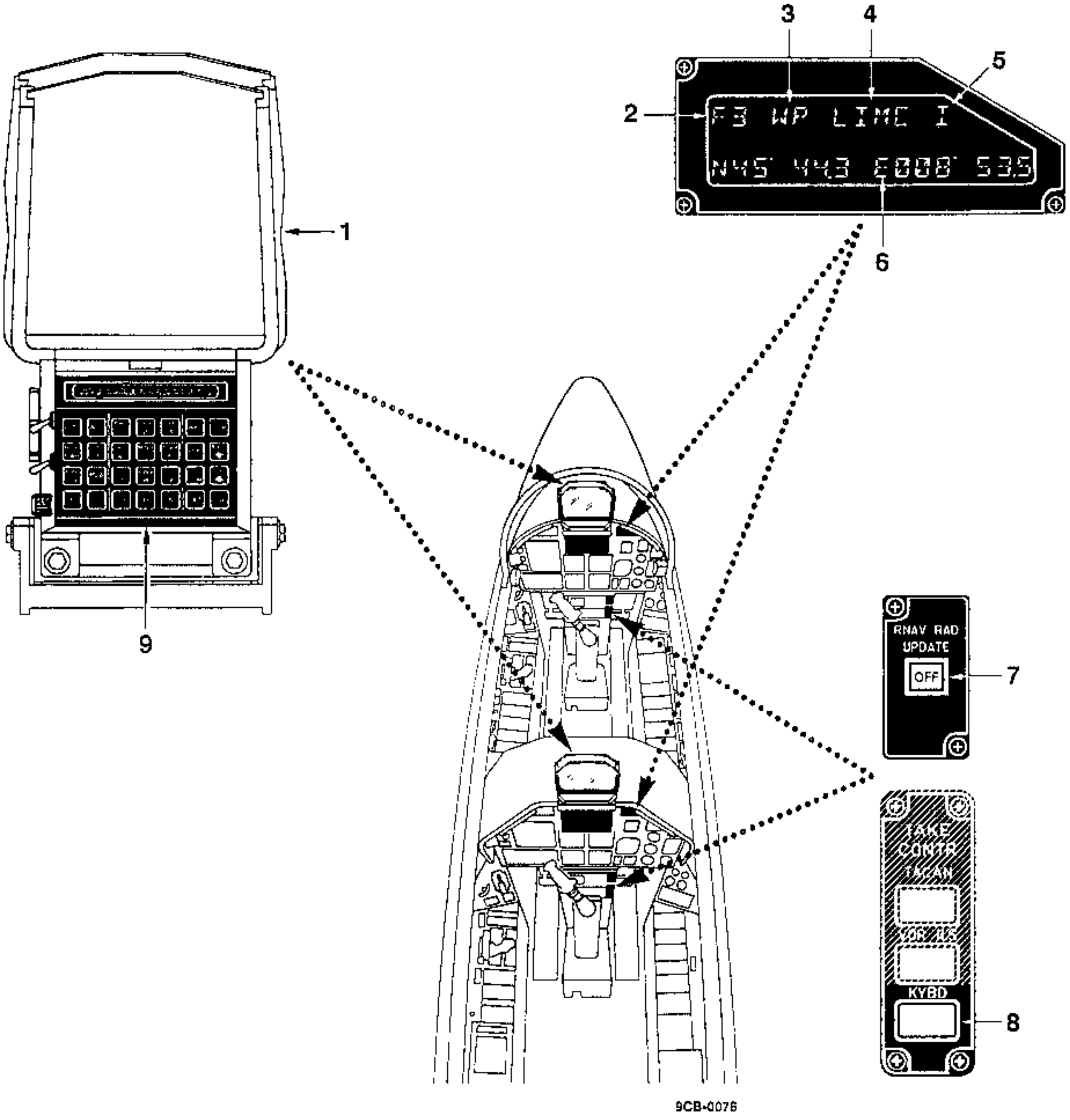


Figure 1-74 (Sheet 1 of 2)

TRNAV SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. Pilot display unit (PDU)	Displays all information received from the HUDWAC system.
2. "F" display	Shows the number (from 0 to 9) assigned to the current steerpoint in the flight plan (F).
3. Mode display	Shows a maximum of 3 characters annunciating the currently selected mode for the data displayed on the data display.
4. Identity display	Shows the identity of waypoint or steerpoint in WP mode and SP mode respectively, with RNAV selected on the NFDCP. The identity is two numbers for numeric waypoints or three or four letters for beacons and airports respectively.
5. Status display	Shows a "one letter" message indicating the status of the navigation system.
6. Data display	Shows the data related to the mode display selected on a 16-character display.
7. "RNAV RAD UPDATE" push-button light	Pressed and illuminated (in RNAV mode only) - Disconnects the data bases of the TACAN and VOR sensors from the NCU which, therefore will not use the radio-aids to calculate the best position. **NOTE** When changing from the RNAV to the TACAN, VOR, ILS modes, the push-button light extinguishes; it comes on again when the RNAV mode is selected (the function is stored).
8. "TAKE CONTR/KYBD" push-button light	Pressed and illuminated - Provides control of the DEP keyboard.
9. Data entry panel (DEP)	Permits the navigation and attack data to be loaded in the navigation and weapon aiming computers. For a detailed description of the controls, refer to para "Data Entry Panel".

Figure 1-74 (Sheet 2)

TRNAV System Operation

BACK-UP OPERATION MODES

For the calculation of the present position and the bearing/range to the steerpoint in the primary operating mode, the area navigation system uses the data from the DIRS, updated by means of the data delivered by the VOR/ILS and TACAN systems. In case of lack or invalidation of the latter data, the system proceeds to the navigation calculations using only the data furnished by the DIRS, with no significant degradation of performance. In case of partial failure of the DIRS (faulty operation of the Doppler velocity sensor or the inertial reference unit), the area navigation system continues accomplishing the navigation calculations using the information furnished by the DIRS in the back-up modes, integrated by the heading information provided by the directional reference subsystem, in case of IRU failure. The aircraft position thus obtained is updated by a method similar to that used in the primary operating mode, viz. by means of the data from the VOR/ILS and TACAN system, if valid and available. In case of total failure of the DIRS, the aircraft position and speed with respect to the ground is determined through the data furnished by the VOR/ILS and TACAN systems filtered by means of the air data continuously calculated by the system, and by means of the magnetic heading and attitude data furnished by the directional and attitude reference systems. In case of lack or invalid radio navigation data, the area navigation system goes on determining the aircraft position with the dead reckoning (DR) method, based on the calculation of the air data (true airspeed), the information of magnetic heading provided by the directional reference subsystem and the last valid wind velocity data. This data is continuously computed by the system by comparing the aircraft true airspeed and the ground speed determined during regular reception of the VOR/ILS and TACAN signals. If the radio-aids used during the flight mission are suspected to be unreliable (because of jamming, or beacon position different from that contained in the NCU data base), it is possible to activate the radio update inhibit function. Activation of this function causes the data bus of the TACAN and VOR sensors to be disconnected from the NCU which, therefore, will not use the radio-aids to calculate the "best position". The function is activated through the "RNAV RAD UPDATE" push-button light, only when the RNAV mode is selected. The push-button is inoperative in TACAN, VOR, and ILS modes. The accomplished activation of the radio update inhibit function remains memorized when the RNAV mode is changed to another navigation mode ("RNAV RAD UPDATE" push-button light goes off), and returns on when the RNAV mode is selected again, (push-button light comes on).

INFORMATION DISPLAY

The navigation data computed by the area navigation system are furnished directly to the pilot on the remote display unit, or delivered to the integrated instrument system, MFD system and HUDWAC system. All data applicable to the aircraft position can be displayed in geographic or UTM coordinates, as selected by the pilot. The area navigation system delivers the information for identification of the steerpoint to the remote display unit and, where applicable, its sequence number in the flight plan. Besides, it provides all available information referred to the steerpoint or to any other stored waypoint, to the aircraft speed and present position, to the wind direction and speed, to the radio frequencies being used (VOR or VOR/DME frequency, TACAN channels), to the time and fuel required to reach any waypoint and, finally, the indication of the operating mode (primary mode, back-up radio aided mode or air data dead reckoning mode). The integrated instrument subsystem is provided with the aircraft bearing and horizontal distance with respect to the selected waypoint (steerpoint); aircraft deviation from the radial manually selected by means of the knobs of the HSI, or from the computed course to steerpoint, "TO", "FROM", and status information. Besides, the area navigation system provides the HUDWAC system with the aircraft bearing and range information with respect to the steerpoint and with the identification code of the steerpoint.

TRNAV System Test

The TRNAV system test mode is initiated by pressing the "TST" key on the DEP, when the "RNAV" push-button is selected on the NFDCP. The response to test initiation is displayed on the RDU, HSI, ADI, and MFD. Note that during test mode the DEP scratchpad is not available.

SMOKE GENERATING SYSTEM

The smoke generating system (Figure 1-75) provides for the generation of white or colored smoke trails from the aircraft tail. The system consists of two smoke liquid tanks that are carried under the pylons, at stations 3 and 4, and of two electro-pneumatic circuits for the generation and control of the smoke trail. The tank under the left wing (underwing station 3) will be filled with colored liquid, the tank under the right wing (underwing station 4) with white liquid. The system includes two push-buttons in each cockpit, which control the generation of the white and colored smoke trails which are located on the control stick grip (weapon release push-button - white smoke generation) and the engine throttle ("DOGFIGHT" push-button - colored smoke generation), and a control panel and an indicator panel in each cockpit. On the "SMOKE" control panel there are a "MASTER" switch permitting alternative use of either the smoke generating system or the armament system, and two smoke control switches marked: OFF, ON. The indicator panel is mounted on the right side of the PDU. It provides three indications:

- Illumination of the rectangle indicates opening of the smoke generation shut- off valve, and start of smoke generation.
- Illumination of letter "C" indicates colored smoke generation.
- Illumination of letter "W" indicates white smoke generation.

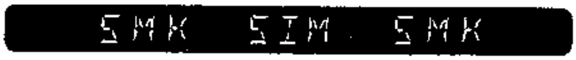
The three indicator lights can be tested for operation by pressing the "WARN LT TEST" push-button on the caution lights panel. In an emergency situation, the two underwing smoke tanks can be jettisoned by pressing the "SALVO JETTISON" push-button. The electrical circuit controlling the smoke generating system is powered from the 28 V dc secondary bus via the "CAMERA CONTR" circuit breaker.

SMOKE GENERATING SYSTEM CONTROLS

The smoke generating system controls are described and illustrated in figure 1-76.

OPERATION OF SMOKE GENERATING SYSTEM

Missions with smoke fluid tanks shall be carried out only in SMS simulate mode. The LCDs of the WCP and WMP will provide information in MAP 0 only.
Therefore, to have store indications, the pilot shall visualize MAP 0 pressing the "WPN DIS" push-button on the WCP.
The following map is displayed on the LCDs of the WCP and WMP:



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SMOKE GENERATING SYSTEM

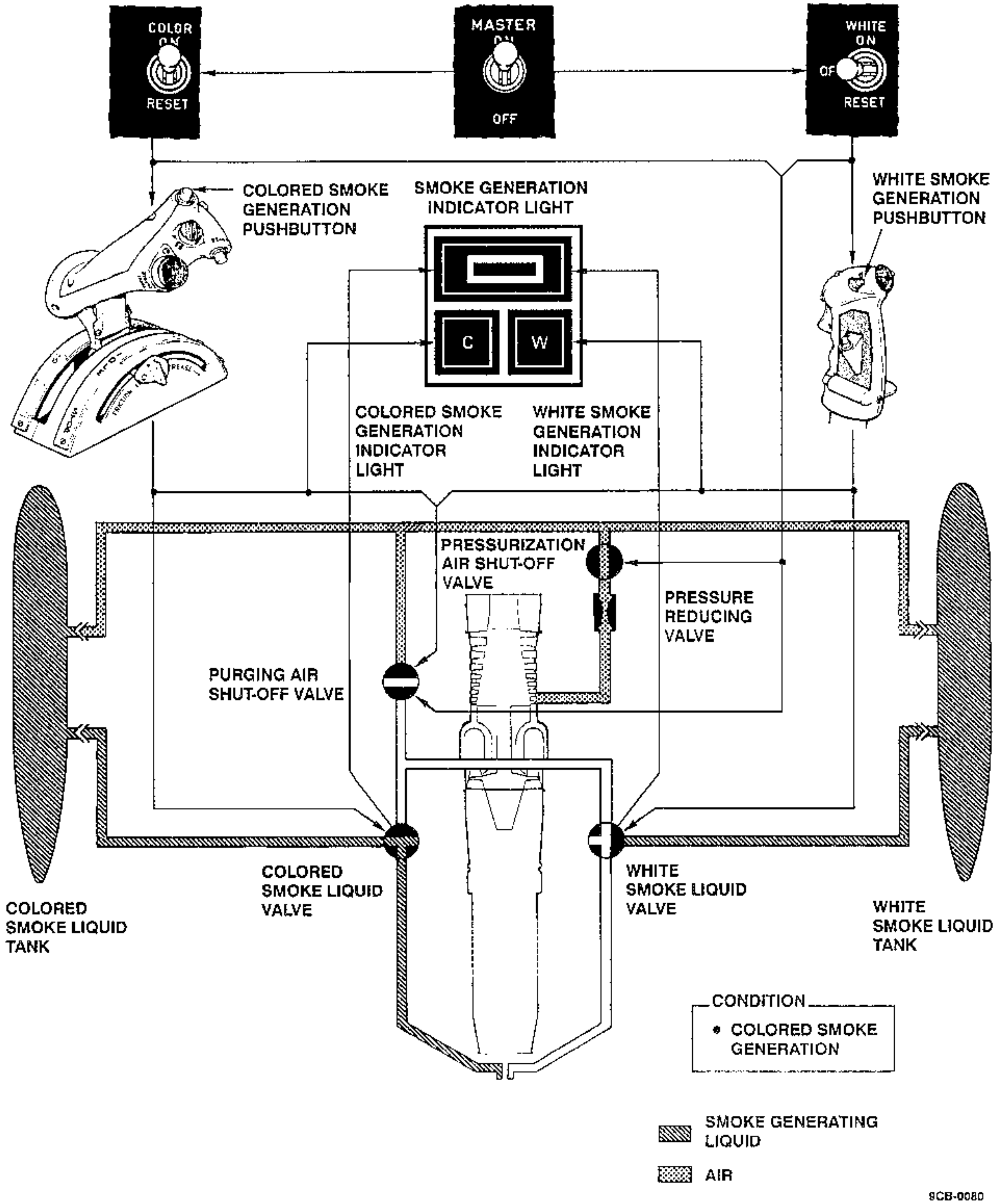


Figure 1-75

SMOKE GENERATING SYSTEM CONTROLS AND INDICATORS

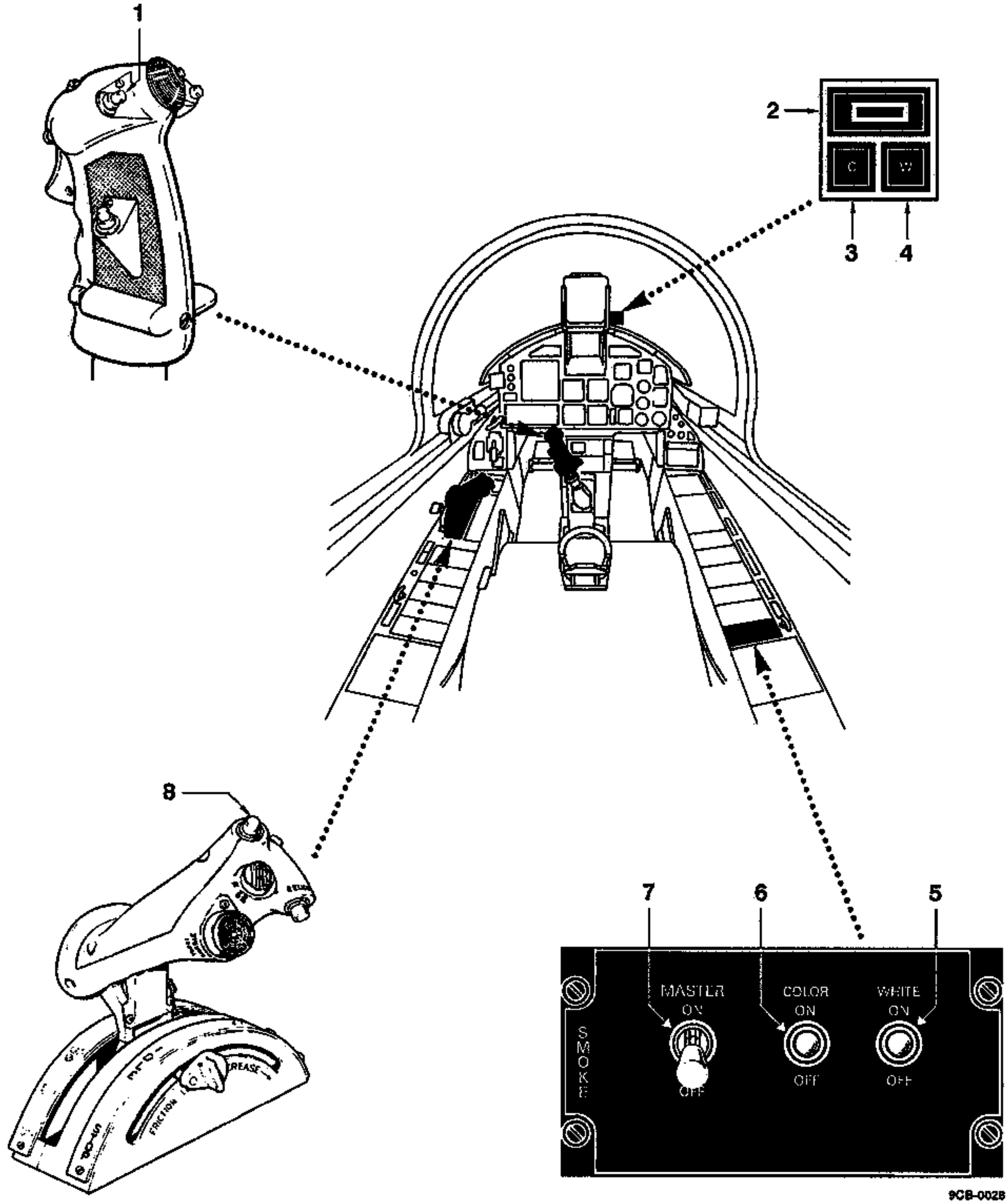


Figure 1-76 (Sheet 1 of 2)

SMOKE GENERATING SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. White smoke generation push-button	1st press - Starts white smoke generation. 2nd press - Stops smoke generation.
2. Smoke generation indicator light	Illuminated - Indicates generation of smoke.
3. "C" indicator light	Illuminated - Indicates colored smoke generation selected.
4. "W" indicator light	Illuminated - Indicates white smoke generation selected.
5. "WHITE" control switch	ON - Energizes the white smoke generation circuit. OFF - De-energizes the white smoke generation circuit.
6. "COLOR" control switch	ON - Energizes the colored smoke generation circuit. OFF - De-energizes the colored smoke generation circuit.
7. "MASTER" switch	ON - Energizes and sets the smoke-generating system for operation (the push-button on the control stick grip is enabled for white smoke generation and the push-button on the engine throttle is enabled for colored smoke generation). OFF - De-energizes the smoke-generating system and restores the armament system functions (the push-button on the control stick grip is enabled for bomb release or rocket firing and the push-button on the engine throttle is enabled for Dogfight operation).
8. Colored smoke generation	Pressed and released - Starts colored smoke push-button generation. Pressed again and released - Stops smoke generation.

Figure 1-76 (Sheet 2)

Setting of controls on the "SMOKE" control panel:

1. "MASTER" switch - ON
2. "COLOR" switch - ON
3. "WHITE" switch - ON

Colored Smoke Generation

1. "DOGFIGHT" push-button on the engine throttle - Pressed and released.
2. "C" indicator light - Illuminated.
3. Smoke generation indicator light - Illuminated.

NOTE

> When generating the first smoke trial, the smoke generation light illuminates with a maximum delay of 8 seconds after actuation of the "DOGFIGHT" push-button. For subsequent smoke trials, the delay is approx 1 sec.

4. To stop smoke generation, press again and release the "DOGFIGHT" push- button, and make sure that the indicator lights go out.

White Smoke Generation

1. Weapon release push-button on the control stick grip - Pressed and released.
2. "W" indicator light - Illuminated.
3. Smoke generation indicator light - Illuminated.

NOTE

> When generating the first smoke trial, the smoke generation light illuminates with a maximum delay of 11 seconds after actuation of the "DOGFIGHT" push-button. For subsequent smoke trials, the delay is approx 1 sec.

3. To stop smoke generation, press again and release the weapon release push- button and make sure that the indicator lights go out.

WEAPONS SYSTEM

STORES MANAGEMENT SYSTEM (SMS)

The aircraft is fitted with a stores management system (SMS) (Figure 1-77), which provides for the release, launching and firing of the armament stores that can be carried under the wings. The system also provides for emergency release, in a safe condition, of the droppable stores. The emergency release of all droppable stores is achieved by pressing the "SALVO JETT" push-button, located on the main instrument panel, while the emergency release of the droppable stores selected by the pilot is achieved by pressing the "SEL JETT" push-button located on the front weapon control panel. The SMS consists of:

- WIP (Weapon Inventory Panel) that communicates with the weapon aiming computer (WAC) for automatic release and for weapon delivery computation. In the WIP is integrated the computer of the system (SMC).
- WCP (Weapon Control Panel) that displays the situation to the pilot and receives the selection from the pilot.
- WMP (Weapon Monitor Panel) that repeats the indications and selections made on the WCP, and enables/disables firing
- PUS (Pylon Unit Standard) that contains the circuits for control of the power lines required for the arming, fire, release of all stores except missiles and guns
- SJB (Salvo Jettison Box) controls intervalled release of the store pairs after actuation of the salvo jettison push button.

The system is interfaced with: WRB (Weapon Release Button), gun firing trigger, salvo jettison push-button, target designator position, "DOGFIGHT" push-button and the "UNCAGE" push-button. The stores management system controls the selection and release of bombs, the launch of missiles, and the firing of guns and rockets. The stores management system is powered from the 28 V dc essential, primary and secondary busses and the 115 V ac secondary bus. The SMS controls and indicators are illustrated in figure 1-78.

SMS Operation

The front pilot can select the type (Figure 1-77), quantity and method of store release through the weapon control panel. The system allows the front pilot to select the attack modes through the weapon control panel, and furnishes the information related to the mode, type and quantity of selected stores to the HUDWAC system. The selection performed by the front pilot can be monitored by the rear pilot through the weapon monitor panel, but the rear pilot does not have the possibility of changing it. The rear pilot can also enable, disable or transfer the release and firing functions by use of the "CUT" and "FIRE" switches located on the weapon monitor panel. The system provides both pilots with the information applicable to the number and type of stores available in the aircraft at every moment, to the number and type of selected stores, to the number of rounds available for the guns, the selected mode and the typical parameters. The weapon inventory panel allows the ground crew to enter the data applicable to the armament store configurations (quantity and position of suspended stores, quantity of stored gun rounds) and includes the controls required to check system serviceability on the ground. A "NORM/SIM" switch permits blank in-flight operation of the weapon system. All armament functions can be inhibited, when the aircraft weight is on wheels, by the armament safety switch, manually operated by the armorer; the armament function inhibition status (armament safety pin in place) is clearly displayed on the weapon control panel. The weapon control and monitor panels allow the pilots to monitor and check the entered set of information (store configuration display). Store release is obtained only upon completion of selection and by moving the Master Armament switch on the weapon control panel to ARM. Besides, the SMS can simulate all procedures applicable to store and mode selection, and to arming and release also in lack of the actual armament stores for "blank" training purposes.

OPERATIONAL MODES

The SMS allows the front pilot to accomplish the following selections through the weapon control panel:

- firing of guns and machine guns
- firing of rockets
- release of bombs
- release/firing of bombs and rockets from practice dispensers

- In the bomb release mode it is possible for the pilot to select:
  - the type of bomb as compatible with the data entered in the WIP by the ground crew
  - the quantity of bombs to be released during the attack (as compatible with the number of bombs carried on the aircraft, and with the data delivered to the system through the WIP)
  - the type of release, with single option (release of one bomb at a time, according to a preset sequence) and pair option (release of two bombs at a time, according to a preset sequence)
  - interval of release in meters (from 40 to 995 m according to the preset intervals, only in CCIP mode) - arming of fuzes, with nose, tail, nose & tail options
  - the attack submode (CCIP, CCRP). When bomb release is selected, the system automatically selects the CCIP mode, while pilot's action is required to change to the CCRP mode.

STORES MANAGEMENT SYSTEM BLOCK DIAGRAM

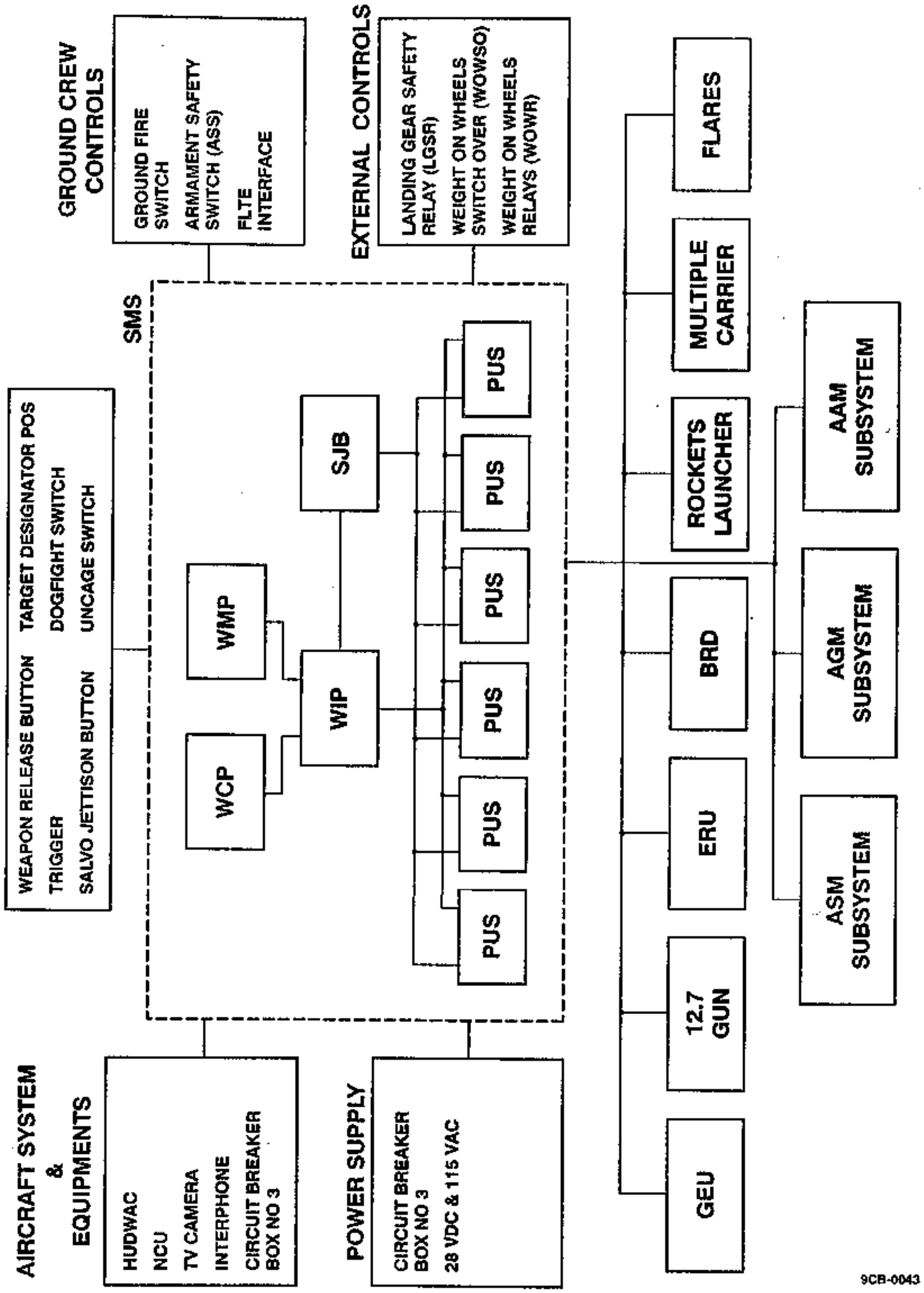


Figure 1-77

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

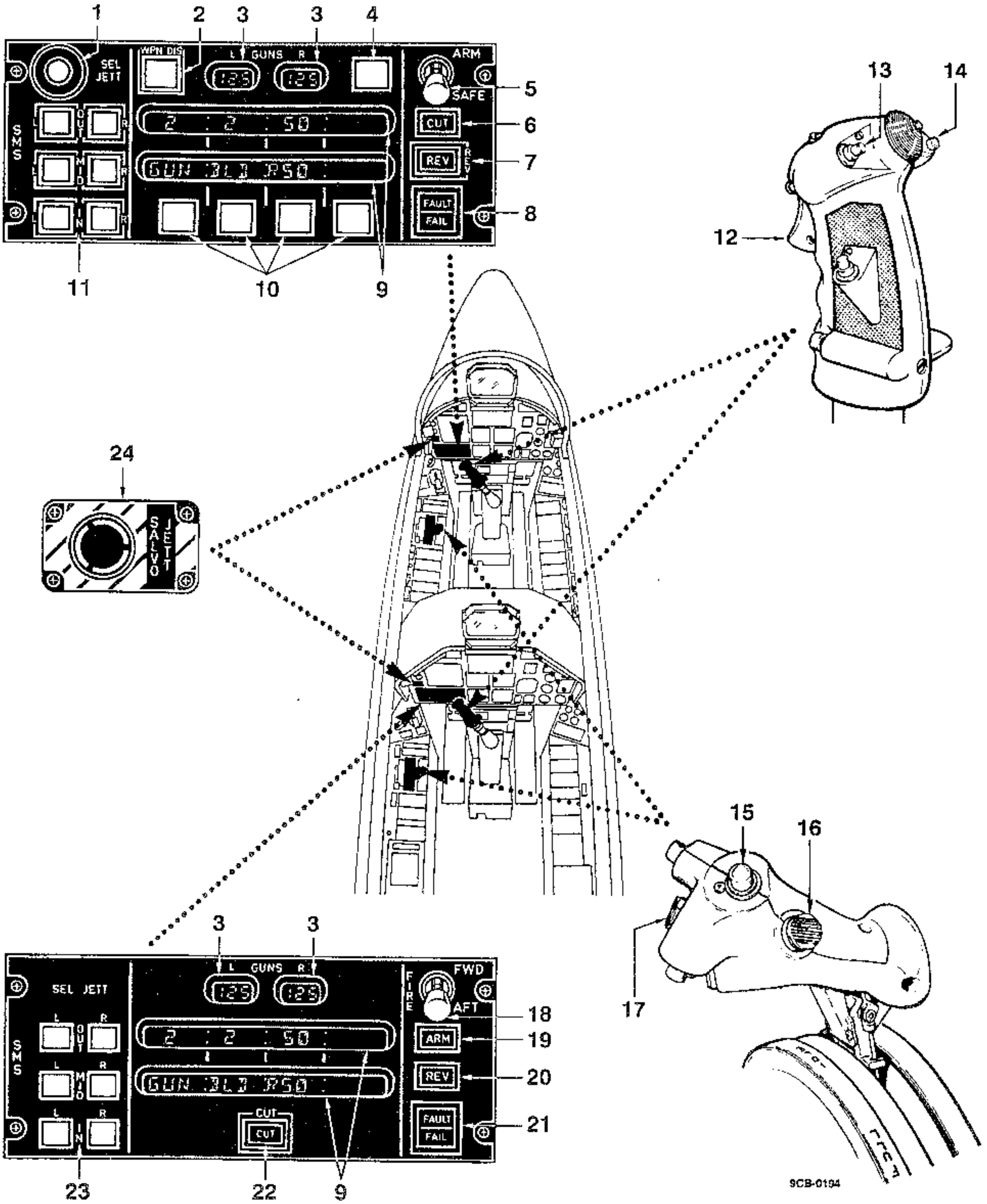


Figure 1-78 (Sheet 1 of 6)

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "SEL JETT" push-button	Pressed and held - Causes intervaled release, in a safe condition, of any selected external store carried under the pylons. **NOTE** Release occurs only when the aircraft is airborne.
2. "WPN DIS" push-button	Pressed - If MAP 0 is shown, shifts the presentation to MAP 1. - If MAP 1 is shown, shifts the presentation to MAP 0. - If MAP 2 is shown, shifts the presentation to MAP 1. - If MAP "Dogfight" is shown, shifts the presentation to MAP 1.
3. "GUNS" rounds displays	L - Displays the quantity of 30 mm gun rounds available in the left gun pod. R - Displays the quantity of 30 mm gun rounds available in the right gun pod.
4. Mode push-button	Used in conjunction with the LCDs to select the HUDWAC attack mode. In a simulated mission, after all simulated weapons are expended and MAP 1 is displayed, pressing the push-button reloads the simulated weapons and guns.
5. Master armament switch	ARM - Up position - Enables the release/firing/ /launch of the carried weapons. SAFE - Down position - Disables all the circuits of the SMS except for the circuits connected to the "SALVO JETT" and "SEL JETT" push-buttons.
6. "CUT" light	On (on the ground) - Indicates that the armament safety pin is in place or that the "CUT" push-button is pressed or the "FIRE" switch is at AFT. On (in flight) - Indicates that the "CUT" push-button is pressed or the "FIRE" switch is at AFT.
7. "REV" push-button light	Pressed - Selects the reversionary mode of the SMS ("REV" light illuminated). The reversionary mode is selected automatically in the event of failure of the HUDWAC.

Figure 1-78 (Sheet 2)

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
8. "FAULT/FAIL" push-button light	FAULT - On - Continuous monitoring detects one or more failures that do not impair the operation of the whole weapon system, but must be indicated to the pilot. **NOTE** The pilot must press the push-button to reset the circuit. If the "FAULT" light comes on again, it means that a new failure as occurred at a station different from the one whose failure was originally indicated. FAIL - On - Continuous monitoring detects a failure that is critical for operation of the whole weapon system. In this case all system operations are inhibited. Only the salvo jettison function available.
9. LCD displays	Display the type and the quantity of weapons on board or, after weapon selection, the weapon delivery parameters (fuzing, intervals, quantity, etc.), and the selected attack mode.
10. Soft push-buttons	Used with the LCDs to select the weapon type (in the inventory display mode) or the weapon delivery parameters (fuzing, intervals, quantity, etc.) after weapon type selection.
11. Jettison selection push-buttons light	Light off - Station deselected. Flashing light - Hang-up at the station. Steady light - Station selected and circuits set to receive the selective jettison input.
12. Trigger	Permits firing of the guns through the WCP. The trigger has two detent positions: Pressed first detent - Operation the booster motor of the machine gun pods. Pressed second detent - Provides firing of guns or machine gun pods, and event marker information to video camera and TV camera recorder.

Figure 1-78 (Sheet 3)

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
13. Weapon release push-button	Pressed - Permits launch of missiles, fire of push-button rockets, release of all droppable stores. In addition, it provides event marker information to video camera and TV camera recorder.
14. CCRP designator	Pressed provides for: - Target designation during CCRP attacks. - Aircraft position update during navigation (position update or fix), or storage of the position of anoverflown waypoint (MARK).
15. "DOGFIGHT" push-button	First press - Allows rapid data entry into the air-to-air operation mode. When "DOGFIGHT" is selected, the air-to-air missiles and all guns (machine gun pods or gun pods) shall be selected, if present, for operation and the other previously selected stores shall be overridden. Second press - The Dogfight mode is deselected, and the SMS displays MAP 1.
16. "UNCAGE" push-button	Pressed and released for the first time: - Uncages the seeker head of the selected AIM-9L missile. - Causes jettison of the left selected A/G missile dome cover and electrical alignment of the A/G missiles gyros. Pressed and released for the second time: - Recages the seeker head of the selected AIM-9L missile. - Causes change from a "Wide Field of View" image to a "Narrow Field of View" image; subsequent switch actuation will change form "Narrow Field of View" image to "Wide Field of View" image and viceversa.
17. Target designator position/ /Stadiamwetric range control	It can move momentarily along two perpendicular directions (axes X and Y), with a center-off position. It is used to: - Proportionally move the target designation symbol appearing on the HUD during the CCRP attack on the target to improve the acquisition of the target coordinates previously carried out by direct aiming.

Figure 1-78 (Sheet 4)

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
	- Orient the camera located on the A/G missile to permit target acquisition. - Adjust, in A/A gun modes, the diameters of the aiming reticle until the wings of the target fill the reticle.
18. "FIRE" switch	FWD - Firing, launch, release and designation of the target in CCRP, or laser telemeter controls are available at the front cockpit. AFT - Firing, launch, release and designation of the target in CCRP, or laser telemeter controls are transferred from the front cockpit to the rear cockpit. The "CUT" indicator on the WCP illuminates concorrently.
19. "ARM" light	On - Indicates that the master armament switch on the front WCP is at ARM.
20. "REV" light	On - Indicates that the reversionary mode has been selected.
21. "FAULT/FAIL" light	Repeats the information of the indicator provided on the WCP.
22. "CUT" push-button light	Permits the instructor to cut-out the firing, launch, release (except jettison), and designation controls in the front or rear cockpit depending upon the "FIRE" switch position. The push-button light operates as follows: - Legend not in view: SMS is enabled to fire. - Pressing the push-button, it illuminates with "CUT" legend in aviation red on black background; in these conditions the above controls are disabled. - Pressing the push-button again, the "CUT" legend goes off and the above controls are available. In case the aircraft general power supply is removed and the "CUT" had been previously operated (legend illuminated), applying power again returns the push-button automatically to the normal condition (fire enabled).
23. Jettison selection annunciator lights	Inform the instructor about the stations for which store jettison has been selected.

Figure 1-78 (Sheet 5)

STORES MANAGEMENT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
24. "SALVO JETT" push-button	Pressed - Causes the immediate and intervalled release, in a safe condition, of all external stores carried under the pylons. NOTE Release occurs only when the aircraft is airborne.

Figure 1-78 (Sheet 6)

- The rocket firing mode allows the pilot to select:
  - the type of rocket (as compatible with the data entered in the WIP by the ground crew)
  - the quantity of rockets to be fired during the attack (as compatible with the number of rockets carried on the aircraft and with the data delivered to the system through the WIP). Rockets can be fired only in the CCIP mode with the pair option selected automatically by the system (rockets are fired in selected pairs starting from the rocket launchers at the outboard stations, until the entire selected quantity has been fired).

- In the practice dispenser operating mode, the SMS allows the pilot to fire the rockets and to release the bombs (low drag or high drag practice bombs) contained in the dispenser. It is possible for the pilot to select:
  - the type of weapon (practice bombs or rockets). When the dispenser carries both low drag or high drag practice bombs, the system automatically selects the release of all low drag bombs first, then of the high drag bombs
  - the attack mode (CCIP or CCRP) for bomb release. If low drag and high drag bombs are present, the pilot, after release of the low drag bombs shall make a new selection of high drag bombs on the SMS control panel. The CCIP release mode is selected automatically by the system in case of practice high drag bombs.

- In the gun firing mode, the SMS allows selection and firing of the gun pod installed under the wings. The system also processes and displays to the pilot the number of rounds remaining on board (only for gun pod). After enabling the gun mode, the pilot must only select the attack submode, to be fed to the HUDWAC system (Strafe, Snapshoot, LCOS). If the pilot actuates the "DOGFIGHT" override switch on the engine throttle, the system proceeds to the simultaneous selection of the guns and of both the infrared-guided missiles (if present). One or more attack packages, consisting of a succession of the above selections, can be set by the pilot and stored in the system, so as to use them in sequence when necessary. During operation of the system in one of the pre-planned sequences, it is possible for the pilot to interrupt the sequence whenever desired, to verify the available weapons/stores/rounds and to accomplish anyone of the possible selections. The pilot can resume the sequence from the point where it was interrupted in any moment.

SMS Selection

STARTUP

When electrical power is applied to the SMS, the SMS starts operating by performing internal memory and program tests. During these tests all weapons are deactivated. If these tests are successful, all the displays are cleared and the "FAIL" light, located on the "SMS" control panel is off. If, on the contrary, some tests are unsuccessful, the "FAIL" light illuminates indicating a fault.

STORES CONFIGURATION DISPLAY (MAP 0)

When the armament safety pin, located near the WIP, is inserted and power is applied to the SMS, the maps of the weapon and non-weapon stores are displayed on the weapon control panel to indicate the way in which the stores have been loaded by the armorer. The information is presented on the two lines of the LCDs.

9CB-0198

The acronyms used are indicated in the table of figure 1-79. These indications permit the pilot to check the types of stores carried under the wings, thus verifying:

- The correct action of the armorer;
- The correct acquisition of the store configurations by the WIP. The two three-digit indicators display the total number of rounds for the left and right gun. The communication with the WIP is repeated until the armament safety pin inhibit signal is present. In this situation allsoft push-buttons are deactivated.

WEAPON INVENTORY (MAP 1)

When the armament safety pin is removed by the armorer (armament functions activated), the display changes from stores configuration to weapon inventory. On the upper line there are indicated the quantities, while on the lower line there are indicated the types. The left field is dedicated to the guns, if installed, while the three remaining fields are dedicated to the other weapons.

9CB-0199

STORES INVENTORY

STORE TYPE	WIP CODE	WIP INDICATION	WCP and WMP INDICATION
MK 82 LD	01	MK 82 LD	BLD
SAMP 25 LD	02	SAMP 25 LD	BLD
MK 82 SNAKEYE	03	MK 82 SNAK	BHD
MK 82 BALLUTE	04	MK 82 BALL	BHD
SAMP 25 HD	05	SAMP 25 HD	BHD
559 G	06	559 G	BHD
SUPER LEPUS (1)	07	SUP LEPUS	FLR
BAP 100 (1)	08	BAP 100	BAP
BAT 120 (1)	09	BAT 120	BAT
AL-18-50	10	AL-18-50	R50
AL-25-50A	11	AL-25-50A	R50
F2	12	F2	R68
F4	13	F4	R68
LAU-32	14	LAU-32	R70
LAU-51	15	LAU-51	R70
100-F3	16	100-4	R10
LAU-10 B/A	17	LAU-10 B/A	R52
SAL-6-80	18	SAL-6-80	R81
SAL-12-80	19	SAL-12-80	R81
BRD4-250A	20	BRD4-250A	BRD
BRD4-250B	21	BRD4-250B	BRD
BRD4-250C	22	BRD4-250C	BRD
BRD4-268A	23	BRD4-268A	BRD
BRD4-268B	24	RD4-268B	BRD
BRD4-268C	25	BRD4-268C	BRD
BRD4-270A	26	BRD4-270A	BRD
BRD4-270B	27	BRD4-270B	BRD
BRD4-270C	28	BRD4-270C	BRD
AGM-65B	29	AGM-65B	AGM
AIM9 P	30	AIM9 P	AAM
MATRA 550 MAGIC	31	550 MAGIC	AAM
PYLON TANK	32	PYL TANK	TK
BAGGAGE POD	33	BAG POD	LGG
ECM POD (1)	34	ECM POD	ECM
BL755	35	BL755	BCL
MK7	36	MK7	BCL
BELUGA	37	BELUGA	BCL
BOMBE MODULAIRE	38	BOMB MOD	BCL
553 GUN POD	39	553 GUN PD	GUN
-	40	NO PYL	-
AIM9 L	41	AIM9 L	AAM
AGM-65D	42	AGM-65D	AGM
SMOKE TANK	43	SMKPOD	SMK
COMBINED FUEL/ /SMOKE TANK	44	FUEL SMK	TKS

Figure 1-79 (Sheet 1 of 2)

STORES INVENTORY

STORE TYPE	WIP CODE	WIP INDICATION	WCP and WMP INDICATION
SAL-4-122	45	SAL-4-120	B12
MARTE MK2/A ASM (2)	46	NA	-
12.7 MACHINE GUN POD	47	12 GUN POD	G12
LAU-5002 B/A	48	LAU-5002	RV7
BRD4-2CRV7A	49	BRD4-2R7A	BRD
BRD4-2CRV7B	50	BRD4-2R7B	BRD
BRD4-2CRV7C	51	BRD4-2R7C	BRD

NOTE 1: Weapons not managed by the system software.
NOTE 2: Not implemented in weapon system.

Figure 1-79 (Sheet 2)

WEAPON SELECTION

In this mode, the four soft push-buttons on the weapon control panel are activated. Pressing one of the push-buttons selects the corresponding weapon. When the pilot selects a weapon, the stored package is sent to the WAC. It is also possible to revert to MAP 0 (and viceversa) by pressing the "WPN DIS" push-button.

ATTACK PARAMETERS PACKAGE SELECTION

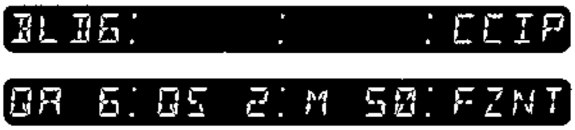
When the pilot selects a weapon, the corresponding programmed attack parameters are displayed on the two lines of the LCD. When a weapon is selected for the first time, the most aggressive possible attack package is calculated by the SMC and displayed on the weapon control panel. The pilot can change these parameters by operating the soft push-buttons.

Basic Modes of System Operation

BOMB OPERATION

- Bomb Selection

  In case of six low drag bombs, the displayed programmed package is:



9CB-0200

The maximum quantity per attack (6) and the maximum quantity per signal (2) are automatically selected according to the number of bombs loaded.
Operation:

- Mode: automatically set to CCIP. Operation of the adjacent mode push- button changes the mode to CCRP and back, except for the high drag bombs for which the CCRP mode shall be inhibited.
- Quantity per attack: number of bombs loaded (max 6) is set as first choice. Operation of adjacent soft push-button decreases quantity per attack in steps of 1.
- Quantity per signal: automatically set to 2. Operation of the adjacent soft push-button decreases quantity per signal to 1; alternatively programming Q/A = 1 also sets Q/S = 1 and the soft push-button is inhibited.
- Spacing: automatically set to 40. Operation of the adjacent soft push- button changes this to the following: 40, 50, 60, 80, 100, 150, 200, 250, 300, 500, 700, 900 and 995. If Q/A = Q/S, this indicator is blanked and the soft push-button is inhibited.
- Fuzing: nose and tail fuzing is automatically set. Operation of the adjacent soft push-button changes this to nose only, tail only or none.

BOMB RELEASE

In order to obtain the release of the selected bombs, the pilot must position the Master Armament switch on the weapon control panel, to ARM, then press and hold the bomb release push-button.

NOTE

The SMS releases the bombs in sequence to prevent a lateral imbalance in excess of one store on the underwing pylon stations. In case of a hang-up, the release sequence does not stop but changes so as to maintain an imbalance not in excess of one store. If this condition is not satisfied, the SMS inhibits the release sequence.

BOMB AFTER RELEASE

After release, the same attack is retained if available. If the selected quantity per attack is no more available, the remaining quantity is automatically selected, leaving the other package parameters unchanged.

- Bomb Release Reversionary Mode

  In case of failure of the weapon aiming computer, the SMS automatically selects the bomb release reversionary mode. In this mode, the SMS internally builds up the release sequence by calculating the spacing between releases based on the number of bombs and the spacing in meters on the ground as selected for the attack. The computer assummes that the aircraft flies at a speed of 200 m/s.

Rocket Operation

- Rocket Selection

  In case of two rocket launchers, the displayed preprogrammed package is:

9CB-0201

The number of carried rockets and the maximum quantity per attack compatible with the number of rockets, are displayed on the lower row of the LCD:

- Mode: automatically set to CCIP; the corresponding mode push-button is deactivated.
- Quantity per attack: the following numbers are automatically set: RPL, 32, 16, 12, 8, 4, 2. Operation of the adjacent soft push-button decreases the quantity per attack using the same sequence. RPL selection permits:
- A maximum number of rockets (not higher than 50) to be fired in ripple during each attack.
- The remaining rockets to be fired even if their number is not within one of the selections specified.
- Quantity per signal: the quantity of rockets to be fired at every control signal is equal to two (pair).

- Rocket Firing

  If the Master Armament switch, on the weapon control panel, is in the ARM position, when the pilot presses the rocket firing push-button, located on the control stick, the SMS automatically sends pairs of pulses to the symmetrical stations, to simultaneously fire pairs of rockets, until the full quantity of rockets selected for the attack has been fired. At the same time the number of rockets shown on the upper display row of the LCD is decreased during firing. If more than two rocket launchers are present, the firing sequence starts from the outboard launchers and continues until all the rockets contained in this pair of launchers have been fired, then launch continues from the inboard launchers. The SMS is capable of firing rockets from a single launcher when the symmetrical launcher has been jettisoned by selective jettison. The pilot can perform a clearing of the rocket launchers by feeding a series of pulses to all rocket launchers once the last rocket of the last rocket launcher has been fired. The end of the clearing causes shifting to MAP 1 presentation.

ROCKET AFTER FIRING

After firing, the same attack package is retained, if available. If the selected quantity per attack is no more available, the remaining quantity is automatically selected, leaving the other package parameters unchanged.

PRACTICE WEAPON DISPENSER OPERATION

Only two practice weapon dispensers may be carried in the aircraft. These dispensers can include ballistic bombs, retarded bombs and rockets. If the pilot wants to carry out an attack using the practice weapon dispensers, the SMS automatically gives the pilot the possibility of delivering rockets, low drag bombs (if installed), high drag bombs (if installed), in sequence. Priority to bomb release over rocket firing is however provided upon operating the soft push-button under LD indication: in this case the SMS automatically gives priority to low drag bombs over high drag bombs with no possibility for the pilot to change this priority.

- Practice Dispenser Selection

  In case of one practice dispenser, the displayed preprogrammed package can be:

9CB-0202

- Practice Rocket Selection

  The following parameters are automatically selected by the SMS with no possibility for the pilot to change them.

  - Quantity per attack: 1
  - Quantity per signal: 1
  - Delivery mode: CCIP.

- Practice Rocket Firing

  When the pilot sets the Master Armament switch on the weapon control panel to the ARM position and the rockets-before-bombs sequence is selected, pressing the rocket firing push-button on the control stick, causes one rocket to be fired from the practice dispenser. At the same time, the rocket counter is decreased by one. Pressing the rocket firing push-button again causes another rocket to be fired from the same launcher, while RKT disappears from the lower row of the LCD.

- Practice Bomb Selection

  In order to release practice bombs, the pilot must select the type of store (in this case "practice bombs") on the WCP. This involves the automatic selection of the release sequence (low drag bombs, high drag bombs), as well as the automatic selection of the following parameters by the SMS:

  - Quantity per attack: 1
  - Quantity per signal: 1
  - Delivery mode: CCIP.

  The pilot is enabled to change the delivery mode from CCIP to CCRP. After delivery of all the low drag bombs, a new selection by the pilot is required for release of high drag bombs. All remaining selections are automatically effected by the SMS as in the case of the low drag bombs, except for the Delivery mode, for which the available option is CCIP.

- Practice Bomb Release

  When the pilot wants to release bombs in case of bomb-before-rocket selection, or when rocket firing is completed, it is necessary that the bomb release push-button on the control stick grip be pressed and held. Only one bomb per attack is released.

9CB-0203

Gun Operation

The SMS is designed to perform attacks with two gun pods containing a gun each or, alternatively, with two machine gun pods containing a machine gun each, mounted under the wing inboard stations. The SMS is also designed for the accomplishment of attacks with one only gun pod containing machine gun indifferently used under the left or right imboard station.

- Gun Pods

  Each underwing gun pod contains a 30 mm DEFA gun type 553 F3 with 125 rounds, which is controlled by a gun electronic unit (GEU). The GEU contains all the required circuits to control the electrical functions that command gun firing in response to the input from the SMS.

- Gun Selection

  When the pilot selects the "GUN" push-button on the control panel, gun operation starts automatically.

  - Gun selection: the display shows GUN and cannot be changed. Before selection, the two upper three-digit counters show the rounds available in the left and right gun.
  - Mode selection: automatically set to STRF; the lower row indicates the SS or LCOS option. Operating the corresponding push-button changes the mode selection and the label of the push-buttons.

- Gun firing

  When the pilot sets the master armament switch to the ARM position and holds the trigger fully pressed, the corresponding gun electronic unit supplies firing command to the gun; the number of rounds fired is automatically counted and the display indication is updated.

MACHINE GUN POD OPERATION

Each underwing machine gun pod contains a 12.7 mm AN-M3 Browning machine gun with 300 rounds, and the associated devices.

- Machine Gun Pod Selection

  The selection of the underwing machine gun pods is made through the relevant push-button on the WCP. The two upper three-digit displays show the rounds previously carried in the left/right gun pod. Automatic selection of STRAFE (CCIP mode) and of the SS or LCOS mode is the same as required for the gun pods. Deselection of the machine gun pods is performed by means of the "WPN DIS" push-button on the WCP.
- Machine Gun Pods Firing

  The pilot must position the master armament switch (on the WCP) to ARM. When the pilot presses the trigger (1st detent), the ammunition boost motor feeds rounds to the machine gun. When the pilot presses the trigger (2nd detent), the machine gun is caused to operate and to remain in operation as long as the trigger is pressed.

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DOGFIGHT

When the pilot depresses the "DOGFIGHT" push-button, both missiles and guns are selected. The AAM missiles and all guns or machine gun pods (if installed) are automatically selected. The snapshoot (SS) mode is automatically selected. The operation is the same as described for gun firing and AAM launch. The MAP "Dogfight" mode gives the pilot the set of information required for attack as a function of the presence or lack of the guns and air-to-air missiles.

9CB-0204

The selection of the Dogfight mode is accomplished in the following two ways:

- With another actuation of the Dogfight push-button
- By pressing the "WPN DIS" push-button on the WCP.

In both cases, the SMS goes out of the Dogfight mode and displays MAP 1, thus allowing the pilot to select another attack weapon.

SALVO JETTISON

The salvo jettison, initiated by pressing the "SALVO" push-button, external to the SMS, provides the unarmed and intervalled release of all stores except the air-to-air missiles, gun pods and machine gun pods. To initiate release of the stores, it is necessary that the push-button be held depressed for approx 0.2 seconds. The salvo jettison sequence shall then continue even if the push-button is released. The time intervals and jettison sequence is generated by the salvo jettison intervallometer.

SELECTIVE JETTISON

Selective jettison is a SMS operation which releases or launches all of a selected store type from the selected station(s) in an unarmed and unguided state. This operation is not applicable to the guns or machine gun pods. On the WCP, there are six plus one push-buttons dedicated to the selective jettison of stores. Each selection push-button is dedicated to a wing station. When it is desired to jettison a store, the pilot selects the corresponding station by operating the dedicated push-button which becomes steadly illuminated to indicate acknowledgement of the selection made. The pilot can deactivate the previously activated station by operating the illuminated button again or by pressing the "WPN DIS" push-button, which returns to the off state. Selective jettison can be selected at any time by depressing one or more push-buttons (OUT, MID and IN), provided on the WCP. Pressing the guarded "SEL JETT" push-button/indicator on the WCP initiates the selective jettison sequence. The push-button/indicator must be held depressed until completion of the jettison sequence, otherwise the sequence is interrupted (the push-button must be held pressed for approx 2 seconds to complete the sequence). The selective jettison operation is possible even if the master armament switch is not in the ARM position and the landing gear control lever is set to UP. When one of the six station selection push-button lights is pressed, the system visualizes MAP 0 on the LCDs. When the jettison push-button/indicator is depressed, the system shifts to MAP 1 if all the stores are jettisoned correctly. If a hang-up persists, MAP 0 will be confirmed. The push-button/indicator will extinguish when jettison has taken place or when the push-button is pushed again for deselection.

- Selective Jettison and Dogfight Mode

  The SMS permits performance of selective jettison in the Dogfight mode as well. In particular, the system operates as follows:

  - It accepts the selective jettison selection of all stores, except the guns, machine guns and the air-to-air missiles.
  - MAP 0 appears on the LCDs of the control panels.
  - The Dogfight representation is retained in the HUDWAC.
  - The "SEL JETT" push-button/indicator restores MAP "Dogfight" on the LCDs.

HANG-UP

In case of failure, i.e. when the store(s) remain(s) hung-up after jettisoning or normal release, the push-button(s) corresponding to the station on which hang-up has taken place, illuminates with flashing green light. In case hang-up takes place after a normal release, it will be possible to perform selective jettison by pressing the push-button corresponding to the concerned station, thus obtaining steady illumination of the indicator, and then pressing the "SEL JETT" push-button. If the hang-up condition is not removed, the selection push-button light will resume flashing, and the system will return to the initial conditions. In case of more than one hang-up, the SMS shall not stop the selective jettison sequence.

SIMULATE OPERATION

In analogy with the procedures specified for the real missions, the armorer shall load in the WIP the weapons that are expected to be simulated in the training mission. This operating mode of the SMS is shown up by the SIM word coming into view on the WCP in MAP 0. After the appearance of SIM word, all selections, controls, firing and release sequences, counting of expended stores on the WCP, are performed in the same way as specified for the operating modes of each single weapon except for missiles for which only MAP 2 is displayed. Air-to-air missiles can be fully simulated only in Dogfight mode. In simulate mode, the HUDWAC will show the pilot the symbols of the selected attack mode in the same way as done for real modes.

- Simulate Firing or Release of Weapon

  Simulation of firing, launching or release shall be accomplished with no stores fitted to the aircraft. To obtain a simulate firing or release of the weapons, after moving the master armament switch on the WCP to ARM, the pilot must operate as in a normal attack with live weapons. The arming, as well as the firing and release signals, are disabled, whether the pylons are present or not. The decrement of stores, rockets, etc. takes place in the same way as in the live weapons case.

- Weapon Reloading Simulate

  In order to permit training missions in "Simulate" mode to be continued after all simulated weapons or rounds have been expended, it is possible to reload the weapons or rearm the guns or machine guns by pressing the push-button usually used to change the attack mode (CCIP/CCRP) when MAP 1 is displayed. In particular, the same weapon loading configuration available at the beginning of the mission is displayed.

9CB-0205

Continuous BITE

The equipment is provided with built-in-test equipment. The BITE circuit continuously monitors the equipment function. Continuous BITE is operative under the following conditions:

- Master armament switch at SAFE on WCP.
- "CHANGE/STORE" switch, on WIP, at STORE.

The internal continuous monitoring circuit detects 95% of all defects occurring in each equipment function, which can cause a degradation of the safety rate applicable to the following failures:

A. Catastrophic failures.
   1. Accidental release or jettison of store.
   2. Accidental launch of AAM or AGM or ASM.
   3. Accidental launch and firing of rockets, guns and machine guns.

B. Critical failures.
   1. Release or firing of a type of weapon other than the selected one.
   2. Launch of AAM, AGM and ASM with activated warhead when selective jettison was selected.
   3. Rocket firing rate higher than specified.
   4. Release of armed bombs in selective jettison.
   5. Application of ARM and FUZING signals to the selected stores with master armament switch in SAFE position.

In addition, the continuous monitoring performs:

- The test of EPROM and RAM memories (only at power on);
- The monitor of ac and dc power for AGM and AAM.

The detection of one or more failures causes illumination of the "FAIL" indicator light or "FAULT" indicator light on the WCP and the WMP depending upon the failure that has been detected and the effects that it can produce in terms of safety:

A. The "FAIL" indicator light will come on in presence of any failure which:
   - Prevents system operation.
   - Happens during the tests performed at "power-on".
   - Impairs the integrity of the system, and is detected during weapons loading operation.

   The salvo jettison function is always available.

B. The "FAULT" indicator light comes on in presence of any failure detected during the mission that may involve variations in the quantity of the available stores and/or an impair of the integrity, as to the above mentioned catastrophic and critical failures. If the continuous BITE detects a failure of this kind, the "FAULT" advisory light illuminates, and dots appear around the store legend in MAP 0, or, still in MAP 0, an error wording comes in view in a central position on the lower display line of the WCP and WMP. In this case, if the detected failure is not the first one, only the last failure detected after reset of the "FAULT" light is indicated. The table in figure 1-80 shows the FAULT error legends. Any other FAULT type failures are neither detected nor indicated untill the "FAULT" light is reset (extinguished) by the pilot, by pressing the "FAIL/FAULT" push-button. The dots shown at the stations, and the last error indication of system signals remain in view also in lack of other failures. The presence of FAULT type failures (both with FAULT light on and reset off), does not prevent the pilot from using the system operattionally. The release or jettison of the store from a failed station does not reset the dots; the failure is thus kept memorized for ground check. The reset of the dots and/or the fault indication displayed on the WCP and WMP can be done only by the armorer. The

FAULT TYPE ERRORS IN CONTINUOUS BITE

FAILURE TYPE	ERROR WORDING ON WCP AND WMP DISPLAYS
Test of 1st pylon	Dots around 1st station
Test of 2nd pylon	Dots around 2nd station
Test of 3rd pylon	Dots around 3rd station
Test of 4th pylon	Dots around 4th station
Test of 5th pylon	Dots around 5th station
Test of 6th pylon	Dots around 6th station
Control signal from master armament switch	MST
Return signal from WCP and WMP	LNK
Armament bus status	ABP
Status of trigger of installed guns	TGR
Lines from the Salvo Jettison Box	SJB
Power supply lines at WIP level	PWR
Battery charge status	BAT

Figure 1-80

display priority of any detected failures is shown in the table (same sequence as in the table). In particular, a FAIL type failure is immediately indicated, independent of whether the "FAULT" advisory light is on or off.

HEAD-UP DISPLAY AND WEAPON AIMING COMPUTER SYSTEM (HUDWAC)

The aircraft is fitted with a Kaiser HUDWAC system type Strike Attack Bomb Release Equipment (SABRE), which consists of a weapon aiming computer/symbol generator, a sweep driver unit, and front and rear pilot display units (PDU). The WAC system (figure 1-81) accomplishes the ballistic calculations for release, firing and launch of all weapons, and provides the pilot with the data required for flight control and weapon aiming displayed simultaneously with the real world through a dual combiner glass. The HUDWAC system receives information from the doppler/inertial reference, directional reference, attitude reference, integrated instrument, radar altimeter systems and from the tactical area navigation system (TRNAV). All data received from the above systems, along with the information received from the transducers of the air data sensor system, enable the weapon aiming computer (WAC) to make the ballistic calculations for release, firing and launch of the aircraft weapons basing on the actual flight parameters, thus permitting weapon aiming by the pilot under not necessarily pre-planned flight conditions. The HUDWAC system is capable of providing the pilot with the information described in the next paragraph within an instantaneous binocular field of view (IFOV) of 14.5° by 14.5°, viewed from the reference eye position, and a total circular field of view (TFOV) of 20° with normal head movement. The PDUs are also used as a support for the installation of the videocamera or gun camera of the data recording system. The HUDWAC system is powered from the 115 V ac, 26 V ac and 28 V dc primary busses. The HUDWAC system controls and indicators are described and illustrated in figure 1-82. The PDU formats are illustrated in figure 1-83.

HUDWAC System Operation

The HUDWAC system operates in the following modes and submodes:

a. Navigation mode:

- En route navigation submode (NAV)

HUDWAC SYSTEM BLOCK DIAGRAM

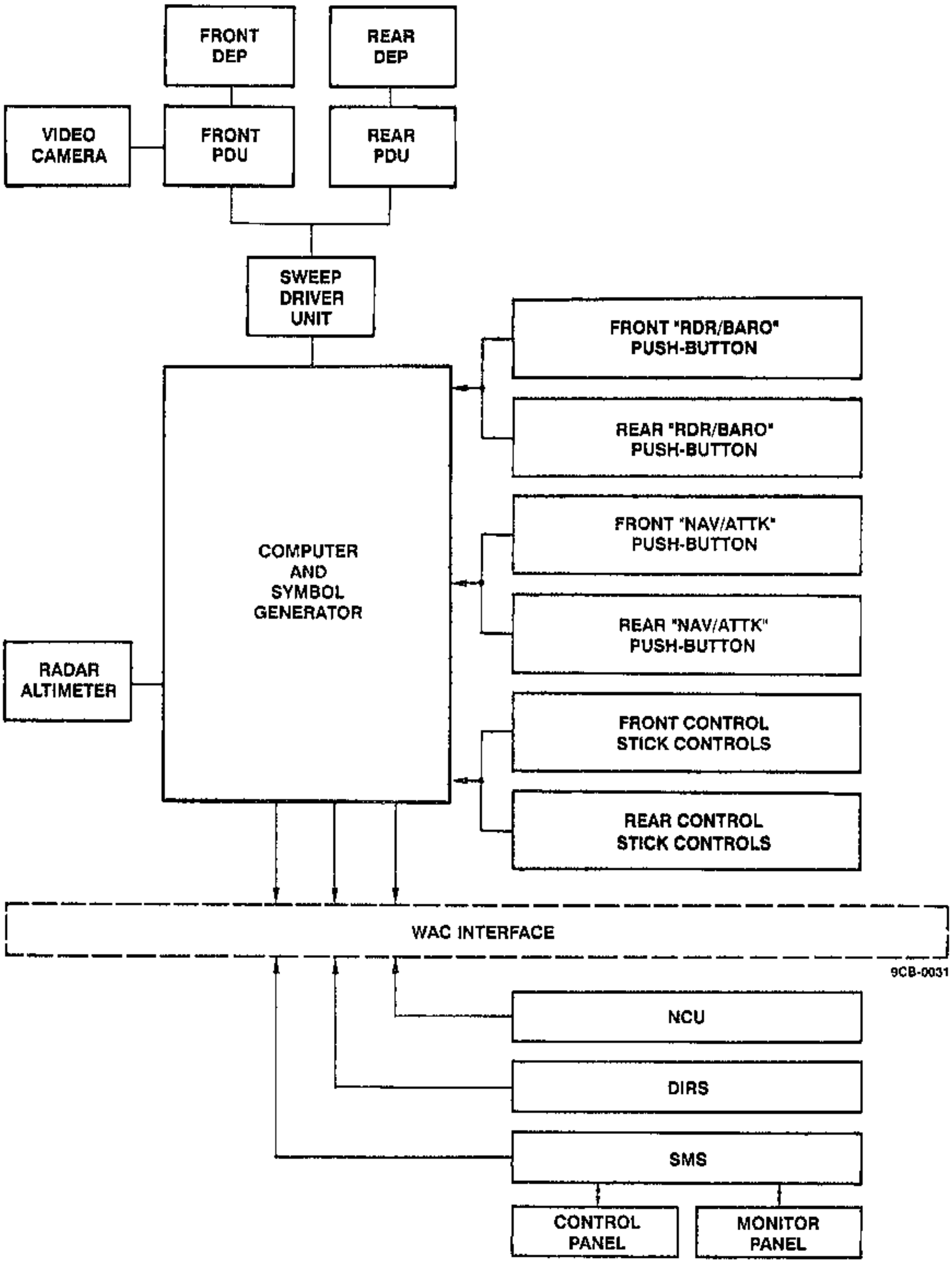


Figure 1-81

HUDWAC SYSTEM CONTROLS AND INDICATORS

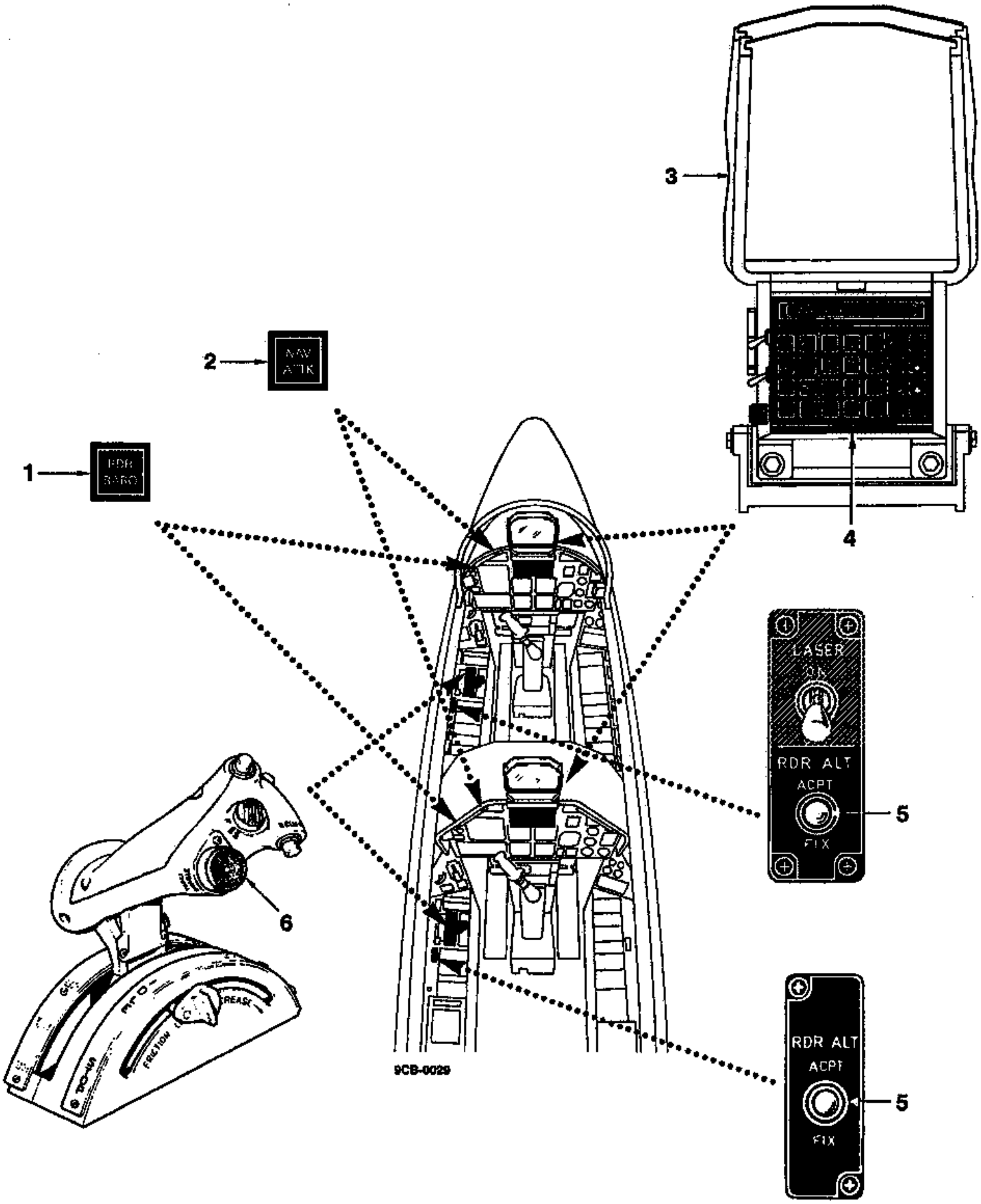


Figure 1-82 (Sheet 1 of 2)

HUDWAC SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
1. "RDR/BARO" push-button light	Permits the selection of the radar altitude or the barometric altitude for calculation of the target altitude during the attack phase.
2. "NAV/ATTK" push-button light	Permits the PDU symbology to be changed from navigation ("NAV" light illuminated) to attack ("ATTK" light illuminated) or viceversa.
3. Pilot display unit (PDU)	Displays all information received from the HUDWAC system.
4. Data entry panel (DEP)	Permits the navigation and attack data to be loaded in the navigation and weapon aiming computers. For a detailed description of the controls, refer to para "Data Entry Panel".
5. "RDR ALT" switch	FIX - The weapon aiming computer adds the initialization altitude (IA) to the altitude measured by radar altimeter, to update the QNH. The radar altitude and IA are presented on the PDU. ACPT - Within 10 s after the FIX, the pilot, can accept the correction introduced by fix operation.
6. "TDCP/ENABLE" control	- During a CCRP attack, it allows positioning of the target designator within the HUD field of view by moving it to any position along the X and Y axes. - During A/A attack, it allows the A/A aiming reticle format displayed on the HUD, to be changed to permit range of the foe aircaft to be estimated. - When pressed (Z axis), if the air-to-ground missile is selected, enables the missile seeker head, and when moved along the X and Y axes permits missile seeker head control. When released, provides target lock-on.

Figure 1-82 (Sheet 2)

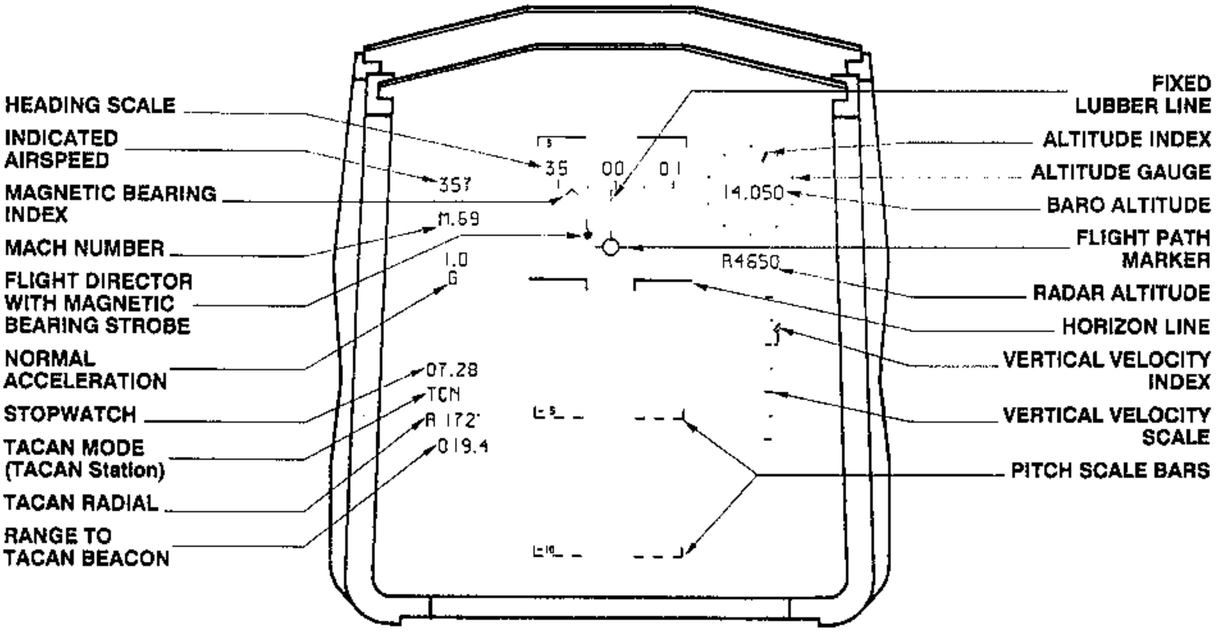
- Approach submode (APP)

b. Air-to-ground attack mode:

- Gun firing submode with continuously computed impact point (CCIP - STRAFE)
- Rocket launching submode with continuously computed impact point (CCIP - ROCKETS)
- Bomb release submode with continuously computed impact point (CCIP - BOMBS)

PDU FORMATS

NAVIGATION MODE FORMAT



APPROACH MODE FORMAT

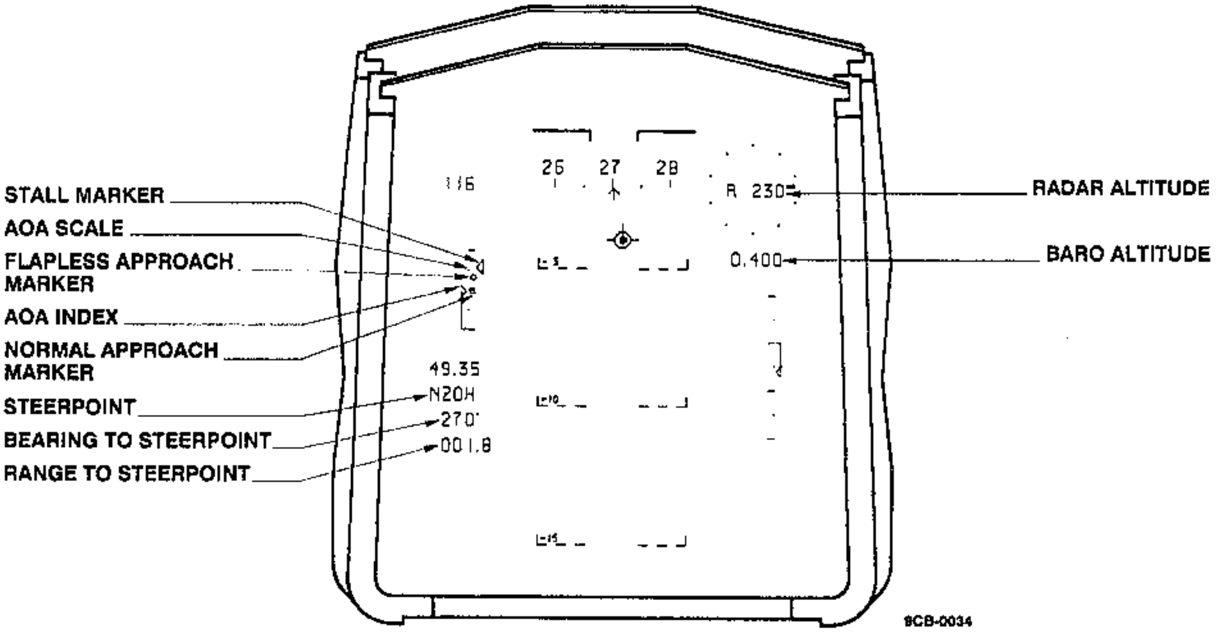
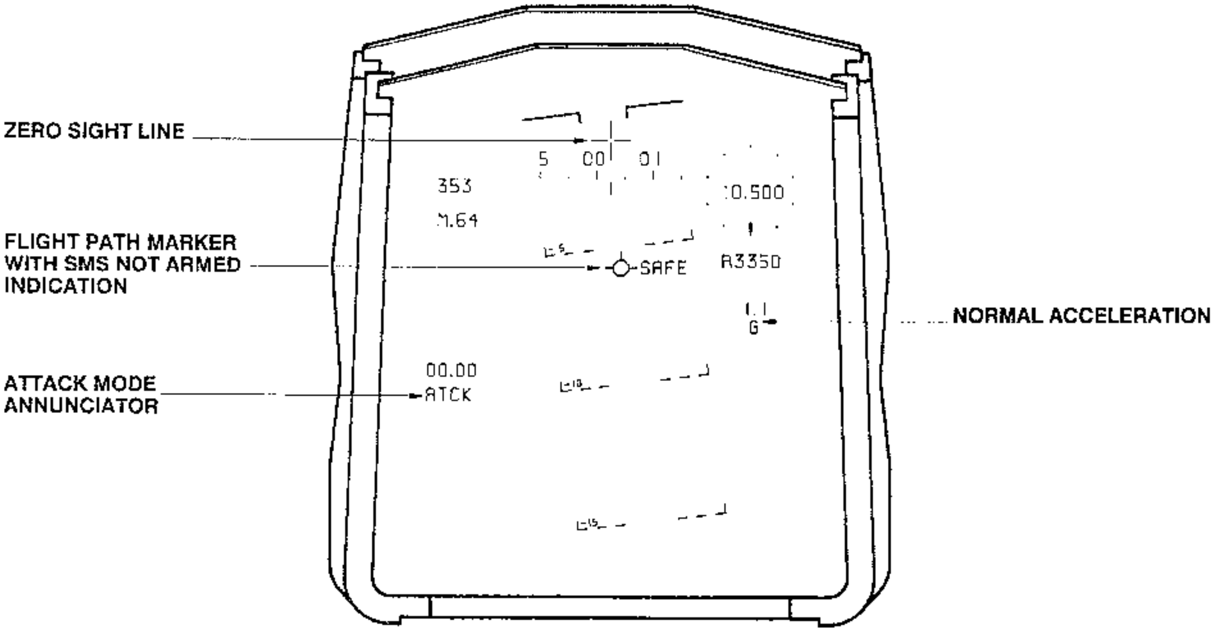


Figure 1-83 (Sheet 1 of 9)

PDU FORMATS

ATTACK MODE FORMAT



CCIP BOMB MODE FORMAT

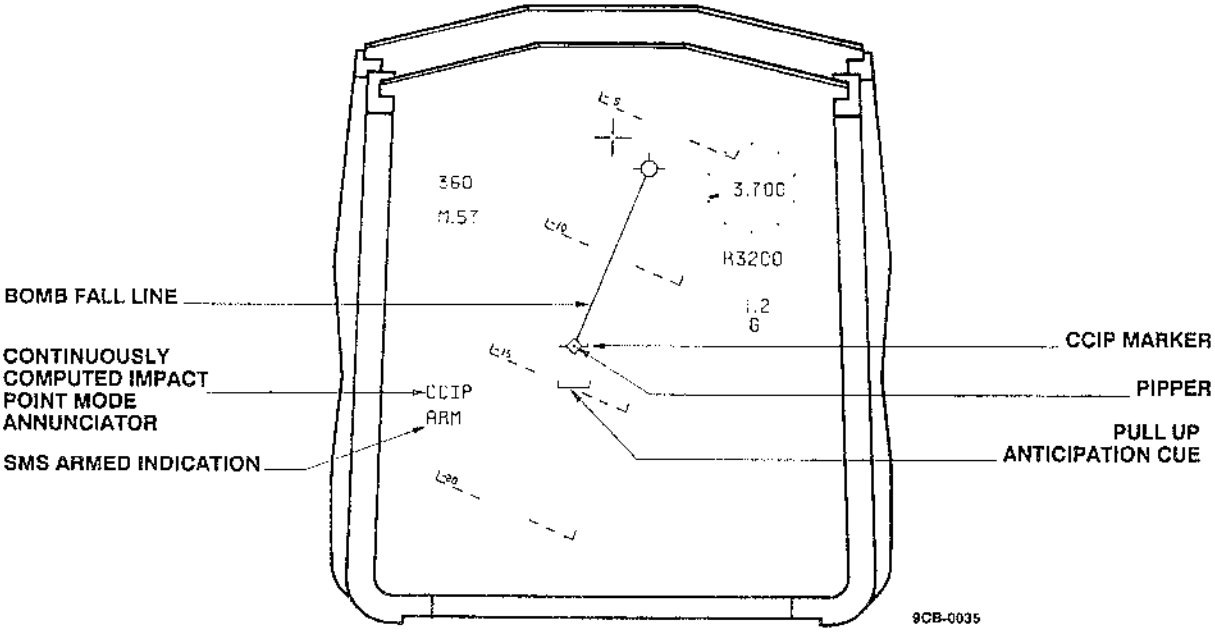
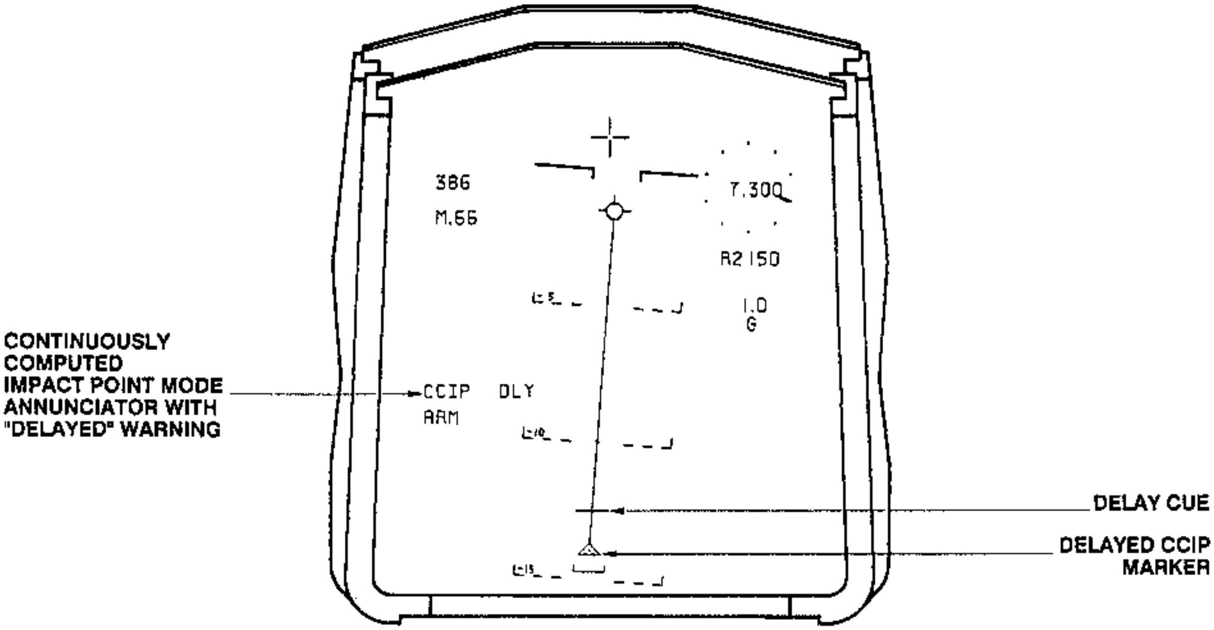


Figure 1-83 (Sheet 2)

PDU FORMATS

CCIP DELAYED FORMAT BEFORE TARGET DESIGNATION



CCIP DELAYED FORMAT AFTER TARGET DESIGNATION

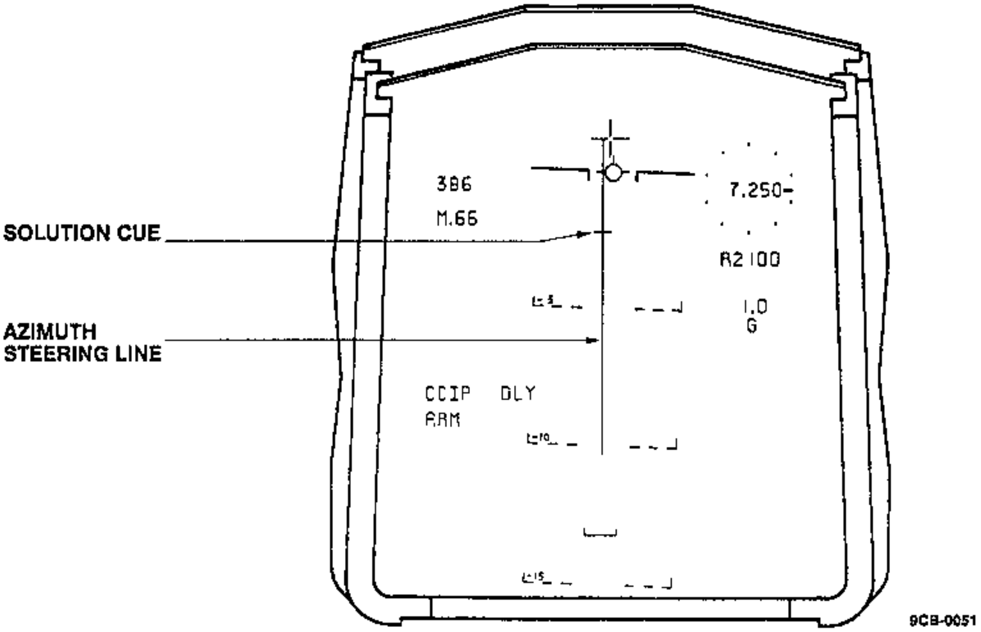
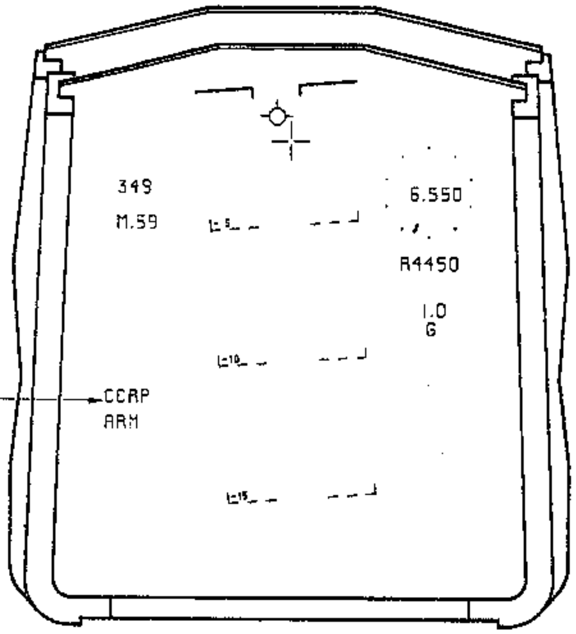


Figure 1-83 (Sheet 3)

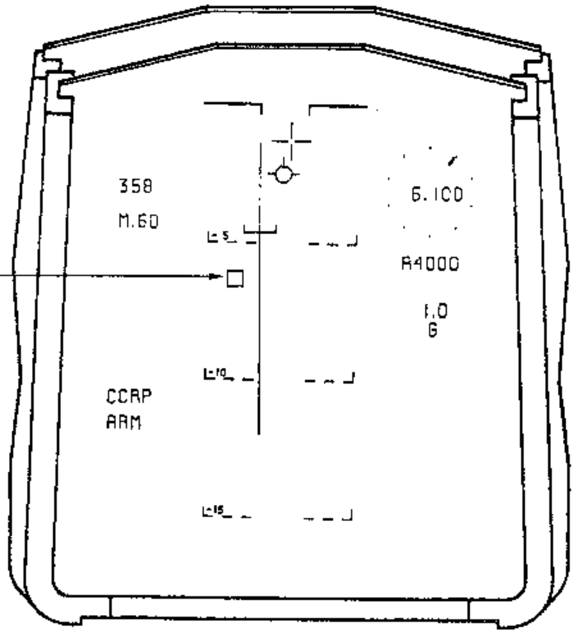
PDU FORMATS

CCRP MODE FORMAT BEFORE TARGET DESIGNATION



CONTINUOUSLY COMPUTED RELEASE POINT MODE ANNUNCIATOR

CCRP MODE FORMAT AFTER TARGET DESIGNATION (NO SOLUTION)



TARGET DESIGNATOR BOX

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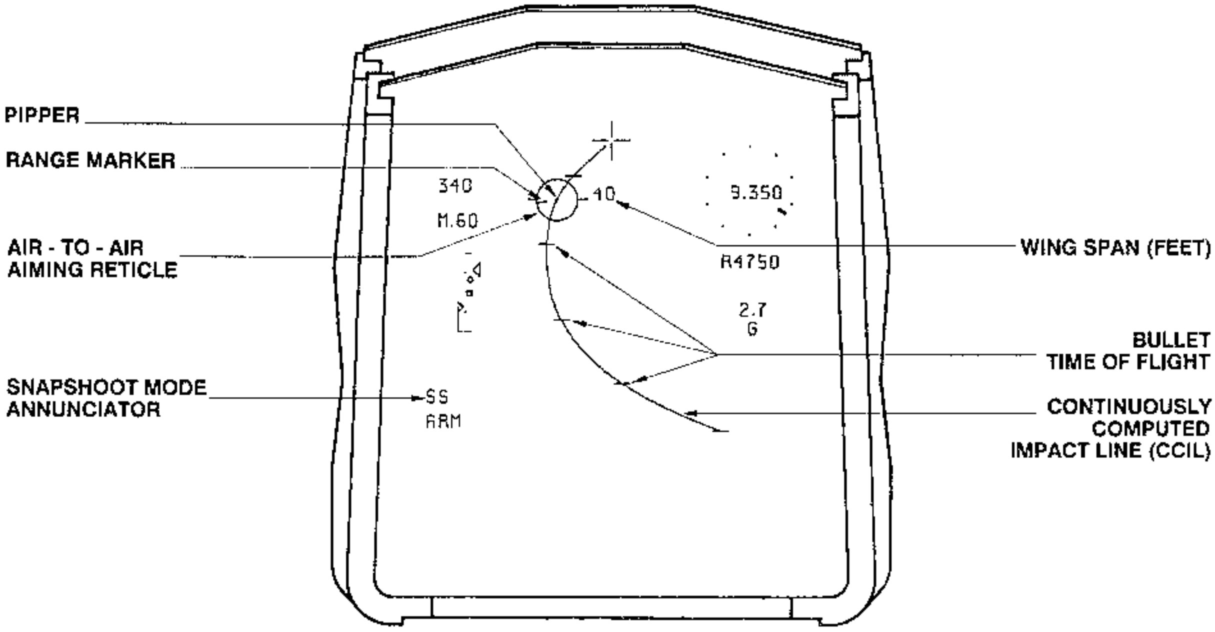
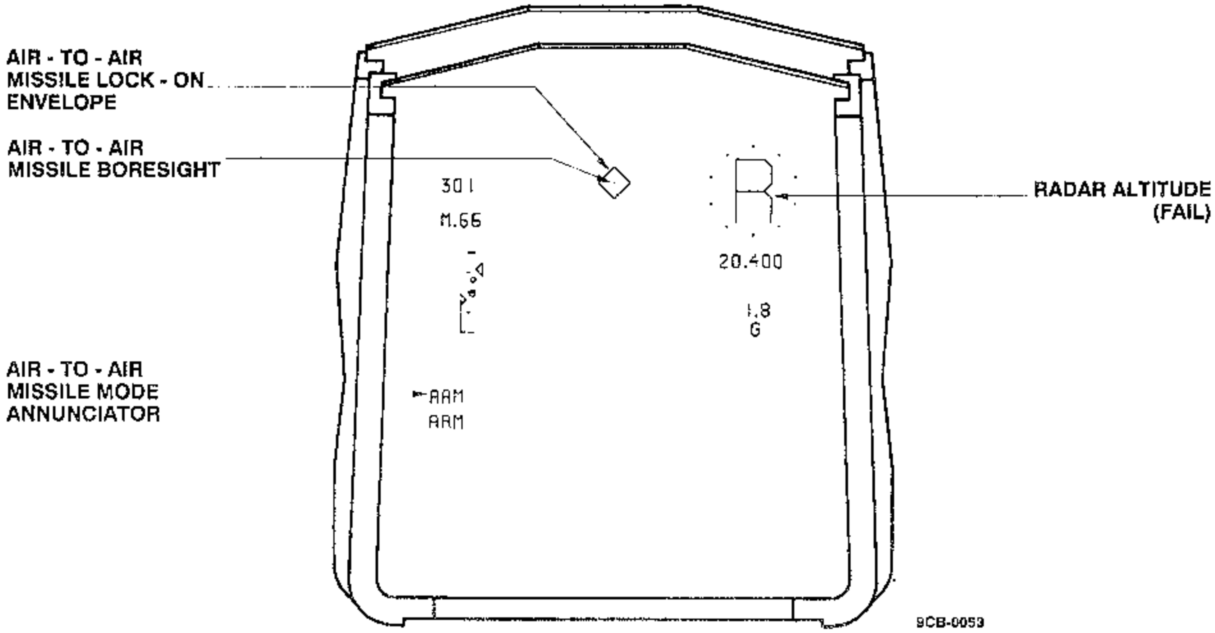
Figure 1-83 (Sheet 4)

PDU FORMATS



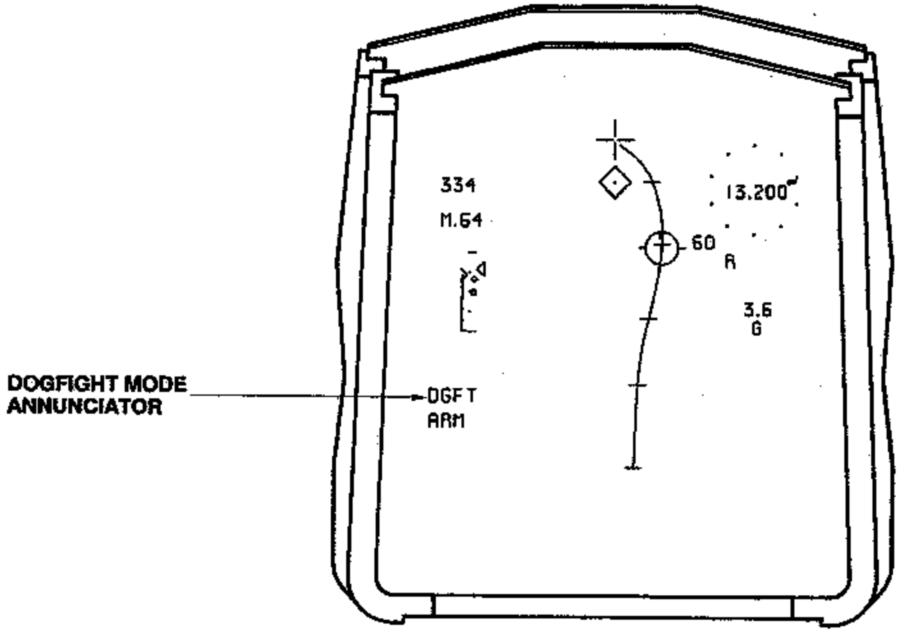
GUN "SNAPSHOOT" MODE FORMAT



AIR - TO - AIR MISSILE MODE FORMAT

Figure 1-83 (Sheet 7)

DOGFIGHT MODE FORMAT



LEAD COMPUTED OPTICAL SIGHT MODE FORMAT

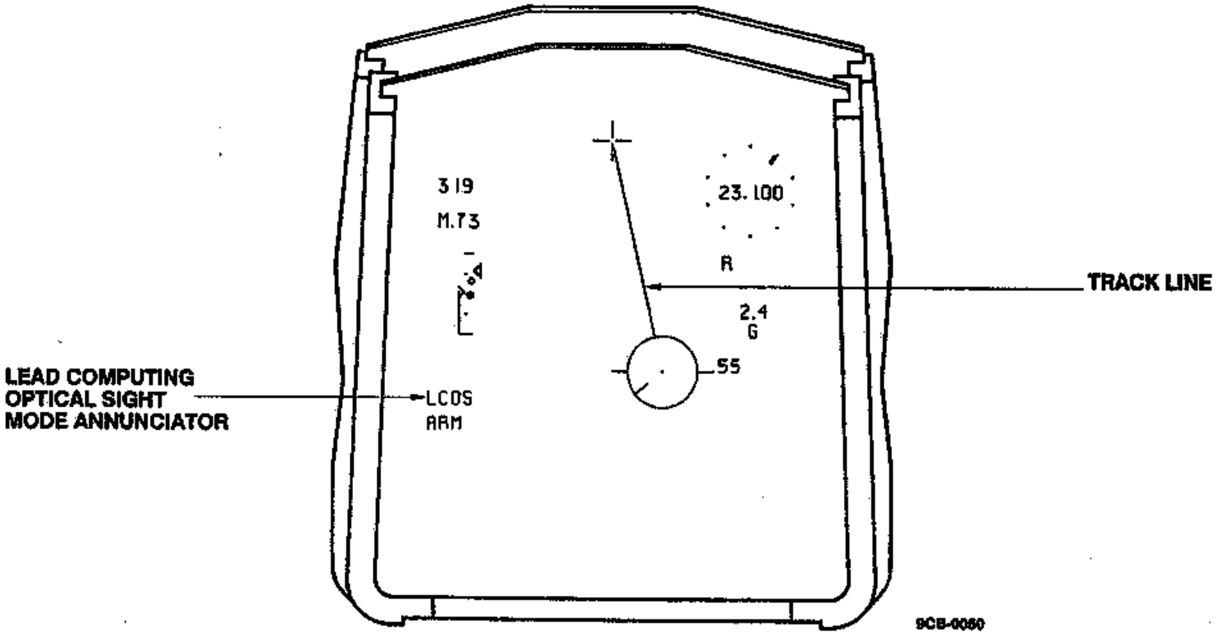
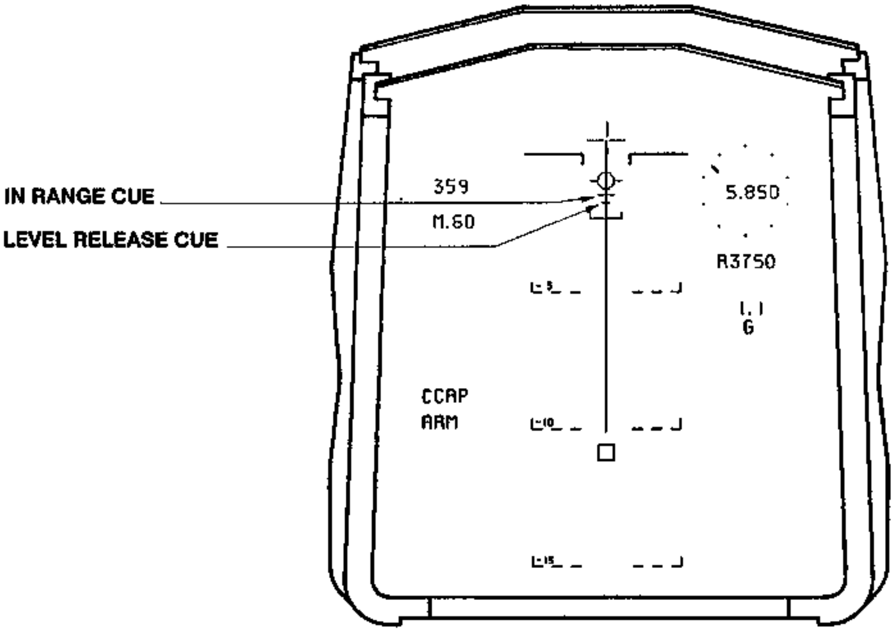


Figure 1-83 (Sheet 8)

PDU FORMATS

CCRP MODE FORMAT AFTER TARGET DESIGNATION (WITH SOLUTION)



GUN "STRAFE" MODE FORMAT

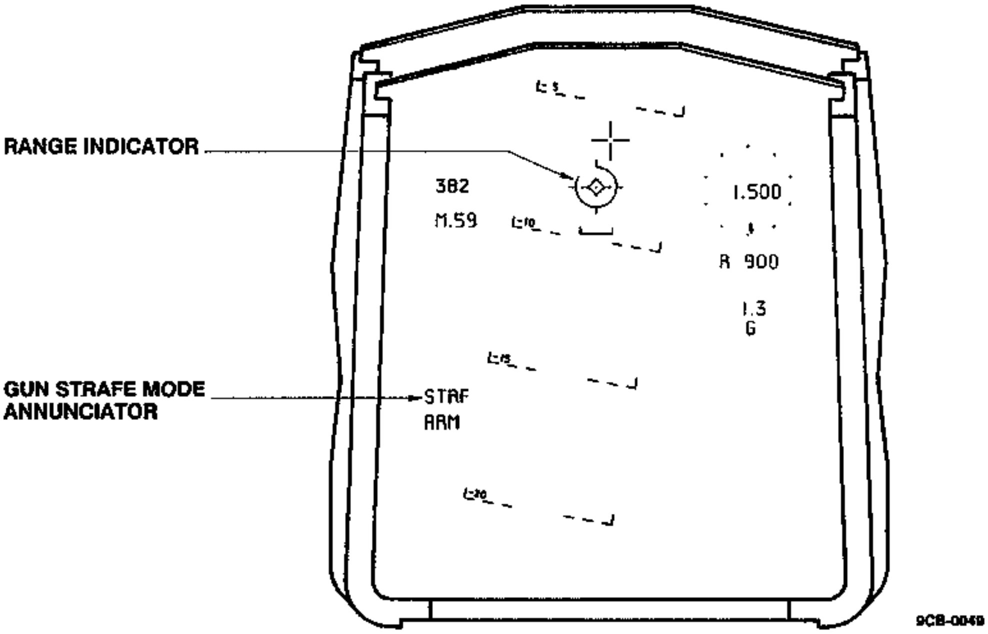
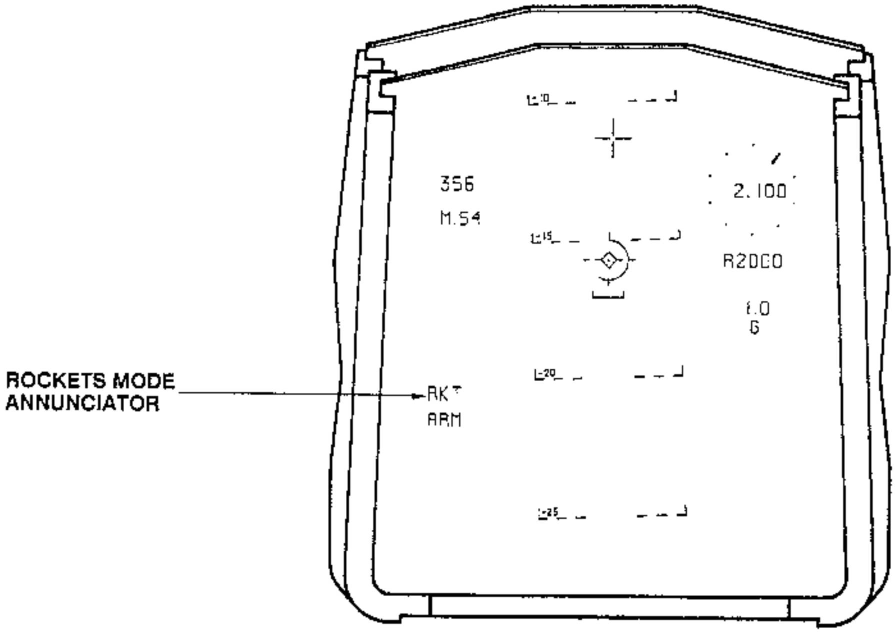


Figure 1-83 (Sheet 5)

PDU FORMATS

ROCKET MODE FORMAT



ELECTRO - OPTICAL MODE FORMAT

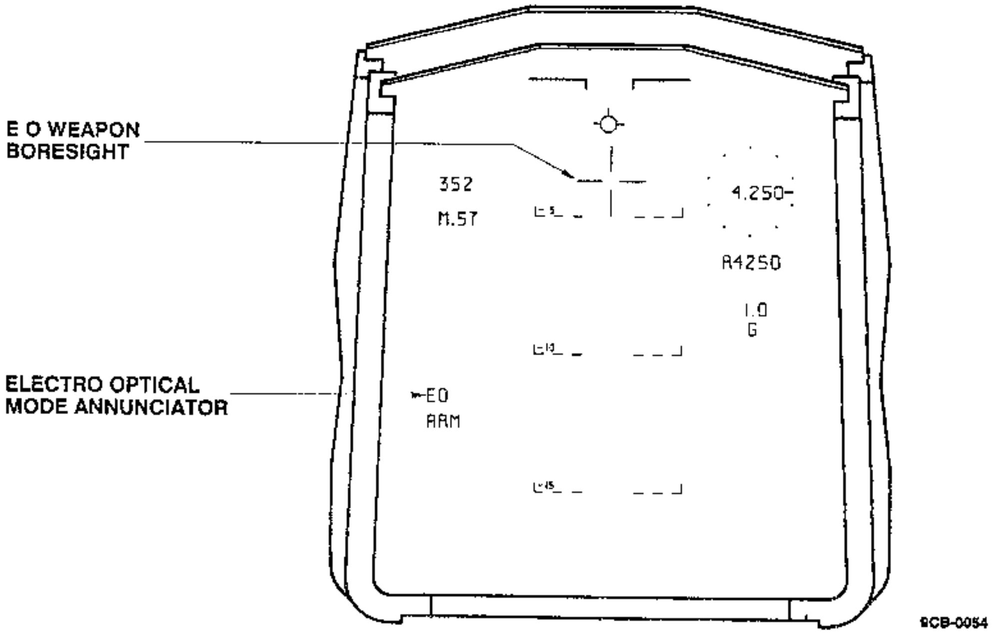
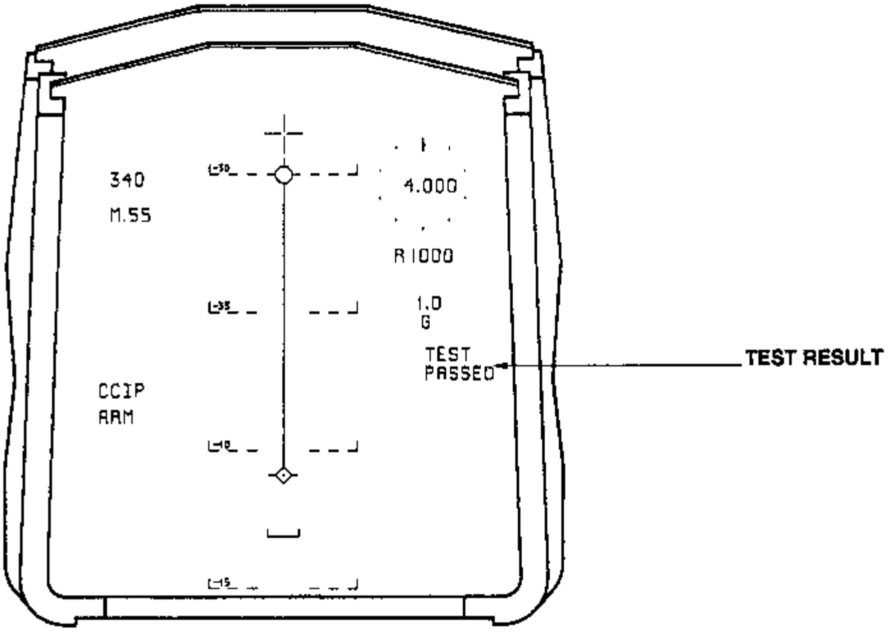


Figure 1-83 (Sheet 6)

PDU FORMATS

TEST MODE FORMAT



TEST FAILED MODE FORMAT

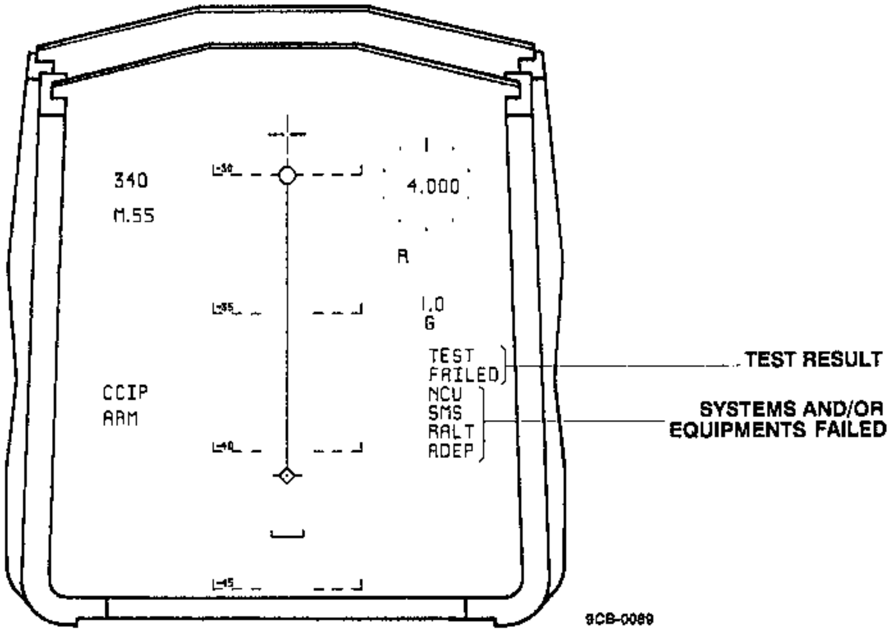


Figure 1-83 (Sheet 9)

- Bomb release submode with continuously computed release point (CCRP- BOMBS) (NOT YET CLEARED)
- Electro-optical (EO) missile launching submode (if the AGM-65() missile is installed)

c. Air-to-air combat mode:

- Snapshoot" gun firing submode (SS)
- "Lead computed optical sight" gun firing submode (LC06)
- Air-to-air missile (AAM) launching submode (if the A/A missile is installed)
- "Dogfight" submode

In the primary operating modes, the HUDWAC system mainly uses the information received from the DIRS for the ballistic calculations. In case of failure of the DIRS, the HUDWAC system is still capable of accomplishing the required calculations using the information received from the attitude reference and directional reference systems, and the data provided by the static/total pressure, angle-of-attack and sideslip angle sensors, using the air mass computation method.

OPERATING MODES DESCRIPTION

The operating modes and submodes are selected by the pilot through switches located on the engine throttle, on the control stick grip, on the weapon control panel, on the data entry panel and on NFDCP. In all submodes, the HUDWAC system provides the pilot, through the symbols displayed on the PDU, with the information required for flight control (altitude, speed, heading, aircraft attitude and normal acceleration) and with the data typical of each submode. Figure 1-83 shows the symbols and data displayed by the HUDWAC system in some typical navigation and attack submodes.

NAVIGATION MODE

In the NAV and APP navigation submodes, the HUDWAC system displays the information required to intercept or maintain the course or the glide slope/localizer signal, basing on the data supplied by the area navigation system and the other systems.

AIR-TO-GROUND ATTACK MODES

- In the CCIP-STRAFE, CCIP-ROCKETS, CCIP-BOMBS air-to-ground attack submodes, the HUDWAC system continuously computes and displays the position of the impact point of the weapons selected on the weapon control panel. The pilot actuates the weapon launching/firing/release controls on the control stick grip, when the symbol representing the impact point (CCIP marker) is superimposed on the target. A flashing breakway cross centered on the CCIP marker comes in view to indicate that a 4 g pull up must be initiated to avoid the weapon blast sphere, ricocheting projectiles or hitting the ground, when minimum safe altitude/slant range is attained. If the computed impact point position is below the lower limit of the pilot's field of view (over-the-nose line of sight), as may occur when high drag bombs are used, the system sets the triangular CCIP marker in a specific position within the pilot's field of view and computes the delay required between actuation of the release control by the pilot and delivery of the selected store release signal to the armament system. To correctly determine the impact point, the HUDWAC system continuously computes the height between aircraft and target (height above target). Three different methods can be used for the calculation of this data, at pilot's discretion:
  - Direct use of the data from the radar-altimeter system (applicable when the target is located in flat areas).
  - Calculation of the difference between aircraft altitude and target elevation, manually set by the pilot (applicable when the terrain is not flat and the target elevation is known). The aircraft altitude is computed by the system using the data obtained from the DIRS, after an "altitude fix" has been performed over a flat area of known elevation, by measuring the vertical distance of the aircraft from the ground through the radar-altimeter.

  - Calculation of the height above target (HAT) at the instant of target designation by the pilot as a function of the target distance measured by the laser range finder (LRF) system (if installed), and of the pitch angle furnished by the DIRS (applicable when the aircraft is fitted with LRF, unconditional on knowledge of the target height and QNH in the target area).
- In the CCRP-BOMS submode, the HUDWAC system displays the symbols for target designation, made by the pilot by means of the relevant control on the control stick grip. After target designation, the HUDWAC system continuously computes the target to aircraft relative position then the pilot will press and hold the bomb release push-button. The HUDWAC system now delivers a bomb release signal to the armament system as soon as this position coincides with one of the possible solutions of the bom ballistic equation. During that time, the pilot receives the instructions required to fly the aircraft to the most favorable position for store release. The relative position between aircraft and target is computed, at the time of designation, based on teh aircraft attitude information and on the distance information furnished directly by the LRF or, in lack of the LRF, as a function of the height difference between aircraft and target obtained from the radar-altimeter. system (flat terrain), or computed as the difference between the aircraft altitude and the target elevation manually set by the pilot.
- In the EO submode, the HUDWAC system allows the pilot to launch the TV guided weapons. In this submode, accurate weapon aiming is effected by pilot using the television image displayed on the MFD, while the HUDWAC system permits aircraft-to-target coarse alignment.

AIR-TO-AIR COMBAT MODE

- The Snapshoot air-to-air combat mode (SS) is optimized for the use of the guns during maneuvered air-to-air combats. In the SS submode, the system displays a continuous line defined by the position the rounds would have if the pilot had controlled the gun to continuous firing. All along the line (continuously computed impact line-CCIL) there are symbols indicating the position of where a hypothetical bullet would be if the gun were fired 0.5, 1 and 1.5 seconds earlier, and a gunsight reticle for the stadiametric definition of the target distance. After entering the target wingspan in the HUDWAC system through the data entry panel of the area navigation system, the pilot uses the control on the throttle grip to have the reticle coincident with the apparent dimensions of the target. The aiming computer processes the target distance and locates the aiming reticle on the CCIL, representing the time of flight required for the bullets to reach the target.
- The LCOS air-to-air combat submode can be used to aim at a target tracking a smooth trajectory through the pilot's field of view. In the LCOS submode, the pilot continuously tracks the target and has the reticle dimensions coincident with the apparent target dimensions. On the basis of the aircraft body rates and the estimated target distance, the computer processes the lead angle and the depression angle (which define the target position after a time of flight equal to that required for the bullets to reach the target), and presents the reticle so as to allow the pilot to point the guns at the future position of the target.
- In the AAM air-to-air combat submode, the HUDWAC system displays the information required to launch the infrared-guided A/A missiles. The missile lock-on envelope and the missile seeker boresight position are presented to the pilot continuously.
- The "Dogfight" combat submode consists of the simultaneous use of both the SS and AAM submodes: the pilot can change from any other submode to the "dogfight" submode by operating an override switch located on the engine throttle.

A few examples of the use of the HUDWAC are given in figure 1-84.

USE OF HUDWAC

NAVIGATION MODE

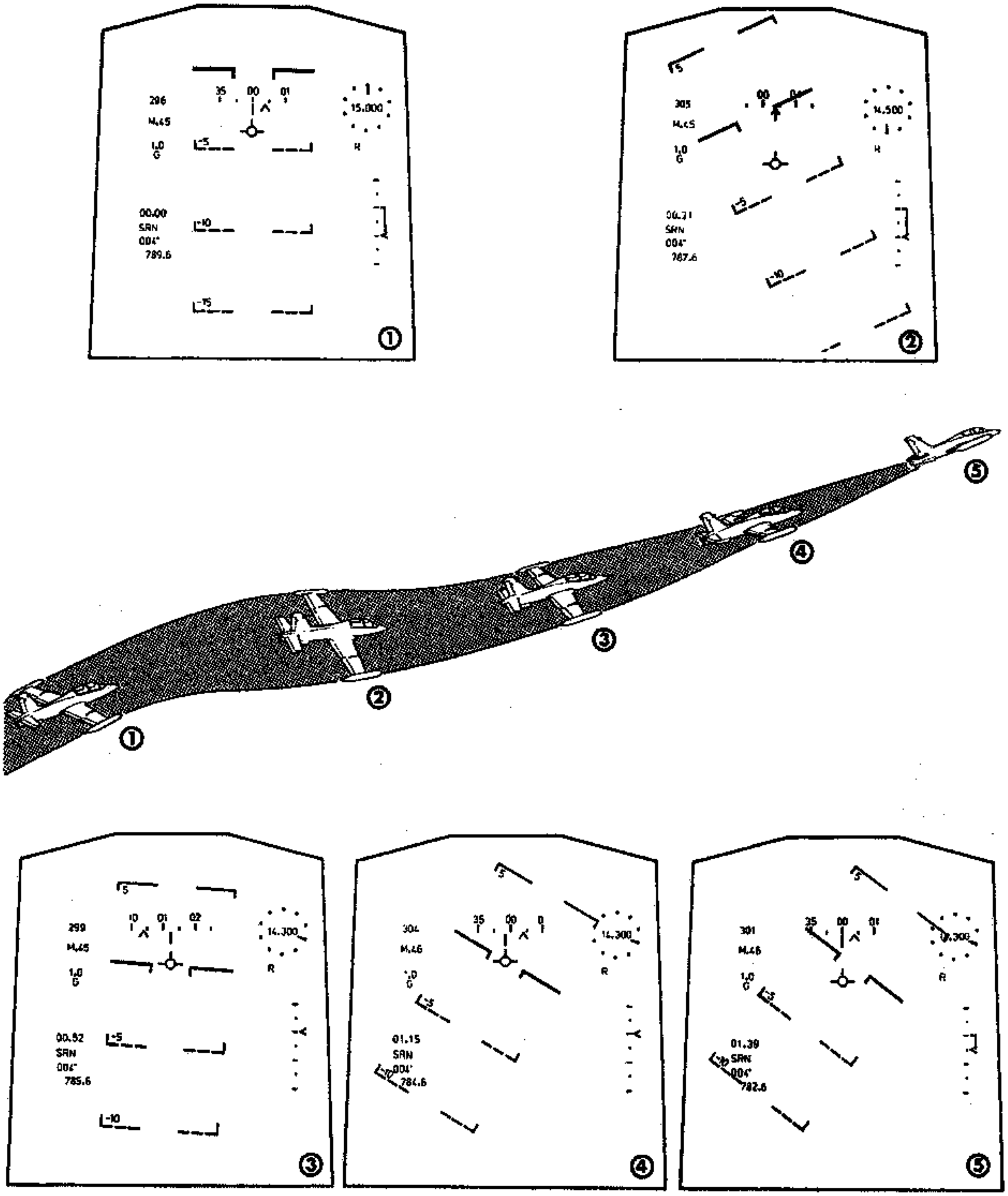


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Figure 1-84 (Sheet 1 of 11)

USE OF HUDWAC

CCIP - BOMBS MODE

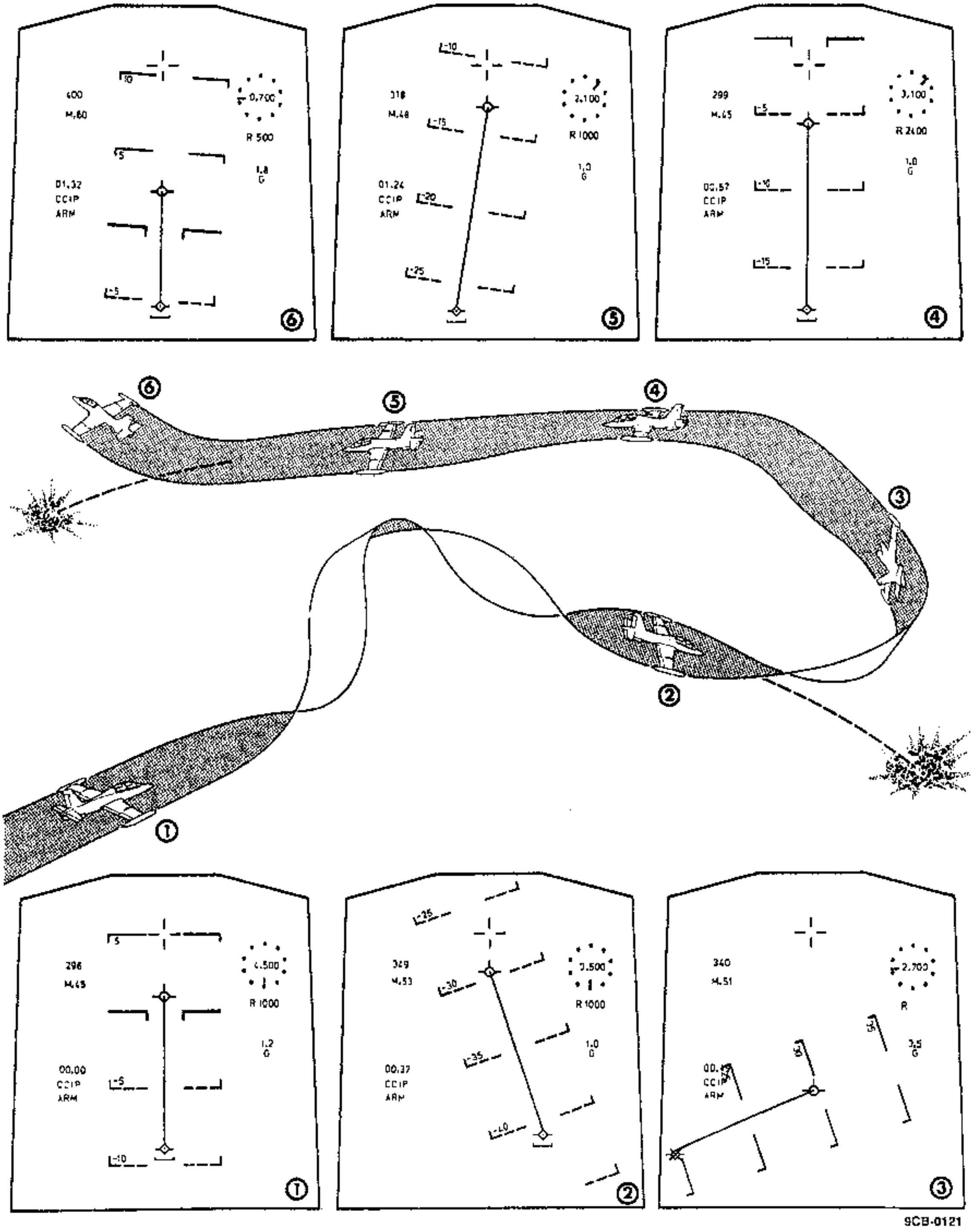

Figure 1-84 (Sheet 2)

USE OF HUDWAC

STRAFE MODE

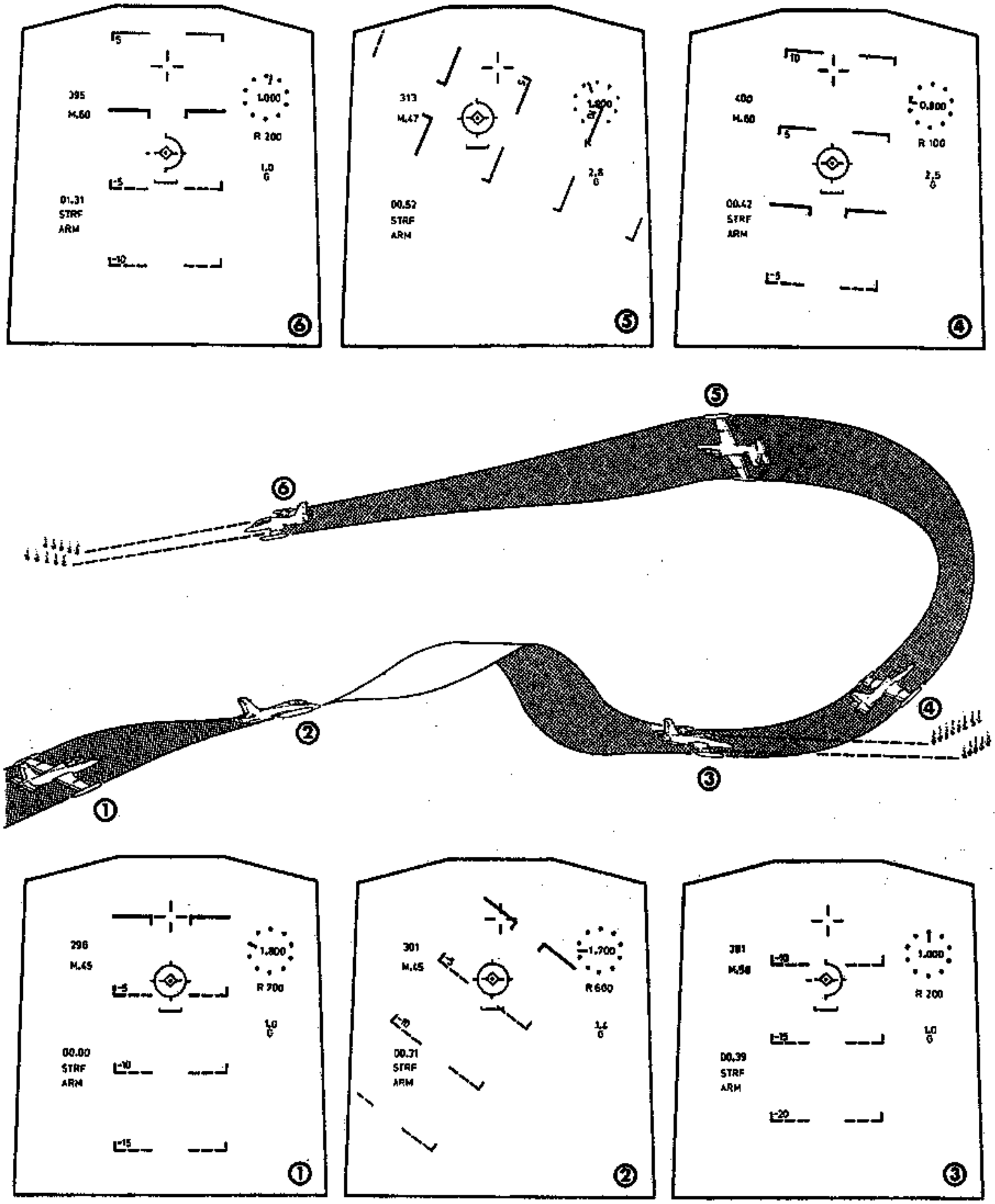

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Figure 1-84 (Sheet 3)

USE OF HUDWAC

LCOS MODE

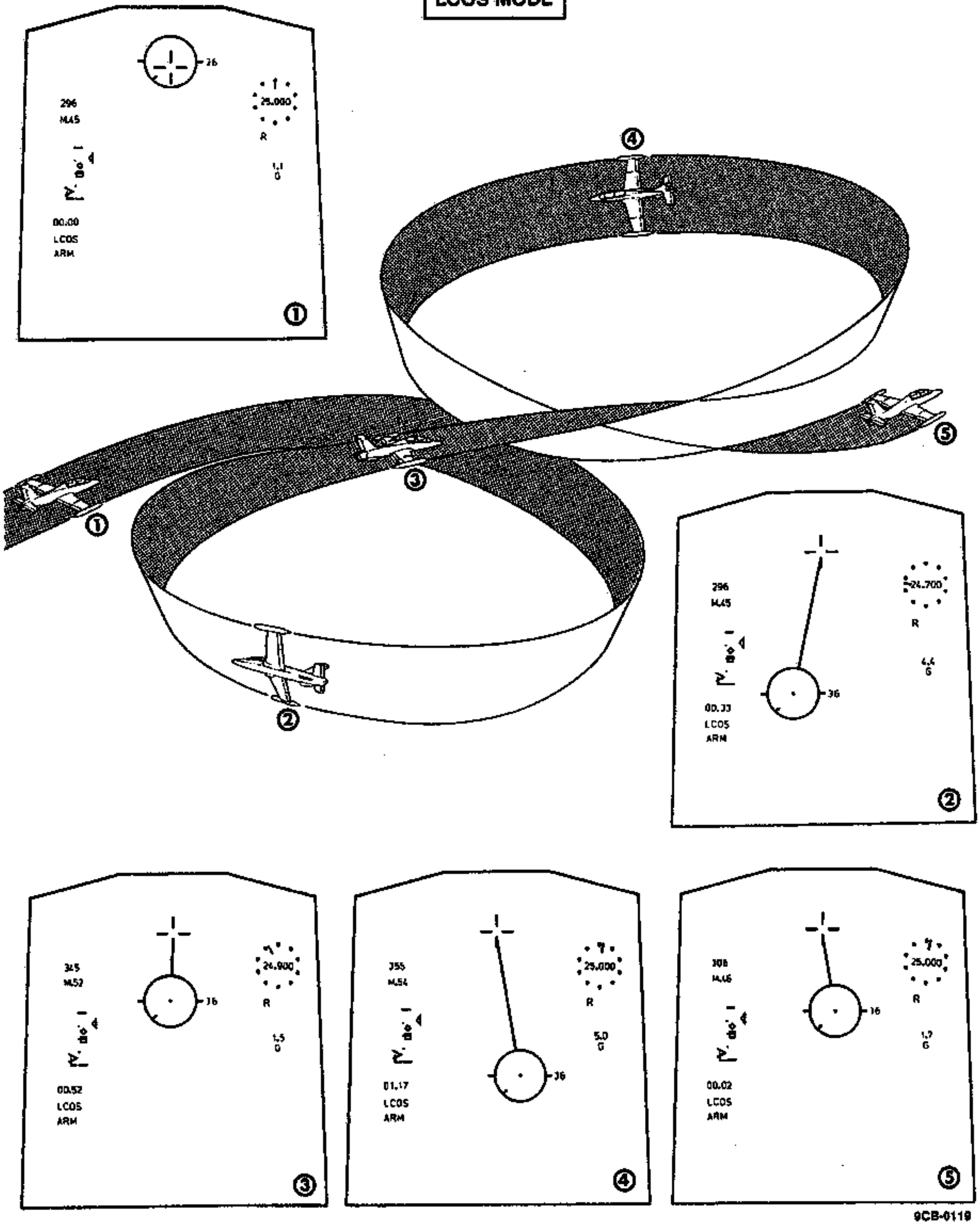
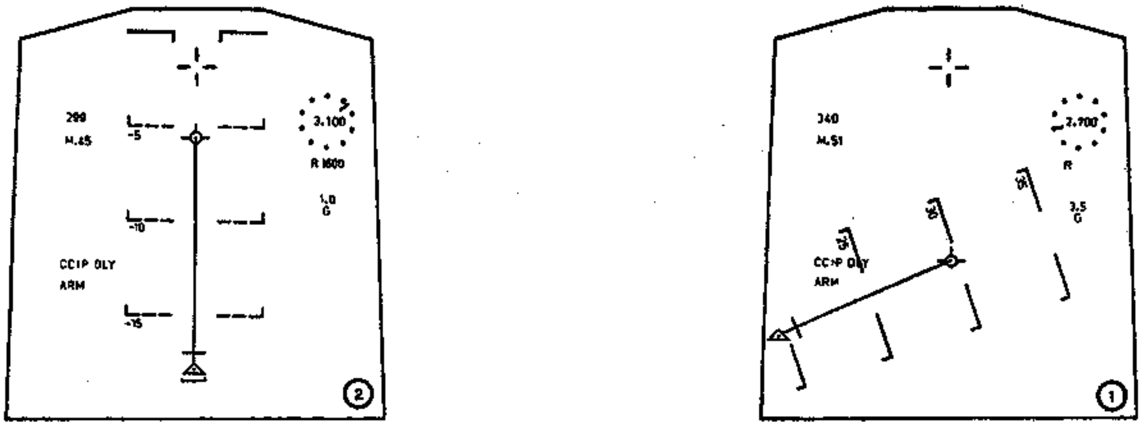
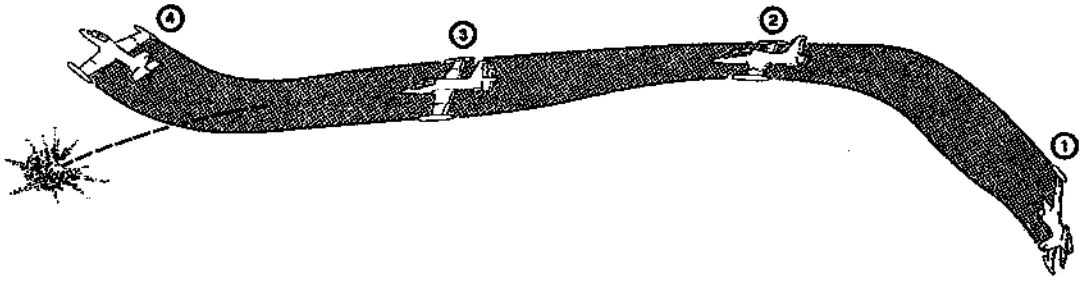


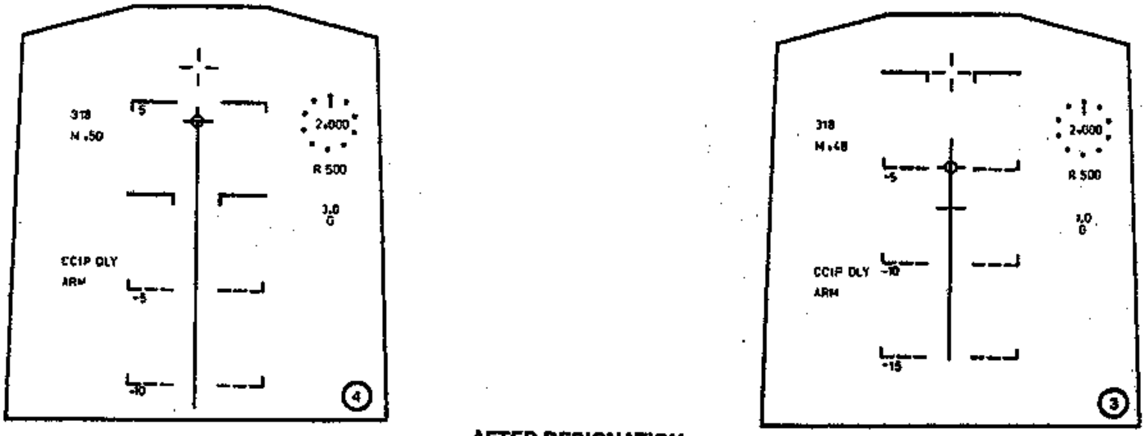
Figure 1-84 (Sheet 4)

CCIP DELAYED



BEFORE DESIGNATION





AFTER DESIGNATION

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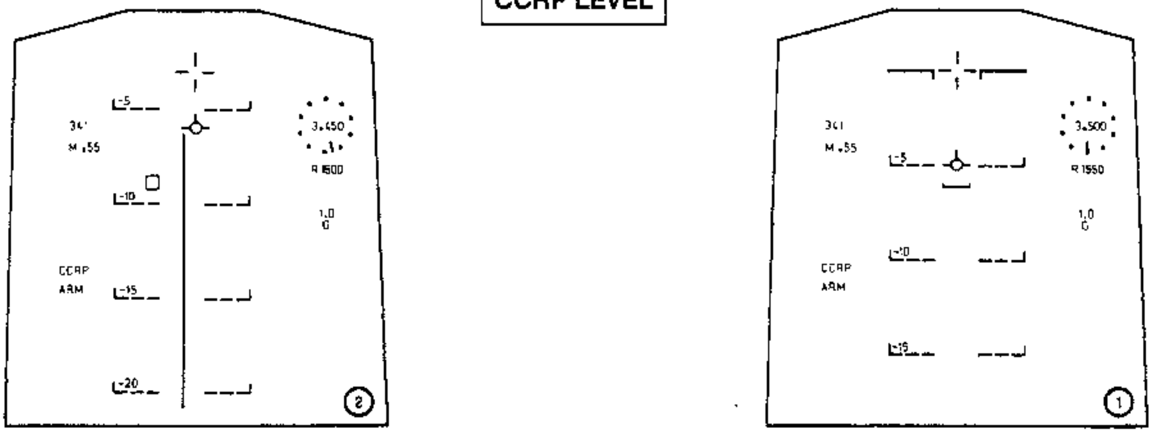
Figure 1-84 (Sheet 5)

USE OF HUDWAC

CCRP LEVEL



AFTER DESIGNATION

BEFORE DESIGNATION

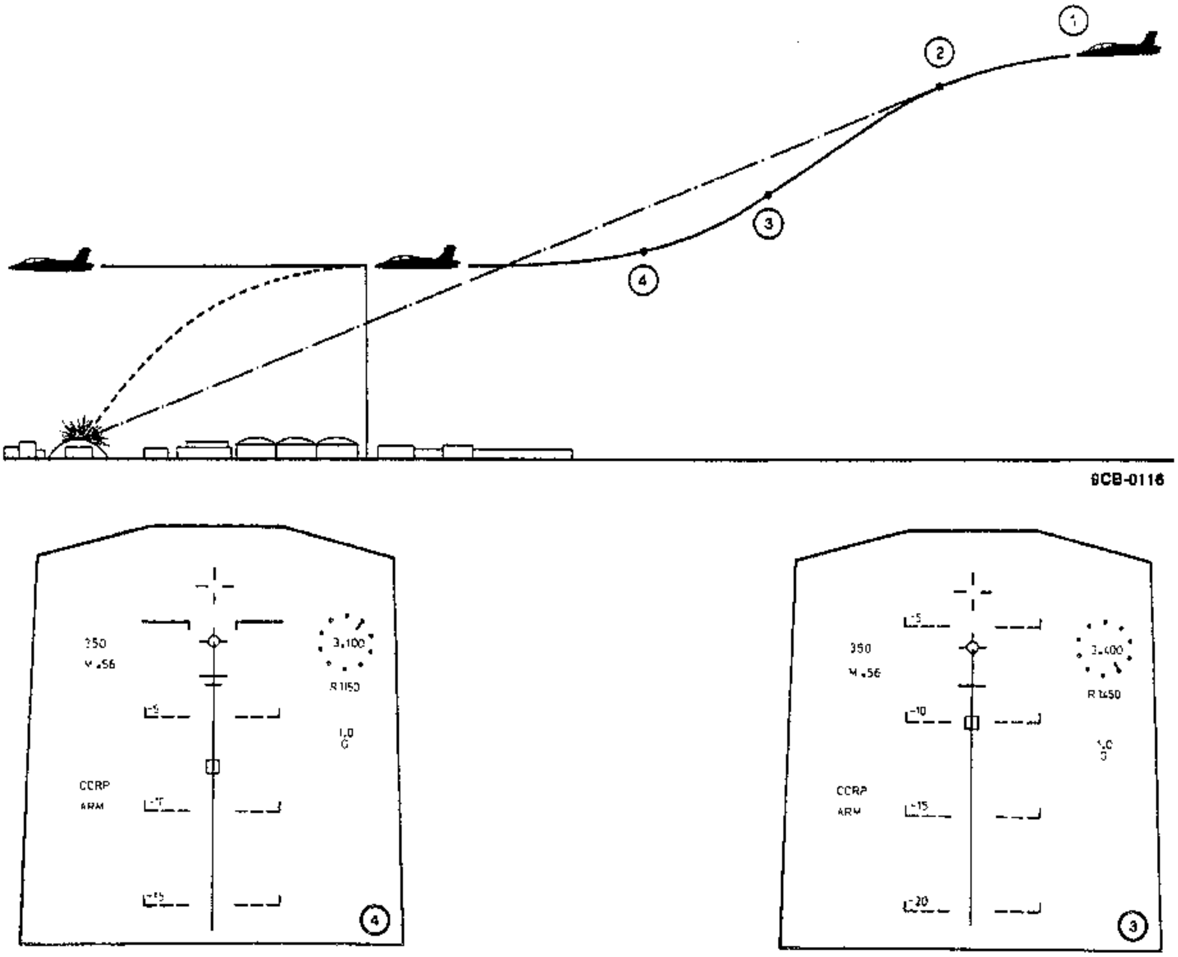


Figure 1-84 (Sheet 6)

USE OF HUDWAC

CCRP DIVE TOSS

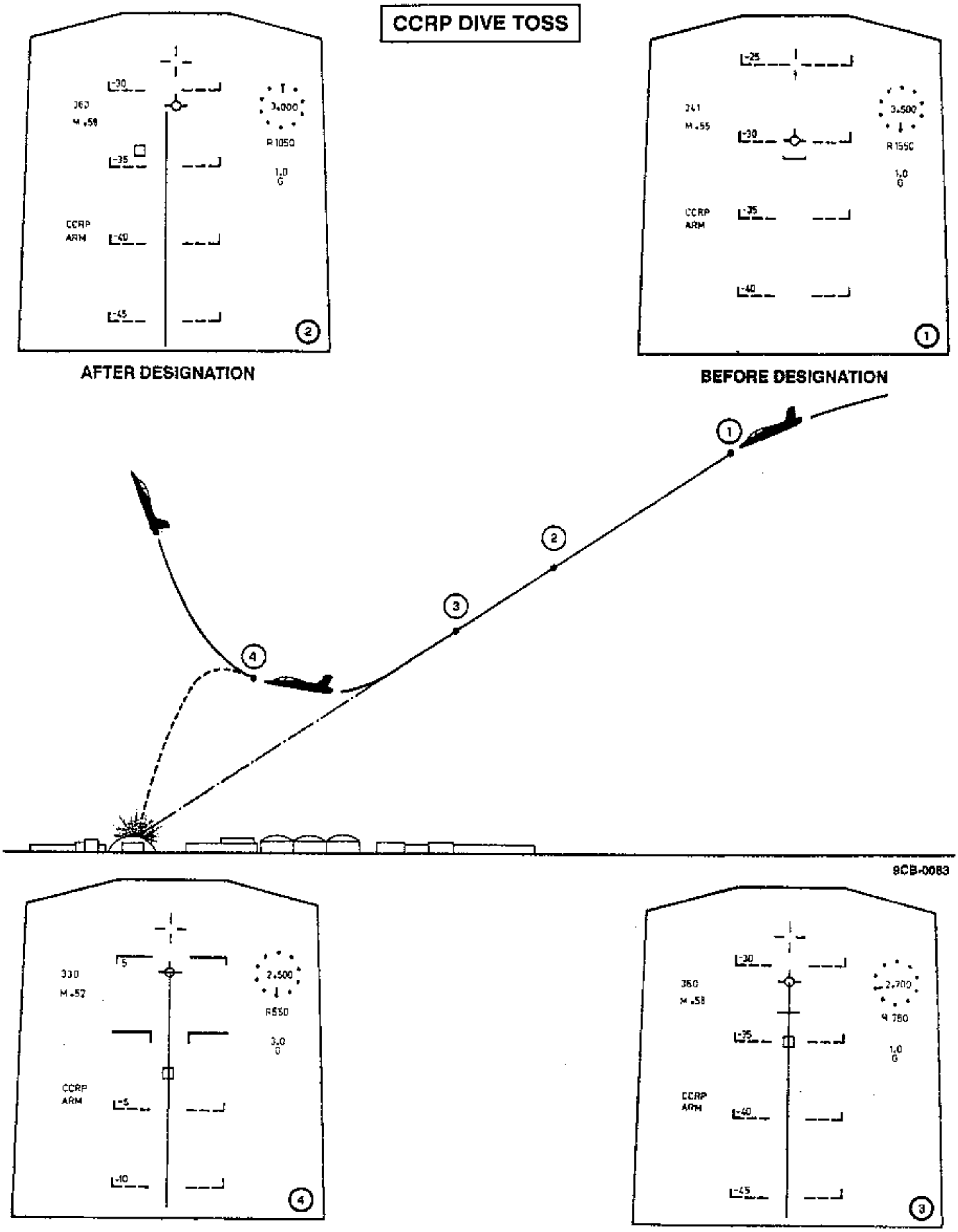
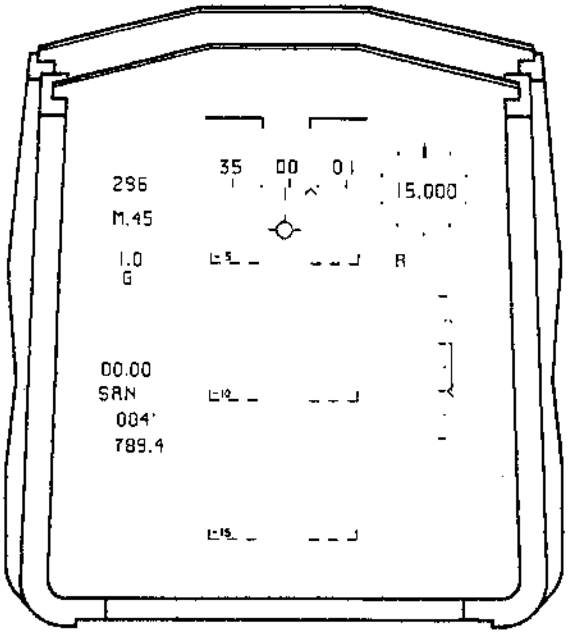


Figure 1-84 (Sheet 7)

USE OF HUDWAC

"INU NORMAL' NAVIGATION MODE



"AUX SELECTED" NAVIGATION MODE

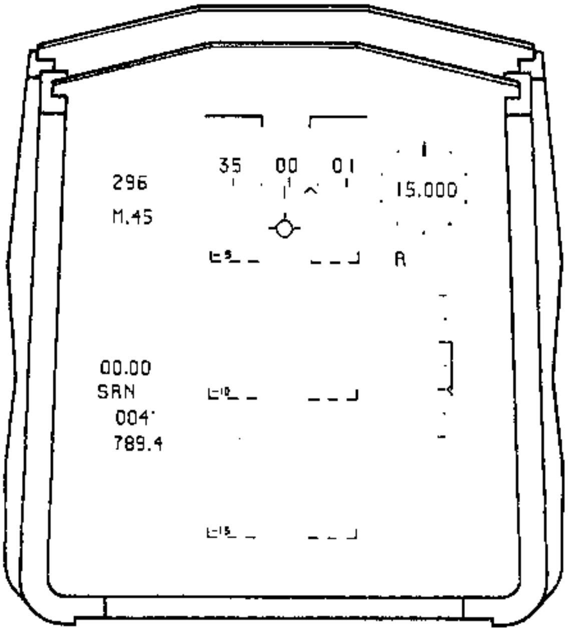


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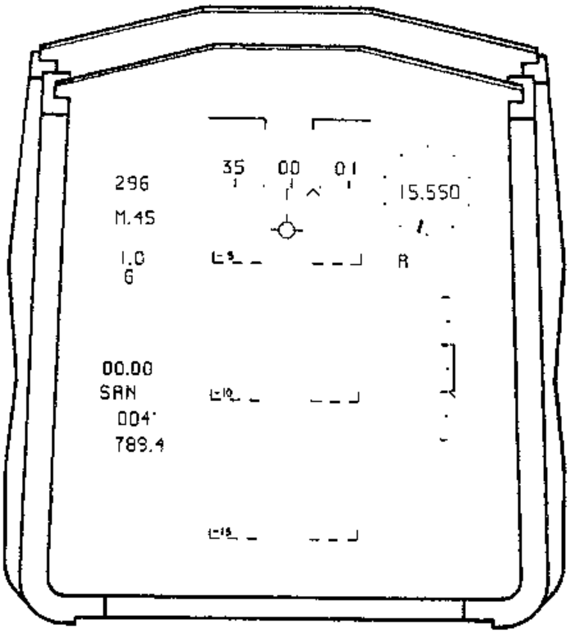
Figure 1-84 (Sheet 8)

USE OF HUDWAC

NAVIGATION MODE WITH 50 FT RESOLUTION IN BARO ALTITUDE INDICATION



NAVIGATION MODE WITH 10 FT RESOLUTION IN RADAR ALTITUDE INDICATION

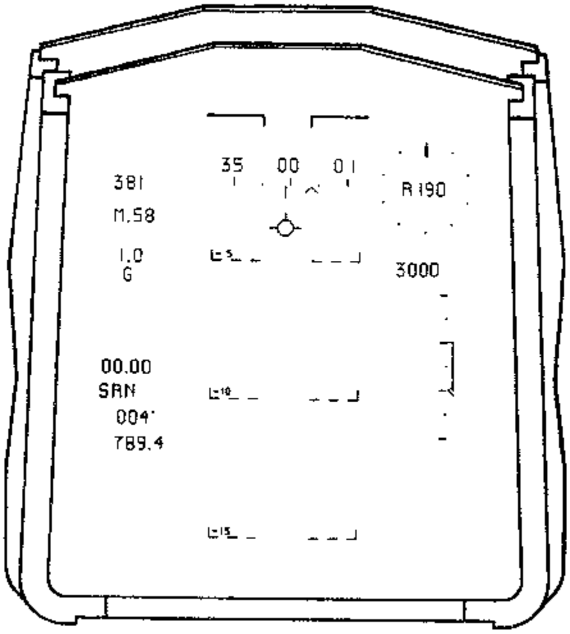


Figure 1-84 (Sheet 9)

HUDWAC Symbology Inventory

AIR-TO-AIR AIMING RETICLE

This is a moving stadiametric ranging symbol used in conjunction with the wingspan input. The target designator position control on the engine throttle determines the reticle diameter. The pilot adjusts the reticle size so that the wings of the target just fill the reticle. The range to target is determined as a function of the circle diameter and the wingspan. In the snapshoot mode, the guns are to be fired when the pilot judges that the aiming reticle coincides with the target, while in the LCOS mode, the pilot must first track the target inside the aiming reticle for 1 to 2 seconds at least.

ANNUNCIATOR

This is a fixed position alphanumeric display of two to four characters. The symbol is located in the lower left portion of the display. The available annunciators are:

RKT (Air-to-ground Rocket Mode)

CCIP (Air-to-ground Continuously Computed Impact Point Mode)

CCRP (Air-to-ground Continuously Computed Release Point Mode)

SS (Air-to-air Snapshoot Mode)

LCOS (Air-to-air Lead Computed Optical Sight Mode)

AAM (Air-to-air Missiles Mode)

DGFT (Air-to-air Dogfight Mode)

EO (Air-to-air Electro-optical Mode)

ASM (Anti-ship Missile Mode)

ANGLE OF ATTACK (AOA)

This is a tape scale symbol with a pointer moving along the fixed tape. The symbol is composed of alternating ticks and dots arranged vertically. The lowest mark represents 0.0 and the upper mark 1.0. A square index marker is located at 0.49 to indicate the best final approach AOA. A diamond is located at 0.66 to indicate the best final approach AOA when the aircraft is in flaps up configuration. A caret index marker, located at 0.79, indicates the stall AOA when the aircraft is in flaps down configuration.

BARO OR RADAR ALTITUDE

This is an alphanumeric string symbol with four places, decimal point, and a leading "R" (radar mode only), or five places and a decimal point (baro mode only). In both modes the alphanumeric string is surrounded by a circle consisting of ten dots. Each dot represents a 100 feet change in elevation. Either radar altitude or barometric altitude is displayed in the altitude gage depending upon the operator selection from the DEP keyboard. The radar altitude range is 0 to 5000 feet and the baro altitude range is 0 to 55 000 feet. A caret moves in a clockwise direction as the altitude increases, and counterclockwise as the altitude decreases.

BOMB FALL LINE (BFL)

This is a straight and vertical line symbol which moves from the CCIP marker. In the CCIP submode this line extends from the CCIP marker up to the flight path marker and is always normal to the horizon. It represent the locus of the CCIP points on a horizontal plane defined by the target altitude. In delayed CCIP, the pipper become a triangle, and a delay cue and a "DLY" warning legend come in view close to the CCIP mode annunciator. In delayed CCIP mode, after designation, the BFL becomes the azimuth steering line (ASL), as in the CCRP mode.

BREAKAWAY CROSS

This is a flashing open cross symbol positioned at the pilot's center of attention (pipper, aiming reticle or FPM). It indicates that a 4 g pullup must be initiated to avoid the weapon blast sphere or going below the minimum altitude.

CONTINUOUSLY COMPUTED IMPACT LINE (CCIL)

This is a moving symbol. The CCIL is a line computed by the computer symbol generator (CSG) showing the projected path of bullets in the snapshoot mode. Tick marks are displayed on this line indicating where the bullets would be if the pilot had been firing continuously.

CONTINUOSLY COMPUTED IMPACT POINT (CCIP) MARKER

This is a moving symbol indicating the impact point of the weapon. The CCIP marker shows the impact point of the selected weapon if it were to be released at that instant. The symbol is a small diamond (box at 45) with a 1 mrad cross at the center for the CCIP, STRF and RKT modes and a triangle with a 1 mrad cross at the center for the delayed CCIP mode. Its position is continuosly computed.

DELAY CUE

This is a moving symbol, moving only along the BFL. The delay cue is displayed in the delayed CCIP mode. Upon entering this mode the pipper is fixed at 14 degree depression. Simultaneously, the delay cue appears on the BFL. The position of the delay cue along the BFL depends on the store release delay. For maximum delay, the delay cue place to a position 40 mrad above the pipper. When the pipper is superimposed on the target, the pilot presses the weapon release switch. This action stabilizes the pipper symbol in azimuth and causes the delay cue to move up the BFL. The distance between the delay cue and pipper is an indication of the time remaining before the actual CCIP will be coincident with the target. When the delay cue reaches the pipper, it means that the CCIP and target coincide. At this time, the CSG commands weapon release provided the pilot has maintained release consent.

STICK RELEASE LENGTH MARKER

This is an X marker along the BFL. This symbol is displayed only when the SMS is set for a sequenced (or "stick") release of bombs. The X along the BFL represents the computed point of impact of the last bomb of the "stick".

EO WEAPON BORESIGHT

This is a fixed, open cross symbol. The cross center indicates the direction at which the EO weapon seeker is pointing. The pilot must maneuver the aircraft to bring the target within the FOV of the weapon. This symbol is displayed in the EO mode only.

FLIGHT DIRECTOR

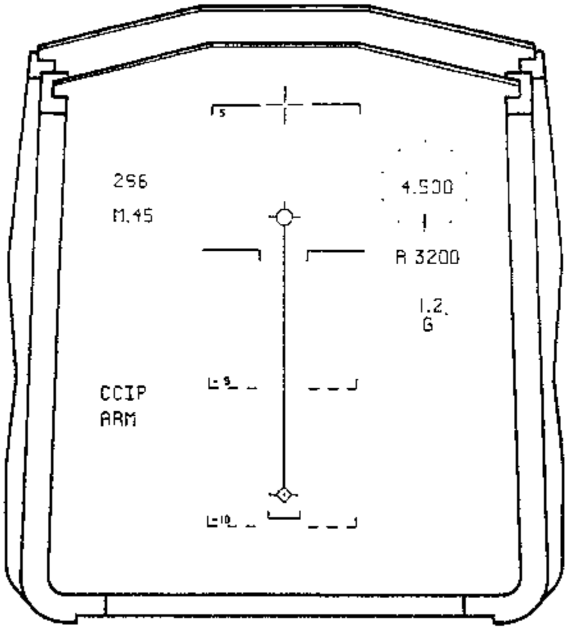
This is a moving symbol. A solid dot, simulated by parallel lines, is drawn in a position relative to the FPM indicating the desired aircraft flight path. The actual symbol position is determined from the flight director computer pitch and roll steering inputs. The aircraft is on course when the FPM and the flight director symbols are coincident.

FLIGHT PATH MARKER (FPM)

This is a moving symbol which moves along the longitudinal and lateral axes. This symbol represents the instantaneous flight path of the aircraft. Its position is derived from the IRU velocity inputs to the CSG. As viewed from the pilot's eye, it is the projection of the velocity vector of the aircraft. The caged FPM is displayed upon takeoff at 26 milliradians below Zero Sight Line (ZSL). In NAV mode, at speeds higer

USE OF HUDWAC

"INU NORMAL" CCIP MODE



"AUX SELECTED" CCIP MODE

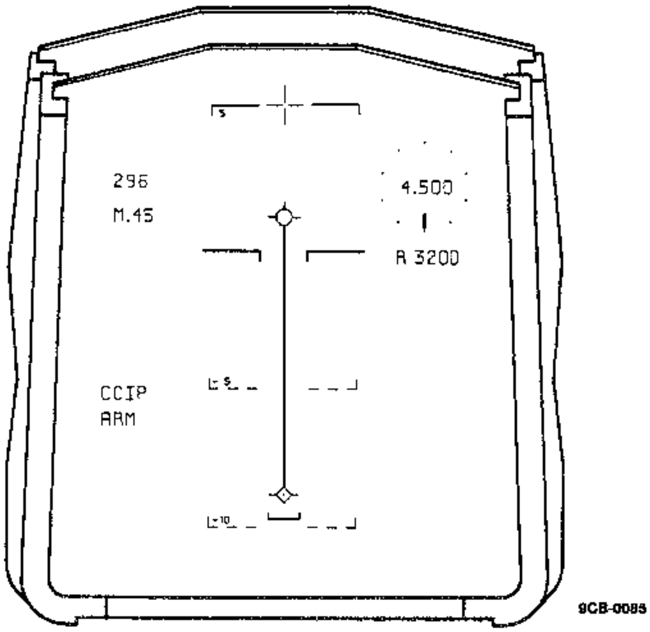
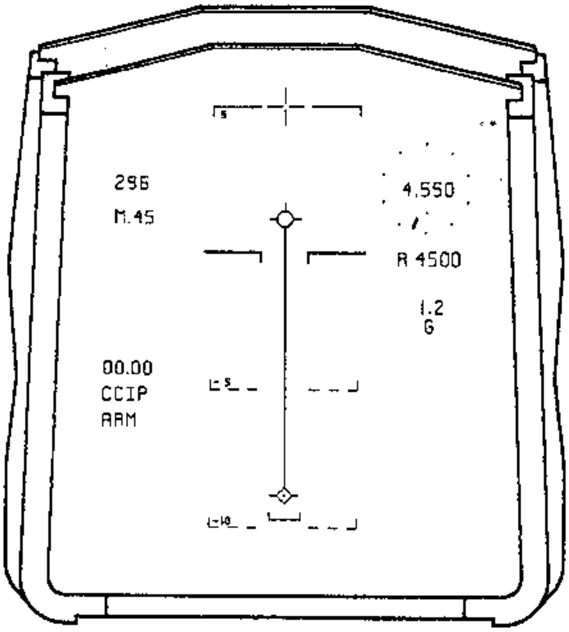


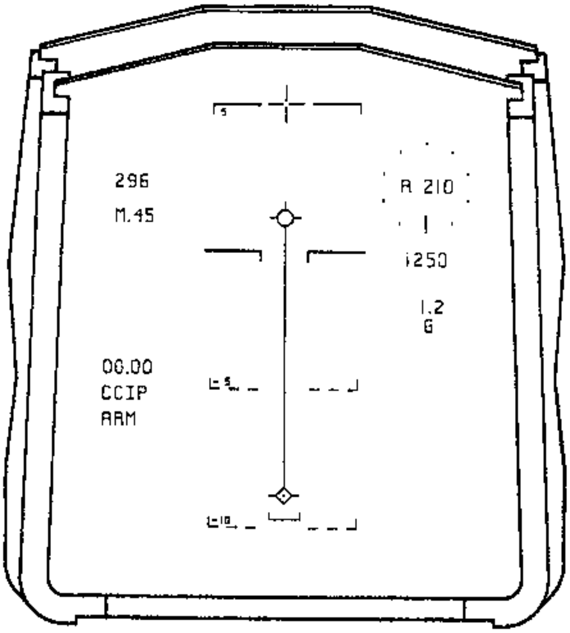
Figure 1-84 (Sheet 10)

USE OF HUDWAC

CCIP MODE WITH A 50 FT RESOLUTION IN BARO ALTITUDE INDICATION



CCIP MODE WITH A 10 FT RESOLUTION IN RADAR ALTITUDE INDICATION



9CB-0066

Figure 1-84 (Sheet 11)

than 50 knots, the FPM can move in elevation only. In the attack and APP mode, it can move both in azimuth and elevation.

INDICATED AIRSPEED

This symbol is a three-character alphanumeric string and shows the indicated airspeed in knots as derived from the differential pressure input. The digits are right justified with no leading zeros or blanks. The range of displayed values is 32 to 660 knots, rounded to the nearest knot. Symbol location is in a fixed position in all modes.

MACH NUMBER

This symbol is a numeric string with two places and one decimal point. It shows the current Mach number of the aircraft. Range displayed is .30 to .99. Digits are right justified with no leading zeros or blanks. An "M" is displayed followed by the decimal point and Mach number. The symbol is located at a fixed position.

MAGNETIC BEARING INDEX

This is a moving pointer symbol, fixed relative to the magnetic heading tape. A caret is located directly beneath the magnetic heading tape. It is a pointer, fixed to the heading tape, and is used to indicate the magnetic bearing to the steerpoint. There are four possible directions the symbol can point to:

- An upward pointing caret indicates that the SPT bearing is within 10 degrees of the actual heading.
- A caret at the extreme right of the heading tape and pointing to the right indicates that the SPT bearing is more than 10 degrees to the right of the actual heading.
- A caret at the extreme left of the heading tape and pointing to the left indicates that the STP bearing is more than 10 degrees to the left of the actual heading.
- A caret pointing downward indicates to the pilot that the SPT bearing is 180 ± 10 degrees off the actual heading. If the caret is centered on the tape, the SPT bearing is exactly 180 degrees off the actual heading.

MAGNETIC HEADING

This symbol is a moving tape of fixed length centered on a fixed pointer. The symbol displays the current aircraft magnetic heading. The scale is symmetrical, and displays 15 degrees on either side of the PDU centerline. Tick marks extend along the tape at five degree-increments and are labelled every ten degrees. The label consists of two digits representing tens of degrees of azimuth. Leading zeros are displayed when necessary.

MISSILE BORESIGHT/LOCK-ON ENVELOPE

This is a static symbol consisting of a point enclosed by a diamond. These symbols are displayed together: the point indicates the missile boresight and the envelope (diamond) indicates the "lock-on" FOV for the missile. The pilot must maneuver the aircraft to bring the target within the FOV of the missile.

NORMAL ACCELERATION

This symbol is a numeric string with two digits separated by a decimal point. The symbol shows the normal acceleration of the aircraft as derived from the IRU input to the CSG. The range displayed is - 9.9 to + 9.9 g, 1.0 g being an aircraft in level flight. Digits are right justified. For values less than one, a leading zero are displayed. Values less than zero are preceded by a negative sign. A G is written beneath the numeric string. This symbol tracks the aiming reticle in elevation in A/A mode.

PITCH SCALE (ATTITUDE)

This symbol consists of moving (pitching and rolling) reference lines which are fixed in earth coordinates. This symbol, commonly referred to as the pitch ladder, displays the aircraft angular pitch and roll relative to the horizon. Reference pitch lines (ladder rungs) are fixed in earth coordinates with the FPM indicating the aircraft direction and roll attitude with respect to the horizon. Ladder rungs are spaced at 5-degree increments in elevation. The range of displayed values is a full 360 degrees in roll and + 180 to - 180 degrees in pitch with the positive pitch up. Negative pitch lines are dashed and positive lines solid. A maximum of four rungs are displayed. The ladder rolls about the fuselage reference line (FRL).

PULLUP ANTICIPATION CUE

This is a moving symbol which tracks the pipper. It is a horizontal bar with upturned ticks on both ends. It is used to indicate how much time remains on a bombing run before the pilot must initiate a 4 g pullup to avoid the terrain. It moves from beneath the pipper and its distance from the bottom of the pipper diamond is the time remaining before pullup. A nominal pilot's reaction time and the dive rate are used to determine the time to pullup. The symbol disappears and is replaced with a flashing breakaway cross when time to pullup is zero. A safety height of 100 feet is factored into this term. Below 100 feet, the breakaway cross is shown as a function of MDA. If MDA is different from 0 ft, the breakaway cross is constantly shown. If MDA is 0 ft, and the aircraft is flying level at an altitude lower than 100 ft, the breakaway cross is not shown.

RANGE INDICATOR

This symbol, centered about the pipper, is a moving circular segment which changes in arc length and position. The symbol indicates the distance from a ground target and the best time to shoot. The circle continues to "unwind" until the breakaway cross appears flashing around the symbol. This table is a key to read the range indicator circle position with respect to the type of weapon.

MODE	**SLANT RANGE**		
	3 o'clock	**6 o'clock**	**9 o'clock**
12.7 mm gun A/G	1750 ft	2350 ft	2950 ft
12.7 mm gun A/A	500 ft	1000 ft	1500 ft
70 mm CRV-7 rokets	2500 ft	5000 ft	7500 ft

STEERPOINT AND DISTANCE TO STEERPOINT

These are fixed position symbols consisting of three lines of characters; the first is alphanumeric, the second and the third are numeric. The first line of this symbol is an alphanumeric identification code of the current selected steerpoint.The second line indicates a magnetic bearing in the RNAV mode and a radial in the TACAN and VOR modes. The third line is the distance in nautical miles to the steerpoint/beacon: is horizontal range in RNAV mode and slant range in TACAN and VOR modes.

SOLUTION CUE

This is a moving symbol moving only along the azimuth steering line (ASL). When a 3 g pullup to a 30 degree climb (loft delivery) achieves a valid weapon delivery solution, the solution cue is displayed on the ASL. The cue will first appear 25 milliradians below the FPM. Its distance from the FPM midpoint is proportional to the time remaining prior to weapon release. In addition to the solution cue, a level release cue appears on the ASL to indicate an alternate delivery mode for level release (automatic).

AZIMUTH STEERING LINE (ASL)

This is a moving symbol. It appears after the target has been designated. It is a vertical line extending 200 milliradians down from a point horizontal to the lower edge of the FPM. Its azimuth location is midway between the FPM and the target designator symbols. Its intended use is to indicate the desired azimuth steering direction. The pilot must steer the FPM to the ASL.

TARGET DESIGNATOR

This is a moving symbol which indicates and maintains the target position by overlaying it. The symbol is displayed as a small square. The pilot must press the target designator push-button on the control stick grip when the zero sight line is superimposed on the target. The designator then remains positioned on the target until the target remains in the FOV of the PDU. The WAC processes the target position referred to the aircraft also when the target designator is out of view but, in this case, the target designator symbol will be removed. The pilot can perform the fine adjustment of the target designator over the target. The pilot can reposition (adjust) the target designator over the target by using the target designator position control on the engine throttle.

TRACK LINE

This is a moving symbol. The track line extends from the zero sight line (ZSL) toward the center of the air-to-air aiming reticle. It terminates at the edge of the air-to-air aiming reticle circle.

VERTICAL VELOCITY

This is a tape scale with the pointer moving along a fixed tape. The tape scale is composed of alternating ticks and dots, the distance between each mark representing 500 feet per minute. The range is from +1000 fpm to -2000 fpm. If the vertical velocity is out of the tape range, the moving pointer (caret-shaped) rotates upward or downward.

WING SPAN

This is a numeric string symbol with two digits. The symbol shows the wing span of the target aircraft in feet. The digits are right justified with no leading zeros or blanks. The range of values, input via the DEP, is 30 to 90 feet in increments of 1 foot. The symbol is shown near the aiming reticle.

ZERO SIGHT LINE (ZSL)

This is a fixed position symbol. The symbol indicates the gun and laser boresight. It is an open cross consisting of four line segments. When the laser is selected and is ready, the symbol is rotated 45°. The center of the symbol is at 1.5° above the FRL or 139.5 milliradians above the center of the FOV.

SLANT RANGE (LASER)

This is a fixed alphanumeric string of up to six characters. The symbol is a readout, in feet, of the slant range to the target as determined by the laser range finder (if installed). It consists of an "L" followed by as many as five right justified digits. The "L" is positioned 5 mrad to the right of the ZSL symbol. The slant range is displayed for 5 seconds following a successful laser. If the laser is not successful, "LXXXXX" is displayed for 5 seconds.

MAGNETIC BEARING STROBE

This is a moving pointer symbol fixed to the tadpole and rotated by the magnetic bearing to the steerpoint. The symbol is composed by a solid dot with a radial pointer (tadpole) extending in a direction which indicates the desired heading or the magnetic bearing to the steerpoint. The pointer or the strobe rotation relative to 12 o'clock represents the relative bearing to the selected steerpoint over a range of 0° to 360°.

STOPWATCH

This is a fixed position numeric string of four digits, indicating the elapsed time. This numeric symbol is controlled by the stopwatch key on the DEP. It consists of two pairs of digits separated by a colon. The leading pair indicates the minutes and the trailing pair the seconds.

INITIALIZATION ALTITUDE

This symbol is an alphanumeric symbol displayed on the PDU, below the altitude symbol. The symbol consists of the "IA" characters, followed by four digits indicating the initialization altitude (IA) in feet, entered via the DEP. This symbol is displayed concurrently with the altitude update symbol. The possible indications are the following:

"IA 1234"	A good baro fix was obtained
"IA ----"	IA was not entered and a good baro fix was obtained. (The pilot can now enter IA).
"~~IA~~ 1234"	An X appears superimposed on IA. A good fix was not obtained.
"~~IA~~ ----"	An X appears superimposed on IA and dashes are shown in lieu of numerals. IA was not entered and a good fix was not obtained.

TARGET ALTITUDE

The target altitude is displayed on the DEP scratchpad only. The symbol consists of the "TA" characters followed by five digits indicating the target altitude (elevation above mean sea level) entered via the DEP.

AIRCRAFT ARMED AND READY FOR WEAPON DELIVERY (ARM)

This is a fixed alphabetic string symbol. The symbol consists of the characters "ARM" displayed as a warning signal below the mode annunciator in attack mode and at the right of the FPM in NAV mode.

SAFE ADVISORY

This is a fixed alphabetic string symbol and consists of the "SAFE" characters displayed to advise the pilot to move the safety armament delivery switch to the ARM position in the attack phase.

STORES MANAGEMENT SYSTEM FAIL

This is a fixed alphabetic string symbol and consists of the "SMS FAIL" characters displayed as a warning signal on the right of the mode annunciator. The "SMS FAIL" symbol is displayed when the stores management system is unserviceable.

ATTACK ANNUNCIATOR

This is a fixed alphabetic string symbol, and consists of the "ATTK" characters displayed as an advisory signal on the right of the FPM. The symbol is displayed in attack no-modes when the attack mode is selected but no weapon has been selected on the weapon control panel.

SUPPORT EQUIPMENT

VIDEO SYSTEM

The video system provides for monitoring and recording of pilot's and aircraft performance during both air-to-air and air-to-ground training or combat missions, and allows immediate post-flight analysis and of the videotaped record. The video system consists of a Fairchild Weston monochromatic TV camera, a Ferranti FD6802 Sealed Video Recorder, an "AVTR" control panel and a "TV CAMERA" control panel. The TV camera is installed on a mount located above the front instrument panel, in front of the PDU combiner glass. It simultaneously records on videotape, through the PDU combiner glass, both the images of the real world scene forward of the aircraft as seen by the pilot, and the HUD symbology. At the same time, these images can be transmitted to the rear MFD to provide the rear pilot with a real-time presentation of visual data, for monitoring during training missions. The SVR is installed on shock-isolator mounts in the left console of the rear cockpit. It records video, audio, and event marker signals on an 8 mm format cassette at a frame rate of 30 Hz. The recording function of the SVR is remotely controlled by the "AVTR" control panel, which also allows switching from the recording of the TV camera-taken images to the recording of images displayed by the MFD, including EO weapon display. The video system controls and indicators are described and illustrated in figure 1-85.

OPERATION OF VIDEO SYSTEM

1. If the images filmed by the TV camera are to be recorded, set the "HUD/MFD" switch on the "AVTR" control panel to HUD. If the images shown on the MFD are to be recorded, set the "HUD/MFD" switch to MFD.
2. Set the "ON/OF" switch on the AVTR control panel to ON.

NOTE

> Illumination of the "RCDR" advisory light (amber), indicates that the AVTR, though receiving the "recording on" command, is not operating correctly, or the tape is finished (tape recording time is 90 minutes).

The rear pilot can operatethe TV camera by moving the "TV CAMERA" switch to ON. The images are shown on the MFD in the rear cockpit even if the "ON/OFF" switch on the "AVTR" control panel is at off (the images filmed by the TV camera are not recorded).

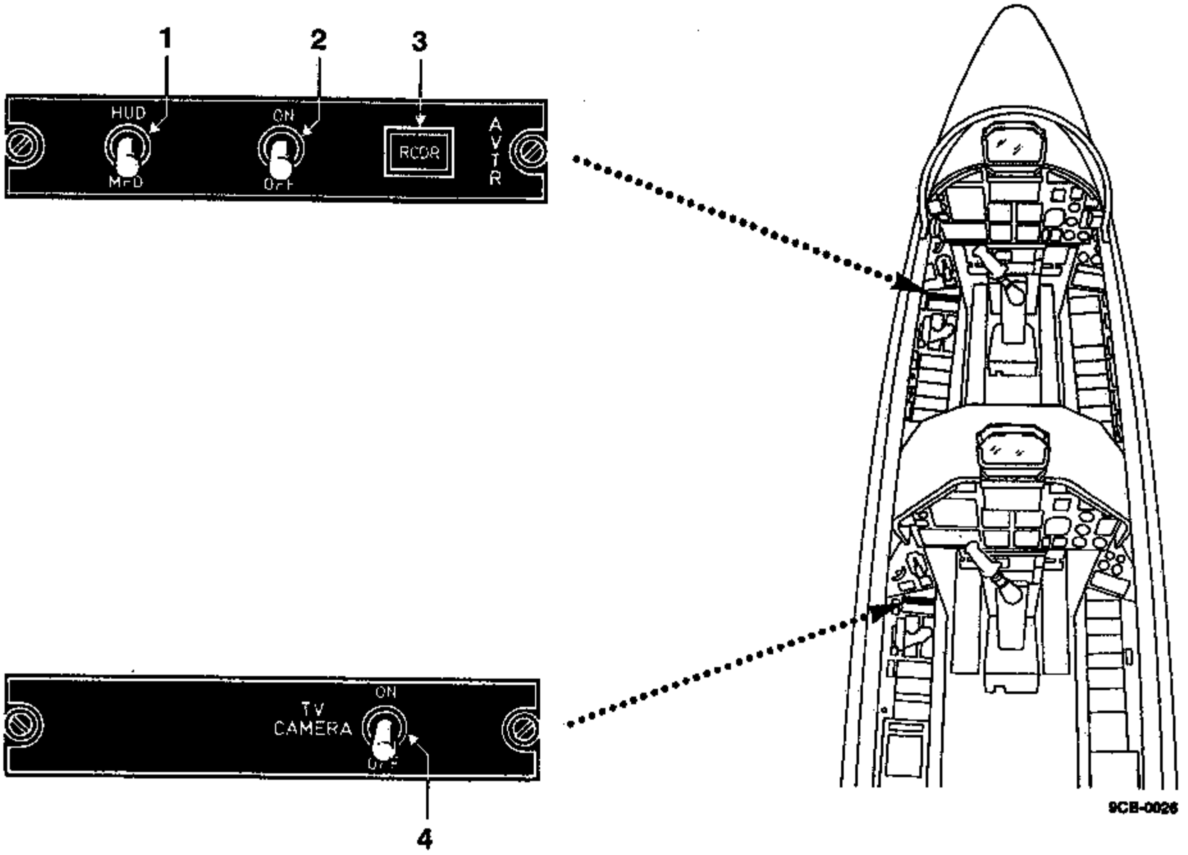
MISCELLANEOUS EQUIPMENT

CONTROLS FOR GROUND CREW

The controls located in the cockpit and to be used by the ground crew for the performance of system tests, consist of four guarded switches grouped on the ground services control panel (figure 1-4) and of the "GROUND FIRE" guarded switch located on the left console of the front cockpit (figure 1-4). The functions of these controls are as follows:

- "BATT GND SERV" switch. Lifting the guard and moving the toggle to ON, energizes the battery bus and the airborne video tape recorder system when the aircraft weight is on the wheels, and the "BATT" switch is at OFF.
- "IGN" switch - Lifting the guard and moving the toggle to OFF enables the performance of an engine motoring cycle; viz. a complete starting cycle without ignition of the engine.
- "FUEL DUMP" switch - Lifting the guard and moving the toggle to ON operates the booster pump with no need for actuation of the "ENGINE MASTER" switch.
- "LG SW ORIDE" switch - Lifting the guard and moving the toggle to 1 permits the inflation of the canopy seal for the pressurization tests with the aircraft weight on the wheels. The switch actuated by the extension of the landing gear left leg is thus overridden. When the toggle is moved to the momentary position 2 (if released, it springs back to position 1), overriding of the landing gear left leg switch permits the operation of other circuits, thus simulating the condition opposite to that of aircraft resting on wheels or raised on jacks

VIDEO SYSTEM CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. "HUD/MFD" switch	HUD - The Sealed Video Recorder (SVR) records the video signals supplied by the TV camera. MFD - The SVR records the video signals supplied by the MFD.
2. "ON/OFF" switch	ON - Supplies the TV camera and the SVR with electrical power, and operates the SVR to record video and audio signals. OFF - De-energized position.
3. "RCDR" light	On - The SVR is not operating correctly or the available video tape is finished.

Figure 1-85 (Sheet 1 of 2)

VIDEO SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
4. "TV CAMERA" switch	ON - Supplies electrical power to the TV camera (if not previously powered by the "ON/OFF" switch) and displays the images taken by the TV camera on the rear MFD. OFF - De-energized position.

Figure 1-85 (Sheet 2)

- "GROUND FIRE" switch - Lifting the guard and momentarily moving the toggle to ON, overrides the safety switch in the landing gear control lever through a relay which remains self-energized; this permits firing tests to be performed with the landing gear lever in the DWN position. Upon completion of the tests, when the master armament switch is opened, the relay drops out and the function of the landing gear safety switch is restored. The controls for store selection are grouped on the weapon inventory panel (WIP), located in the electrical bay. The WIP is used by the armorer and by the ground crew to enter the store selection; it also incorporates the interface with the gun electronic unit to drive the guns and count the fired ammunition rounds. The functions of the controls located on the WIP are as follows:

  a. Alphanumeric liquid crystal display. A LCD consisting of 16 alphanumeric characters provides the armorer with the following information:

     - number of the selected station ("ST" field of the display)
     - code of stores envisaged for installation ("CODE" field of the display). See figure 1-79.
     - type of installed store ("DESCRIPTION" field of the display)
     - quantity per station ("QTY" field of the display)
     - possible entry errors
     - information about failed units.

  b. "ST" push-button. Permits display of code, description and quantity information related to each station. Shifting from one station to the subsequent one is obtained by pressing the push-button again.

  c. "10N" and "N" push-buttons. Permit entering a new code for an already installed store or a store to be installed under the selected station. Whenever the "N" push-button is depressed, an increase of 1 unit is obtained; whenever the "10N" push-button is pressed, the obtained increase is 10 units. If the push-buttons are held pressed, a variation of 3 units or 3 tens is obtained every second.

  d. "QTY" push-button. Permits entering the quantity of ammunition of the weapon already installed or to be installed under the selected station.

  e. "STORE/CHANGE" switch. A two position toggle switch permits access to the information available in the WIP memory.

     STORE - The information previously entered through the "10N", "N" and "QTY" push-buttons is stored; these push-buttons are disabled when the switch is in this position.

     CHANGE - The WIP is enabled to accept the entry information and to permit trouble-shooting. The "10N", "N" and "QTY" push-buttons are enabled to enter new data.

  f. "BITE" switch and indicator light. When the "BITE" switch is in the BITE position, the interruptive BITE routine is started. The "BITE" indicator light illuminates with red light from the beginning of the test; it extinguishes upon cycle completion.

g. "SIMULATE/NORM" switch. A two position toggle switch is provided to permit store presence to be simulated during training missions, with the exception of missiles.

SIMULATE - Simulates the presence of stores.

NORM - Returns the SMS to its normal status (not simulated stores).

BLIND FLYING HOOD

On aircraft incorporating the required provision, a blind flying hood can be installed in the rear cockpit (figure 1-86). The hood mainly consists of two canvas panels suitably stiffened, which are joined on top by a velcro strip. When the hood is deployed, exterior vision is precluded. The two canvas panels can be unfastened by the pilot and slid down on the two sides along the bows located at the two hood ends of the concerned canopy portion, and then secured to the special hook at the canopy base, exterior vision is thus restored.

REAR VIEW MIRRORS

Three adjustablerear view mirrors are mounted on the forward and aft edges of the canopy frame.

MAP CASES

The map cases are located on the right side of both cockpits, below the instrument panels, at the side panels.

HOLDERS

Holders for the HSI compass card and stand-by compass (front cockpit only), reading correction tables and the climb schedule table are provided on the right canopy frame in each cockpit. The holders for the UHF pre-selected radio frequencies are located on the left canopy frame.

EMERGENCY LOCATOR TRANSMITTER SYSTEM

The emergency locator transmitter (ELT) system delivers a radio signal which permits a crashed aircraft to be located through the DF system. The ELT system includes a control panel, an emergency locator transmitter, an emergency locator transmitter box and an antenna. The ELT is supplied from an independent battery unit. The transmitter starts operating automatically in case of a crash, and transmits a standard sweeptone on the 121.5 and 243.0 MHz guard frequencies. Activation of the ELT, caused by a g-switch contained in the ELT, is independent of the position of the "ON TEST/AUTO" switch on the control panel, and of the switch on the ELT. The transmitter cannot be disabled through the "ON TEST/AUTO" switch; it can only be switched off after it has been activated. The system controls and indicators are illustrated in figure 1-87.

BLIND FLYING HOOD

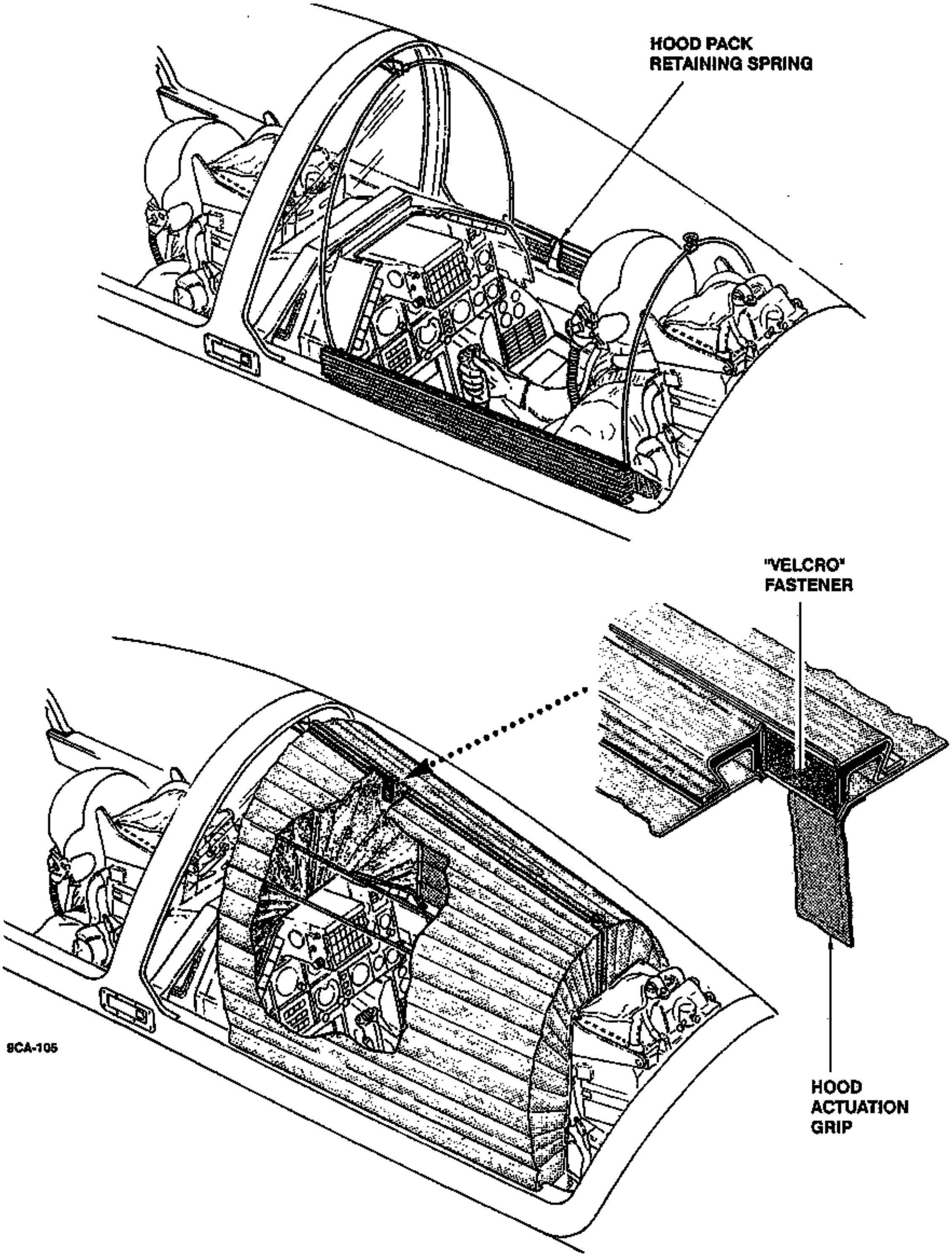
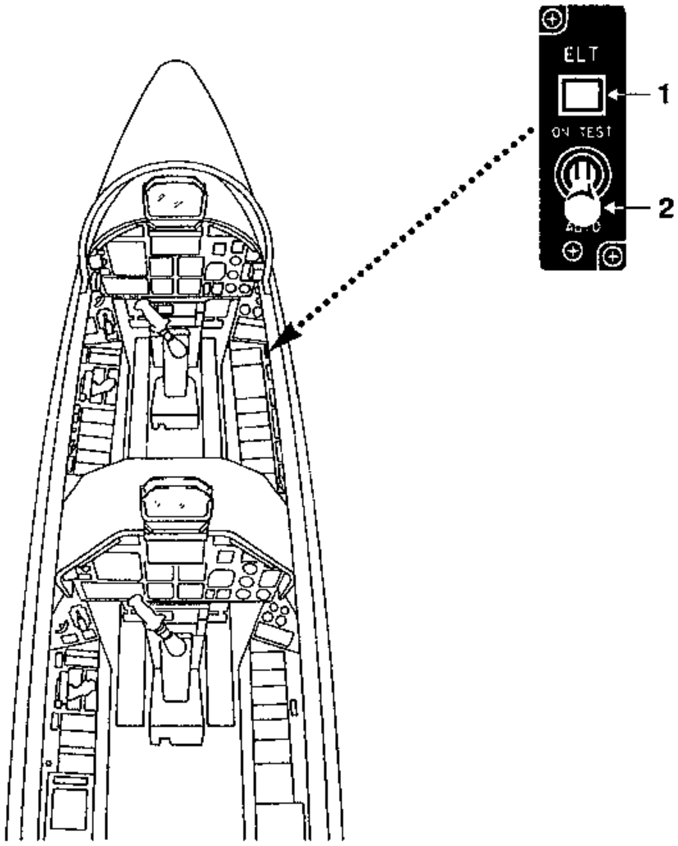


Figure 1-86

ELT SYSTEM CONTROLS AND INDICATORS



NOMENCLATURE	FUNCTION
1. "ELT" advisory light	Illuminated - Indicates that the ELT system has been activated, either manually or automatically. **CAUTION** Failure of the light to illuminate during first 3 seconds of test indicates possible g-switch failure. **NOTE** Serviceability of the ELT advisory light can be tested through "WARN LT TEST" push-button. The light brightness is not adjustable.

Figure 1-87 (Sheet 1 of 2)

ELT SYSTEM CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
2. "Lever lock" switch	AUTO - The ELT system is set to operate automatically. ON TEST - The ELT system is operated manually, and delivers the RF signal. The signal transmission is permitted in the first 5 minutes of every hour; if the test is carried out at a different time, the local air traffic control must be advised. - The transmitter can be reset if it is accidentally activated. To reset the transmitter, the switch must be held in the in the "ON TEST" position for 1 second, then returned to AUTO (the "ELT" light must extinguish). Reset operations are not to be accomplished in fast sequence; intervals of 5 seconds must be observed between two subsequent reset operations. **NOTE** To shift from AUTO to ON TEST, the switch toggle must be first pulled, then moved to the new position.

Figure 1-87 (Sheet 2)

SERVICING DIAGRAM

<table>
<tr><th colspan="4">FUEL
FILLING PRESSURE: 2 ÷ 3,5 bar (30 ÷ 50 psi)</th></tr>
<tr><th>USE</th><th>NATO Code</th><th>British Specification</th><th>USA Specification</th></tr>
<tr><td>Primary</td><td>F-34</td><td>DERD 2453</td><td>ASTMD, JET A-1 plus F.S.I.I. or MIL-T-83133A, JP8</td></tr>
<tr><td rowspan="3">Alternate</td><td>F-40</td><td>DERD 2454</td><td>MIL-J-5624L, JP4</td></tr>
<tr><td>F-35</td><td>DERD 2494</td><td>ASTMD, JET A-1</td></tr>
<tr><td>-</td><td>DERD 2486</td><td>ASTMD, JET B</td></tr>
<tr><td>Emergency (1)</td><td>F-18</td><td>DERD 2485</td><td>-</td></tr>
<tr><td colspan="4">(1) See limitations in the Engine Maintenance Manual</td></tr>
</table>

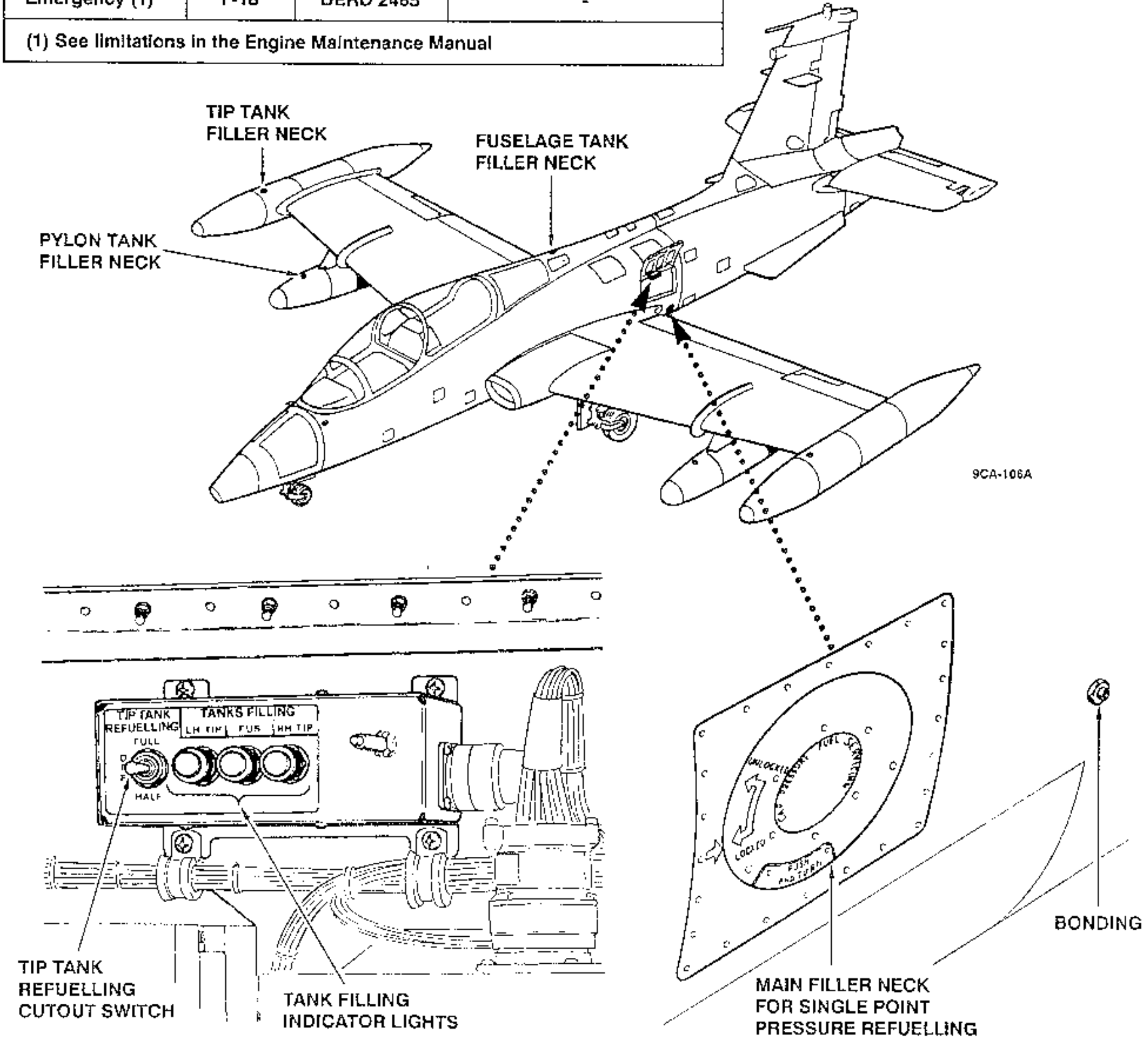
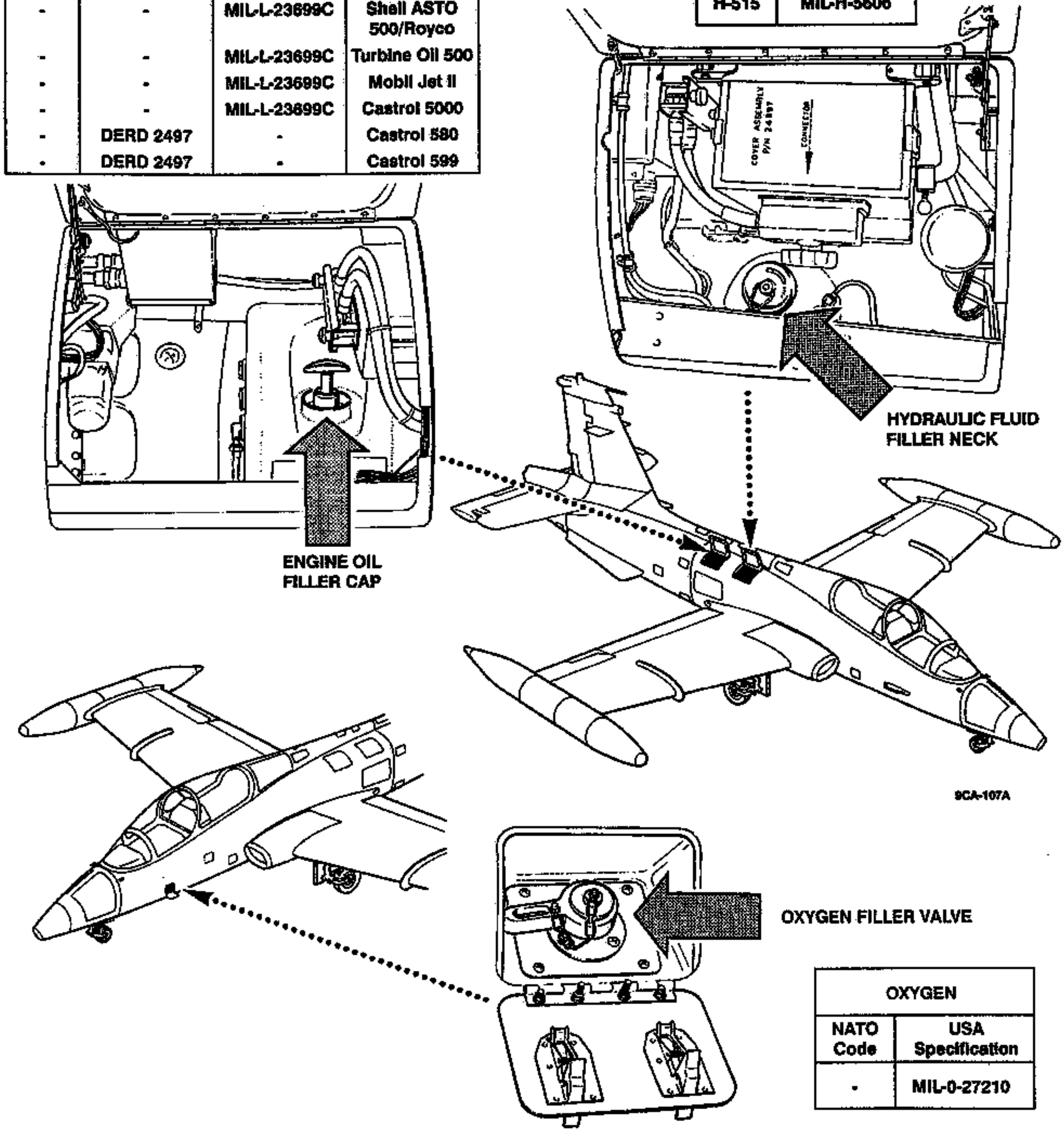


Figure 1-88 (Sheet 1 of 2)

SERVICING DIAGRAM

ENGINE OIL			
NATO Code	British Specification	USA Specification	Commercial Designation
-	-	MIL-L-23699C	Shell ASTO 500/Royco
-	-	MIL-L-23699C	Turbine Oil 500
-	-	MIL-L-23699C	Mobil Jet II
-	-	MIL-L-23699C	Castrol 5000
-	DERD 2497	-	Castrol 580
-	DERD 2497	-	Castrol 599

HYDRAULIC FLUID	
NATO Code	USA Specification
H-515	MIL-H-5606



OXYGEN	
NATO Code	USA Specification
-	MIL-0-27210

Figure 1-88 (Sheet 2)

SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to Section V for all operating limitations concerning the aircraft and the engine.

FLIGHT PLANNING

Publication PI 1T-MB339C-1-1 "Performance Data" contains the performance data of the aircraft, thus allowing estimation of fuel consumption, calibrated airspeed, engine setting and altitude for the proposed flights and missions.

TAKEOFF AND LANDING DATA

The information necessary to complete the "Takeoff and Landing Data Card" comprised in the Check List, is contained in the "Performance Data" manual.

MASS AND BALANCE

Refer to Section V for mass and balance limitations. For mass and balance information refer to Section V and the "Basic Mass Checklist" and "Loading Data" manuals PI 1T-MB339C-5-1 and PI 1T-MB339C-5-2.

PROCEDURES

The procedures described in this section are given in detail, where possible. The same procedures are contained in the Pilot's Check List in an abbreviated form (see foreword to this manual).

CONTROL AVAILABILITY IN THE TWO COCKPITS

The procedures given in this section refer to the pilot in the front cockpit. The controls in the front cockpit are not fully duplicated in the rear cockpit. Therefore the rear pilot, when in control, must instruct the front pilot to actuate the following controls, available in the front cockpit only:

- Power supply switches: "BATT","GEN 1", "GEN 2", "AC POWER", "SEC BUS RESET".
- Engine switches: "START", "JPT LMTR" and "MSTR".
- "FUEL TRANSFER" selector switch.
- Air-conditioning control panel: "CABIN TEMP" selector switch, "CABIN PRESS", "WINDSHIELD/DEMIST" and "WINDSHIELD/RAIN RMVL" switches.
- "NAV", "BCN", "LDG LT/TAXI-NOSE LT" switches.
- "FORM LIGHTS" knob.
- "IFF" control panel.
- "SMS" control panel.
- "IRS" control panel.
- "LG EMERG SEL" handle.
- "GROUND FIRE" switch.
- "MKR" control panel.
- "PHOTO" control panel (when installed).
- "SMOKE" control panel (when installed).
- "AVTR" control panel.
- "WARN LT/TEST" push-button.
- "ELT" switch.
- "RAM-AIR SCOOP" handle.
- "ANTI-ICE/ENGINE" switch.
- Engine throttle friction adjustment.
- "MASTER CAUTION" reset.
- "PARK & EMER BK" handle (park function only).

PRE-FLIGHT CHECKS

REAR COCKPIT CHECKS FOR "SOLO" FLIGHTS

1. Safety pin of ejection seat firing handle - Inserted
2. Check that the survival pack, seat belt and harness, communication lead, normal and emergency oxygen hoses are fastened by the special cover assembly.

CAUTION

Only during ferry flights, if a cover assembly is not available, the parachute and survival pack may be fastened by means of the seat belts or other fastening systems. The pilot is to be responsible for checking that fastening is secure.

WARNING

Aerobatics are forbidden when the cover assembly is not installed on the rear seat.

3. Supply lever on oxygen regulator - OFF.
4. "ANTI-SKID" switch - NORM.
5. "FUEL SHUT-OFF" switch - OPEN (guard down).
6. "AIL SERVO" switch - ON (guard down).
7. "FUEL DUMP" knob - White line horizontal.
8. "FIRE" switch, on "SMS" monitor panel - FWD.
9. Stand-by attitude indicator - Caged.
10. "BRT/OFF" knob, on MFD - OFF.
11. "PWR" switch, on PDU - Lower position.
12. All switches - Off.
13. Circuit breakers panel No 4 - All circuit breakers engaged.

EJECTION SEAT PREFLIGHT

1. Don the leg restraint garters (below the knee, rings forward, quick-release connectors inward).
2. Carry out the following checks on the seat.
   a. Safety pin in place in the seat firing handle.
   b. Remaining safety pins stowed in the backrest.
   c. Sear withdrawal link secured to sear of ejection gun. Safety pin not fitted.
   d. Leg restraint lines correctly attached to aircraft floor.
   e. Manual override handle - Down and locked.
   f. Manual override safety pin - Removed.
   g. Barostatic time release unit trip rod - Connected and safety pin removed.
   h. Pip pin - Unrestricted movement.
   i. Seat correctly locked to ejection gun as witnessed by top latch indicator.
   j. Drogue withdrawal line secured to drogue gun.
   k. Drogue gun trip rod connected and safety pin removed.
   l. Harness retraction trip lever - Locked.
   m. Rocket pack initiator safety pin - Removed.
   n. Emergency oxygen bottle - Green quadrant on indicator.
   o. Emergency oxygen striker plate - Extended.
   p. All harness connections secure.
   q. Survival pack connected to parachute harness.
   r. Sticker strap lugs engaged in clips.
   s. Command eject (rear cockpit) - As required.

NOTE

The position of the command eject lever is at the discretion of the pilot. However, for non aircrew passengers it is to be OFF.

BEFORE EXTERIOR INSPECTION, FRONT COCKPIT

1. "FUEL DUMP" knob - White line horizontal.
2. External electrical power source - Connected.

3. Stand-by attitude indicator - Caged.
4. "BATT" switch - ON.
5. "GEN 1" switch - OFF.
6. "GEN 2" switch - OFF.
7. "AC POWER" switch - NORM.
8. "GROUND FIRE" switch - OFF (guard down).
9. Ground services control panel:
   a. "BATT GND SERV" switch - Guard down.
   b. "IGN" switch - Guard down.
   c. "FUEL PUMP" switch - Guard down.
   d. "LG SW ORIDE" switch - Guard down.
10. "ASC" switch - Guard down.

TRNAV SYSTEM INITIALIZATION

Initialization Procedure

1. TRNAV system - Test (if desired).
2. Mode selector knob, on the "IRS" control panel - HDG SET.
3. "HDG SET" knob - Turn to center the slave indicator.
4. DEP scratchpad - Read the present heading.
5. "ENT" key, on the DEP - Press.
6. DEP scratchpad - Read the present heading.
7. If the present position is correct: "ENT" key - Press.
8. If the present position is not correct: "SET" key - Press.
9. Enter correct position.
10. "ENT" key - Press.
11. Mode selector knob, on the "IRS" control panel - NORM or FAST ALIGN. If required - Start clock.
12. "RDY/DPLR" advisory light - Illuminates when alignment is complete.

EXTERIOR INSPECTION

The exterior inspection procedures are based on the assumption that maintenance personnel have met all pre-flight and post-flight requirements specified in the applicable technical publications. The pilot will not therefore repeat the same inspections, except for some safety-critical items. When performing exterior inspection, the pilot must check for general conditions, and inspect the items shown in figure 2-1.

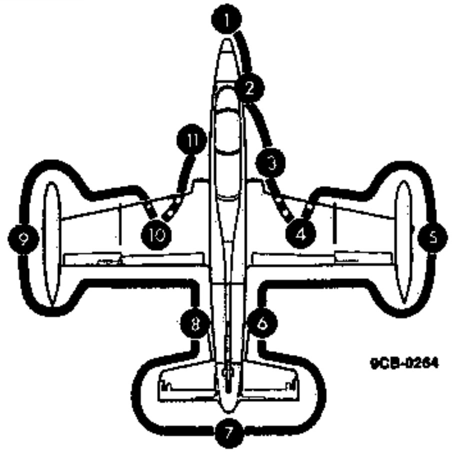
NOTE

In case of landing on a base different from the home base or unassisted base, carry out the more detailed inspection specified in the Pilot's Check List.

STRAP-IN

1. "SEAT ADJ" switch - Adjust the seat height.
2. Adjust the rudder pedal length by means of the "PEDAL ADJ" knob.
3. Connect the anti-g suit hose to the anti-g valve connector.

EXTERIOR INSPECTION



CONDITION:
- Flaps and speedbrake - Down
- Flight controls - Unlocked
- Covers - Removed
- Areas, free from object that could be ingested by the engine
- Fire extinguisher - Available

GENERAL ITEMS
- Breakage, distortion, loose screws or rivets
- Damage to metal skins
- Security of panels or doors
- Fuel, oil and hydraulic fluid leakage

1. FUSELAGE NOSE

Pitot (2) - Unobstructed
Upper IFF antenna - Condition and security
Sideslip sensor - Condition and security
AOA sensor - Unobstructed
Formation light - Condition
Nose light - Condition

2. NOSE LANDING GEAR

Landing gear doors - Condition and security
Taxi light - Condition and security
Shock absorber - Extension
Tire - Condition, inflation
Microswitch - Condition

3. RIGHT FORWARD FUSELAGE

Ram air intake - Closed
Windshield and canopy - Condition
Canopy severance external handle - Stored
Air conditioning air intake - Unobstructed
Engine air intake - Unobstructed and condition
Speedbrake compartment - Condition

4. RIGHT MAIN LANDIND GEAR

Landing gear down - Condition and security
Tire - Condition and inflation
Shock absorber - Extension
Distance tube - Removed
Wheel chock - As required
Microswitches - Condition

5. RIGHT WING

Tip tank - Security and condition. Filler cap - Closed
Navigation light - Condition
Formation light - Condition
Aileron and tab - Condition, movement and plays
Flap - Condition, play, bending and actuating rods

6. RIGHT AFT FUSELAGE

Upper TACAN antenna - Condition and security
Battery compartment - Batteries for condition
- Hydraulic reservoir cap for security
Engine bay - Oil tank cap for security
- Circuit breakers in
Navigation light - Condition and security
Inverter air intake - Unobstructed
Static port - Unobstructed
Engine bay cooling intake - Unobstructed
Strake - Condition
Formation lights - Condition

7. EMPENNAGES

Rudder and tabs - Conditions, movement and plays
Ice detector - Condition and security
VOR / LOC / GS antenna - Condition and security
VHF - AM antenna - Condition and security
Anti - collision light - Condition
Navigation light - Condition
Elevator and tabs - Condition, movement and play
Jet pipe - Dry and conditions
Total temperature sensor - Condition, security

8. LEFT AFT FUSELAGE

STRAKE - CONDITION
Engine bay cooling intake - Unobstructed
Static port - Unobstructed
Radar altimeter antenna - Condition and securiry
MKR antenna - Condition and security
Lower TACAN antenna - Security
Lower IFF antenna - Condition and security
Electrical panel - Circuit breakers in
- GCU circuit breakers engaged
Engine bay - BOV unobstructed and clean
Battery compartment - Accumulator pressure gauges for correct pressure (860 psi min)

9. LEFT WING

Flap - Conditions, plays, bonding and actuating rods
Aileron and tab - Condition, movements and plays
Tip tank - Security and condition. Filler cap - Closed
Navigation light - Condition
Formation light - Condition
Landing light - Condition

10. LEFT MAIN LANDING GEAR

Landing gear doors - Condition and security
Tires - Condition and inflation
Shock absorber - Extension
Distance tube - Removed
Wheel check - As required
Microswitches - Condition

11. AIRCRAFT LOWER SIDE/LEFT FORWARD FUSELAGE

V/UHF antenna - Condition
Doppler antenna - Condition
ADF antenna - Condition
UHF antenna - Condition and security
Engine air intake - Unobstructed and condition
Windshield and canopy - Condition
Canopy Severance External Handle - Stored

Figure 2-1

4. Connect the personal survival pack lowering line to the flying suit, routing the lowering line clear of the left console.
5. Route the leg restraint lines through the leg garter rings and engage the free ends in the locks on the two seat side guards.
6. Ensure that the go-forward control lever is in the locked position, and position the shoulder straps.
7. Place the quick-release fitting (QRF) mounted on the negative-g restraint strap to the center position.

NOTE

To engage the lugs into the QRF, turn the face plate until the yellow line and dots on the plate are aligned with the line and the dots on the body.

8. Route the crotch straps through the D-rings of the straps.
9. Pass the shoulder straps down through the end loops of the crotch straps and secure the end lugs into the QRF.
10. Fully tighten the shoulder straps and the lap straps ensuring that the QRF remains central.
11. Don the flying helmet and connect the T connector fitted to the oxygen mask hose to the socket on the left shoulder strap.
12. Connect the oxygen hose to the socket on the left shoulder strap.
13. Move the oxygen supply lever to ON and check the correct operation of the mask and of the oxygen system. Check that the "EMG" lever is pressed aft and the diluter lever is at N.
14. Connect the mic/tel lead.
15. Move the go-forward control lever forward and check for free forward movement.

INTERIOR INSPECTIONS

1. Flight controls - Check unlocked.

NOTE

In strong wind, do not unlock the flight controls until the cockpit checks are completed or damage may result to the control surfaces and associated control linkages.

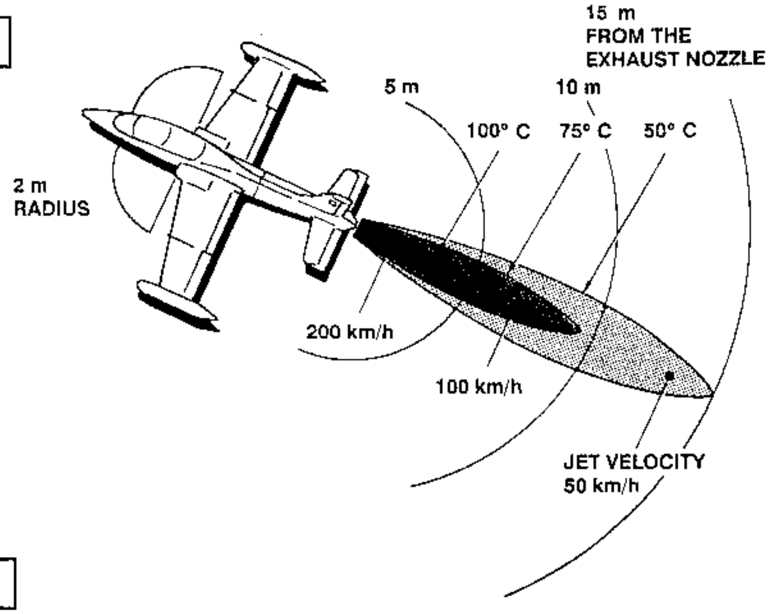
LEFT TO RIGHT CHECKS

Left Console

1. Circuit breakers panel No 1 - All circuit breakers engaged.
2. "GROUND FIRE" switch - Check OFF (guard down).
3. "LG EMERG SEL" handle - Fully in and locked.
4. "IRS" control panel; if TRNAV system is not yet inizialized - Inizialize.
5. "VHF COMM" control panel:
   a. Function selector knob - TR.
   b. Select the frequency.
6. "UHF" control panel:
   a. Function selector knob - BOTH.
   b. Select the frequency.
7. "RDR ALT" switch - Neutral position.
8. "LASER" switch - OFF.
9. Wing flap control lever - DN.

DANGER AREAS TEMPERATURE AND VELOCITY

ENGINE AT IDLE



FULL THROTTLE

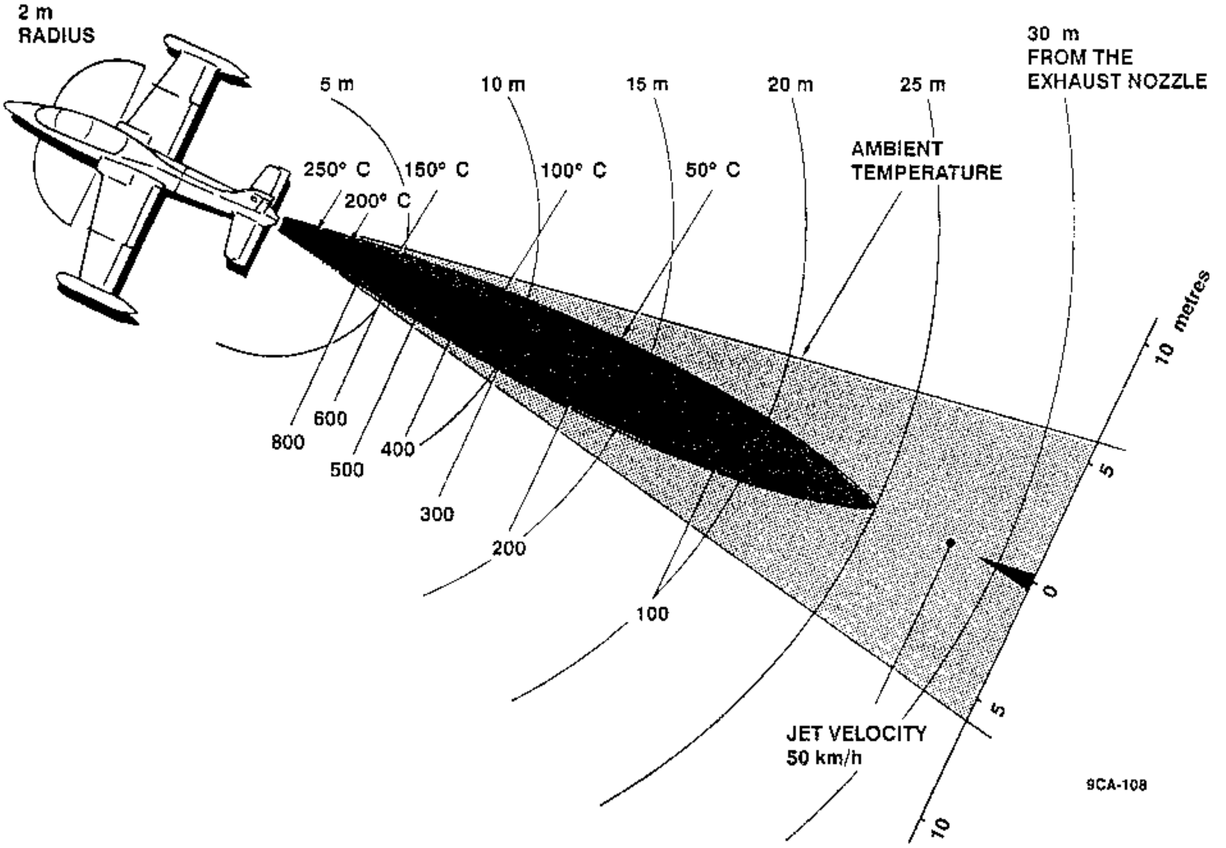


Figure 2-2 (Sheet 1 of 2)

DANGER AREAS | NOISE LEVEL

NOISE PROTECTION REQUIREMENTS	
DECIBEL	**REQUIRED EAR PROTECTION**
0 - 85	No protection required
85 - 120	Ear muffs or ear plugs
120 - 135	Ear muffs and ear plugs
135 - 145	Ear muffs and ear plugs limited time exposure
Above 145	Prohibited

FULL THROTTLE

NOTE

- Noise level areas identical on each side of aircraft.
- Coutours may be altered be surrounding obstacles.

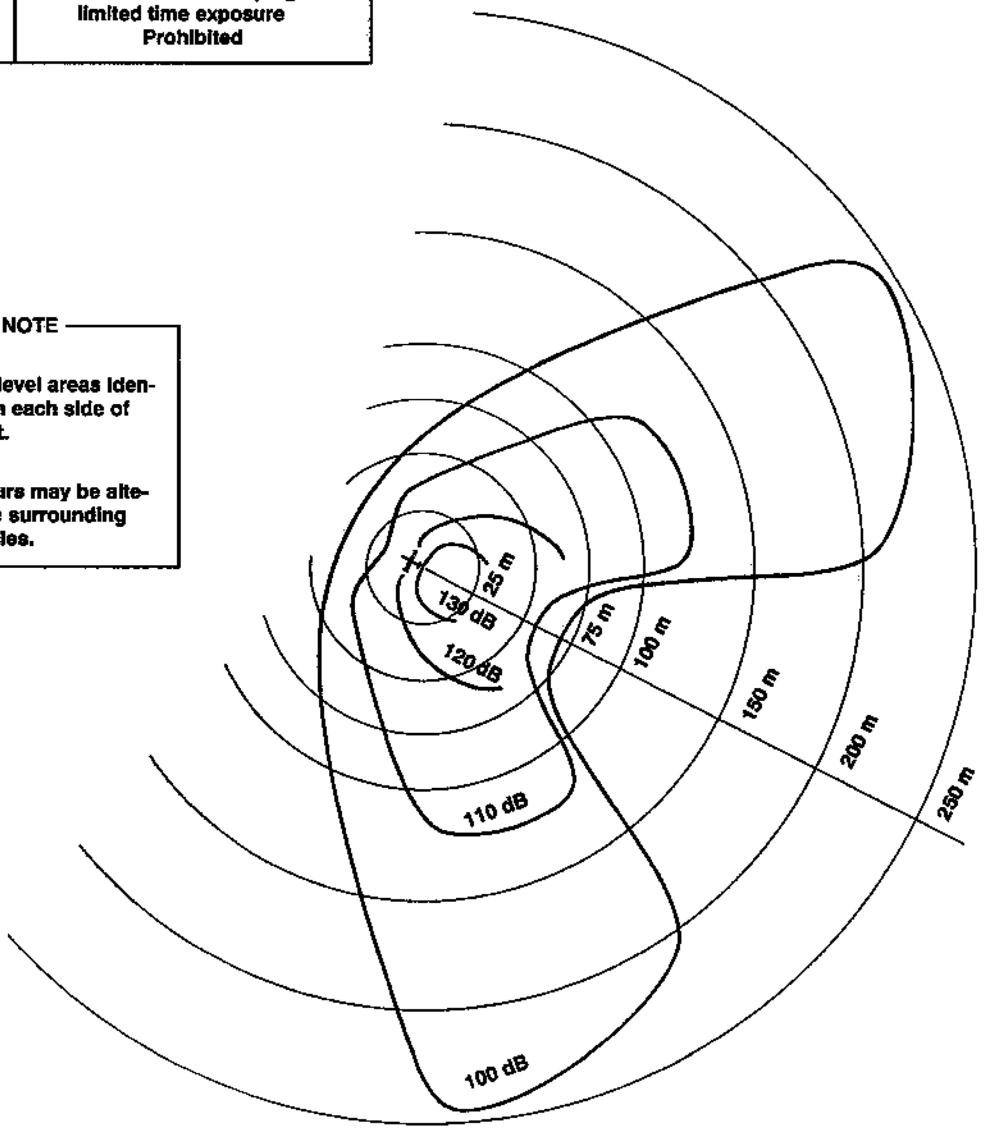


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Figure 2-2 (Sheet 2)

10. Engine throttle - Check for free movement. Check for flashing of the "CANOPY" and "SEAT" warning lights. Adjust the friction knob and move to STOP.
11. "RUDDER TRIM" switch - Adjust.
12. "ANTI-SKID" switch - NORM.

NOTE

> The "A.SKID" caution light goes out when the anti-skid system test is completed, viz. approximately 6 to 10 seconds after that the "BATT" switch is switched ON or after that the "ANTI-SKID" switch is switched to NORM.

13. "FUEL TRANSFER" switch - PYL (if underwing tanks are installed); otherwise TIP.
14. "FUEL SHUT-OFF" switch - OPEN (guard down).
15. "ENGINE" control panel.
    a. "MSTR" switch - OFF.
    b. "JPT LMTR" switch - ON guard down ("JPT LMTR" indicator on rear left console - On).
16. "AIL SERVO" switch - ON (guard down).
17. "AVTR" control panel:
    a. Source selector - HUD.
    b. Power switch - As required.
    c. "RCDR" light - Off.

Instrument Panel Left Side

1. "AIL" and "RUD" trim neutral position indicators - Green light.
2. "LDG LT/TAXI-NOSE LT" switch - OFF.
3. Landing gear control panel:
    a. Landing gear control lever - LG DOWN.
    b. Landing gear position indicators (3) - On (green lights).
4. "PARK & EMER BK" handle - Out (brakes applied).

Instrument Panel

1. "SMS" control panel:
    a. Master switch - SAFE.
    b. Other checks as required according to the type of the armament installed.
2. "SALVO JETTISON" push-button - Cover undamaged.
3. "BRT/OFF" knob, on MFD - OFF.
4. Wing flap indicator - Down (3rd mark).
5. Speedbrake indicator - Extended to 1st mark.
6. Longitudinal trim indicator - Neutral.
7. Clock - Check.
8. "RDR/BARO" push-button/advisory light - Off.
9. "CANOPY" warning light - On.
10. "SEAT" warning light - On.
11. "MASTER CAUTION" light - Press (to reset).

12. "NAV/ATTK" push-button/advisory light - Off.
13. "TEST" push-button, on the CID - Press to test.
14. "PWR" switch, on PDU - Lower position.
15. Mach-airspeed indicator - Check and set outer index for desired reading.
16. "FDC/HSI" control panel - "STBY" and "MAN" lights on.
17. ADI - Check.
18. HSI - Check.
19. "IRU RDY" light - Check.
20. "RNAV RAD UPDATE" push-button light - Check and select as desired.
21. Cabin altimeter - Field elevation.
22. "TAKE CONTR" push-button lights - Press as required. Check lights on.
23. "DF 1", "DF 2" and "ADF" push-button lights, on "BRG" control panel - Off.
24. Vertical velocity indicator - Check for zero indication.
25. Altimeter - Adjust to field elevation.
26. Accelerometer - Check, set to 1 g.
27. Remote display unit - Check.
28. "STEER/A. SKID" advisory light - Off.
29. "FIRE" warning light - Off.
30. "OHEAT" warning light - Off.
31. "MKR" advisory light - Off.
32. "LAND/SEA" push button/advisory light - "LAND" on.
33. Stand-by attitude indicator - Caged.
34. Tachometer - Check for zero indication.
35. Jet pipe temperature indicator - Check for ambient temperature indication.
36. Flowmeter - Check for zero indication.
37. Engine oil pressure gauge - Check for zero indication.
38. "FUEL QTY" indicator - Check for correct indication of each tank. Press the "TEST" push-button to test the system.
39. "OXY" indicator - Correct indication. Check blinker.
40. "ANTI-ICE" indicators panel - All indicators OFF.
41. Stand-by compass - Check.

Instrument Panel Right Side

1. Hydraulic system pressure gages - Condition.
2. Loadmeters - Check zero indication.
3. Caution lights panel - Only the following caution lights should be on:
   - "NO 1 DC GEN".
   - "NO 2 DC GEN".
   - "NO 1 BATT".
   - "NO 2 BATT".
   - "AIL SERVO".

- "FUEL PRESS".
- "OIL PRESS".

NOTE

If external power source is not connected, the "NO 1 BATT" and "NO 2 BATT" caution lights will be off and the "AC SEC BUS" caution light will be on.

4. "WARN LT/TEST" push-button - Press to test and check for landing gear audible warning signal in the headset and illumination of the following caution lights:
   - "MASTER CAUTION". - "FIRE".
   - "OHEAT". - Landing gear control lever.
   - Caution lights panel.

NOTE

The "ICE" caution light goes out when the anti-ice system test is completed, viz. after approximately 1 minute.

5. "MASTER CAUTION" light - Press to reset.
6. "BATT" switch - Check ON.
7. "GEN 1" switch - ON.
8. "GEN 2" switch - ON.
9. "AC POWER" switch - Check NORM.

Right Console

1. "ICS" control panel:
   a. Receiver switches - As required.
   b. Interphone switch - As required.
   c. "VOL" knob - Midway.
2. "IFF" control panel - Preselect mode and code, and check "MASTER" selector switch OFF.
3. "TCN" control panel:
   a. Function selector switch - OFF.
   b. Channel select
4. "VOR/ILS/DME" control panel:
   a Function selector switch - OFF.
   b. Frequency select.
5. "ADF" control panel:
   a. Function selector switch - OFF.
   b. Frequency select.
6. Cabin air conditioning control panel:
   a. "CABIN TEMP" selector - AUTO and at the desired temperature (12 o'clock for standard).
   b. "WINDSHIELD/DEMIST" switch - OFF.
   c. "WINDSHIELD/RAIN RMVL" switch - OFF.
   d. "CABIN PRESS" switch - ON (guard down).

7. "LIGHTS" control panel:
    a. "BCN" switch - ON.
    b. Other controls - As required.
8. "PHOTO" control panel - All switches OFF (when installed).
9. "SMOKE" control panel (when installed):
    a. "MASTER" switch - OFF.
    b. "COLOR" switch - OFF.
    c. "WHITE" switch - OFF.
10. Circuit breakers panel No 2 - All circuit breakers engaged.
11. "RAM AIR SCOOP" handle - Fully in (scoop closed).
12. "FORM LIGHTS" selector knob - As required.
13. "SEC BUS RESET" switch - OFF (guard down).
14. "ANTI-ICE/ENGINE" switch - OFF.
15. "ANTI-ICE/PITOT" switch - TEST for 1 to 2 seconds, then OFF. Check operation by observing that the "ANTI-ICE/PITOT" indicator read ON.
16. "MKR" control panel - Switch in neutral position (LO).
17. "ELT" control panel:
    a. Control switch - AUTO.
    b. Light - Off.

PRE-START CHECKS

1. "ENG MSTR" switch - ON.

Check that the "FUEL PRESS" caution light goes off. If the external power source is connected, check that the "NO 1 BATT" and "NO 2 BATT" caution lights also go off and "AC SEC BUS" caution light comes on.

CAUTION

- Engine starting is permitted only if the following conditions are satisfied:
    - Ground temperature between - 26°C and + 50°C on external power.
    - Ground temperature between - 15°C and + 45°C on the aircraft batteries.

These limitations only apply to the aircraft that remained at temperatures beyond the limits for a long time. In environments where the temperature is beyond the limits, the aircraft must be parked in areas where the temperature is within the limits.

- If the engine is inadvertently started and run with an air intake cover in position, reject the engine for investigation.
- If, after start, the oil pressure remains below minimum, the engine must be shut down and the cause investigated.
- The JPT limits are critical and should be observed at all times, but especially during starting and relighting as flight safety and engine overhaul life can be affected.

2. "RELIGHT" push-button - Press to test. An irregular double clicking of the igniter plugs should be audible.

STARTING ENGINE

1. Throttle - Advance to IDLE.

CAUTION

Keep the throttle at IDLE as little time as possible to prevent accumulation of fuel in the combustion chamber following the opening of the high pressure fuel cock.

2. "START" button and clock - Press for 2 seconds and release. The engine normally lights up within 4 to 12 seconds.

CAUTION

- If the jet pipe temperature rises too quickly and approaches the maximum limit, immediately move the throttle to STOP. Allow the engine to stop and cool, then investigate the cause.
- If the temperature exceeds the specified limits, report the overtemperature condition since flight safety and engine life are affected.
- If after 20 seconds from pressing the "START" button the engine does not light up (by reference to the jet pipe temperature and the engine speed), move the throttle lever to STOP and the "ENG MSTR" switch to OFF.
- Move the aircraft if the ground beneath the tail becomes soaked with fuel.
- Prior to attempting a new start, allow at least 5 minutes for the starter to cool and the engine to drain; then carry out a dry motoring cycle.
- If the engine does not start after the second attempt, investigate the cause.

3. Oil pressure - Check for normal indication.
4. Engine speed - Check for normal rpm increase.
5. Flowmeter - Positive indication (4 to 5 kg/min).
6. JPT - Check for normal increase.
7. "FIRE" and "OHEAT" warning lights - Off.
8. Lights on caution lights panel - Off.

NOTE

The "AIL SERVO" caution light goes off with some delay, viz. when hydraulic pressure exceeds 85 to 90 bar.

CAUTION

If the "BATT HOT" caution light comes on after engine starting, immediately disconnect the batteries and abort the mission.

9. Have the external power source disconnected (if plugged in).

DRY MOTORING CYCLE

1. "BATT" switch - Check ON.
2. Engine throttle - Move to STOP.
3. "FUEL SHUT-OFF" switch - OPEN (guard down).

4. "ENG MSTR" switch - ON.
5. "FUEL PRESS" caution light - Off.
6. "START" button - Press for 2 seconds (the cycle will be cancelled automatically on completion).

CAUTION

If, after three dry motoring cycles in rapid succession, further cycles are necessary, allow 15 minutes for the starter to cool.

AFTER START CHECKS

1. "IRS" control panel - Mode selector to NAV (if "IRU RDY" light is on).
2. "BRT/OFF" knob, on MFD - Turn clockwise and adjust the brightness. Adjust the contrast by means of the "CONT" knob.
3. "PWR" switch, on PDU - PWR (upper position) and adjust the brightness by means of the "BRT" knob.
4. Stand-by attitude indicator - Uncage and adjust.
5. Hydraulic pressure - Check that the indication on the "MAIN" and "EMER" pressure gauges are within the limits.
6. "LOAD-GEN 1" loadmeter - Check for indication equal to or less than 1.

CAUTION

Mantain engine at idle until instrument reading is less than 1.

7. "LOAD GEN 2" loadmeter - It should indicate load values lower than those of the "LOAD GEN 1" indicator.

NOTE

The two loadmeters provide the same indications when engine rpm rise above 60%.

8. "IFF" control panel - "MASTER" selector to STBY.
9. "TCN" control panel - Function selector switch to T/R.
10. "VOR/ILS/DME" control panel - Function selector switch to STBY, then DME.
11. "ADF" control panel - Function selector switch to ADF.
12. "CABIN PRESS" switch - Move the switch to OFF (guard up and toggle aft) and check that the air flow entering the cabin through the pressurization outlets stops. Then, move the switch back to ON (guard down).

NOTE

- It is sufficient that the above check be carried out before the first flight of the day.
- Closing of the cabin pressurization air valve is more noticeable if engine rpm is increased momentarily.

13. "DEP" control panel - Depress the "TST" key and hold.

NOTE

All filaments in all windows of the DEP and the RDU illuminates showing the "British Flag" (all segments on); the MFD will show the RNAV TEST PATTERN.
When the "TST" key is released, on the HSI the "RANGE" and "NAV" flags come on; the deviation bar goes to the left; the bearing pointer moves to 270° (9 o'clock) for about five seconds. Then, automatically, the system starts the second phase of the test while the NCU still processes the navigation data.

14. ADI - Check that the OFF flag is out of view and the attitude indicator is aligned.
15. HSI - Compare the compass card reading with the stand-by compass reading. If required, set the alignment indicator on the "IRS" control panel to zero.
16. "IRS" control panel - Check for normal alignment ("RDY" light - On). Mode selector to NAV. Check that the "AUX" flag, on the ADI, and the "AUX" word, on the MFD in MAP mode, disappear. Set the mode selector to AUX and check the ADI for correct attitude indication. Return the mode selector to NAV. If required, complete the TRNAV set-up procedure.
17. Speedbrake - Retracted: check the indicator and wait for the crew chief to confirm speedbrake position.
18. Wing flaps - UP, then T/O. Check indicator and wait for the crew chief to confirm flap position.
19. Control stick - Free movement and correct response of elevator and ailerons.
20. Rudder pedals - Free movement and correct response of rudder.
21. Canopy - Closed and locked, "CANOPY" light off.

CAUTION

If installed, the blind flying hood must be kept in the open position throughout the takeoff phase to ensure safe seat ejection in an emergency.

22. Remove the safety pin from the seat firing handle and stow it in the special housing on the canopy frame. The "SEAT" warning light must be off.
23. Radio call - As required.

TRNAV SET-UP PROCEDURE

1. "RNAV" push-button on the "HSI" control panel - Press.
2. All required mission waypoint - Check if are stored in the navigation system.
3. Enter any new data relating to stored radio beacon data, if required.
4. Steerpoint - Select, if manual navigation mode is required.
5. Enter the flight plan waypoint sequence.
6. Select the flight plan navigation mode.
7. "AUTO" or "MAN" mode push-button lights, on the "HSI" control panel - Press as required.
8. "LAND/SEA" push-button/advisory light - Press as required.
9. "POS" or "STR" key, on the DEP - Press as required.

TAXIING

NOTE

Do not start taxiing if the IRU alignement is not completed. Before moving the aircraft the mode selector on the "IRS" control panel must be switched to NAV (after "IRU RDY" light comes on).

CAUTION

- During taxiing, the canopy must be closed or open to the intermediate position.
- With the canopy closed, the aircraft can cross the blast of another aircraft of the same category running at idle, at a minimum distance of 15 m.

WARNING

If the canopy is kept in the intermediate position, the safety pin of the seat firing handle must be in place on the seat.

1. Have the wheel chocks removed.
2. Press the push-button (on the control stick) for nosewheel steering engagement. Check for illumination of the "STEER" light.
3. "PARK & EMER BK" handle - Release.
4. Brakes - Test.
5. Approx. 60% rpm are required to start the aircraft moving. Once the aircraft is moving it can be taxied with the throttle at IDLE on a hard level surface, at a safe speed.

CAUTION

- Check the area behind the aircraft is clear of obstacles, personnel or other aircraft.
- When taxiing directly behind another aircraft of the same category, maintain a minimum distance of 28 m from the exhaust blast to prevent damage to the canopy and remain more than 5 m laterally apart from the trajectory of the preceding aircraft.

NOTE

Keep the taxi time to a minimum. Fuel consumption on the ground is about 4 kg per minute with the engine at 40% rpm and 29 kg per minute at max rpm.

6. Maintain directional control of the aircraft by use of nosewheel steering. Steering control is through the rudder pedals. The minimum steering radius is shown in figure 2-3. Directional control can also be obtained by use of differential braking but in this case the nosewheel steering must be disengaged.

CAUTION

- Do not steer the aircraft with brakes with nosewheel steering engaged because damage could be caused to the nosewheel steering system.
- Be prepared to disengage the nosewheel steering in case of system malfunction.

7. Oxygen diluter lever - As required.

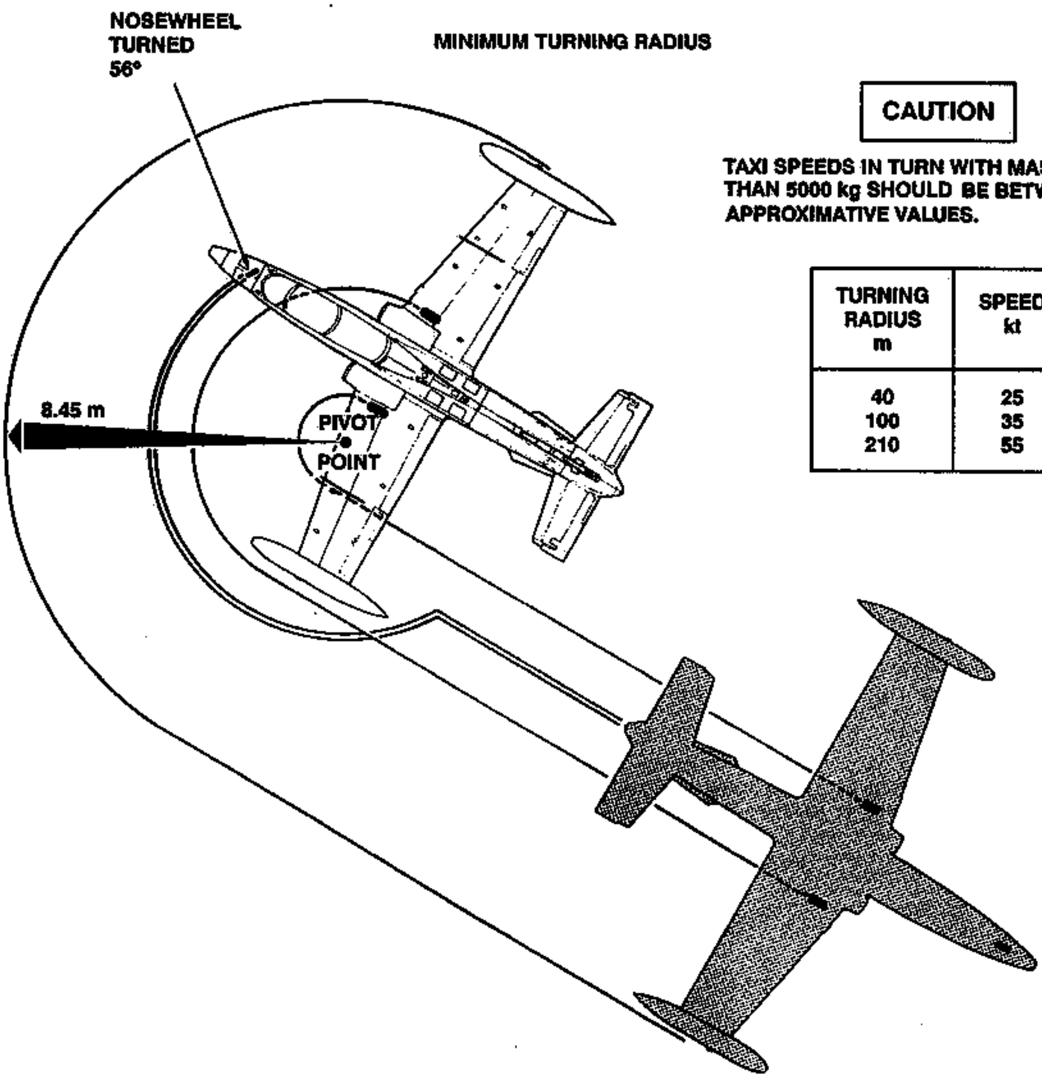
WARNING

If carbon monoxide contamination is suspected during ground operation, use pure oxygen setting the diluter lever at 100%.

8. Flight and navigation instruments - Check. Check the ADI and the stand-by attitude indicator for wing level indications and check the turn indicator and the magnetic heading on the HSI for correct indications during turns while taxiing.

TURNING RADIUS AND GROUND CLEARANCE

MINIMUM TURNING RADIUS



CAUTION

TAXI SPEEDS IN TURN WITH MASS GREATER THAN 5000 kg SHOULD BE BETWEEN THESE APPROXIMATIVE VALUES.

TURNING RADIUS m	SPEED kt
40	25
100	35
210	55

APPROXIMATE GROUND CLEARANCE

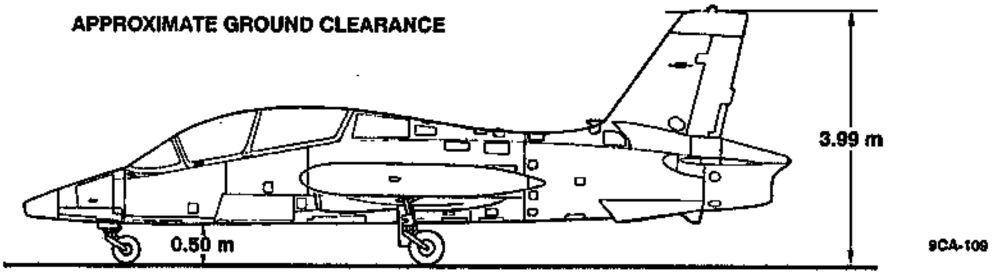


Figure 2-3

9. "PARK & EMER BK" handle - Check operation of the emergency brakes.
10. "BCN" switch - Temporarily to OFF, if required.

NOTE

At night, switch the "BCN" switch off in the vicinity of other aircraft to prevent dazzling the other pilots.

PRE-TAKEOFF CHECKS

1. "FUEL TRANSFER" switch - PYL or TIP.

CAUTION

If pylon tanks are fitted, the correct use sequence is as follows:

1st - PYL (underwing tanks) up to fuel depletion.

2nd - TIP (tip tanks).

2. "LDG LT/TAXI-NOSE LT" switch - TAXI-NOSE LT.
3. "TAKEOFF TRIM" indicator light - Illuminated (aileron and rudder trim tabs at neutral).
4. "FLAPS" indicator - Second mark (takeoff position).
5. "SPEED BRAKE" indicator - First mark (speedbrake retracted).
6. Longitudinal trim - Neutral position.
7. "CANOPY" warning light - Check off.
8. "SEAT" warning light - Check off.
9. Flight instruments - Check:
    a. ADI and stand-by attitude indicator - Correct attitude indication.
    b. HSI - Aligned with the runway magnetic heading.
    c. PDU - In accordance with ADI/HSI indication.
10. Oxygen - Check:
    a. Pressure - 20 bar minimum.
    b. "OXY FLOW" indicator - Blinker operating.
11. Hydraulic pressure - Within limits.
12. Warning and caution lights - All off.
13. Interior and exterior lights - As required.
14. If the mission requires smoke generation, perform the following selection on the "SMOKE" control panel:
    a. "MASTER" switch - ON.
    b. "COLOR" switch - ON.
    c. "WHITE" switch - ON.
    d. Smoke generation indicator lights (3) - Off.

TAKEOFF

ENGINE TEST

1. With the throttle at IDLE, check that all warning and caution lights are off and engine oil pressure and idle rpm are within limits.
2. Slam the throttle to FULL. The engine must accelerate smoothly without stagnation or stalling.
3. When the engine stabilizes, check:
   a. Engine rpm - Within limits.
   b. JPT - Within limits.
   c. Oil pressure - In normal range.
   d. Warning and caution lights - Off. SYSTEM TEST

SYSTEM TEST

NOTE

These tests must be performed with the engine running at 60% rpm.

4. "LOAD" indicators - Check that the max difference between the two readings does not exceed 0.1.
5. "ANTI-ICE/ENGINE" switch - TEST, then as required. Check for proper operation by observing that the "ANTI-ICE/ENG" indicator reads ON with the "ANTI-ICE/ENGINE" switch at TEST, and that the value shown on the "LOAD GEN 1" and "LOAD GEN 2" loadmeters increases. Then check that:
   - when the "ANTI-ICE/ENGINE" switch is moved to OFF, the "ANTI-ICE/ENG" indicator shows OFF and the two loadmeters show again a normal indication;
   - when the "ANTI-ICE/ENGINE" switch is moved to ON, the "ANTI-ICE/ENG" indicator reads ON, and the two loadmeters do not show any value icrease.

CAUTION

To avoid damage to the heating elements, hold the switch at TEST only as long as sufficient to note that the "ANTI-ICE/ENG" indicator shows ON, and that the load shown on the loadmeter increases.

6. "ANTI-ICE/PITOT" switch ON. Check that the "ANTI-ICE/PITOT" indicator reads ON.

TAKEOFF (Figure 2-4)

Before the takeoff run review the "Takeoff Data" and mentally go through the "Abort/overrun barrier engagement" procedure. Refer to publication PI 1T- MB339C-1-1 "Performance Data Manual" for the takeoff distances and speeds.

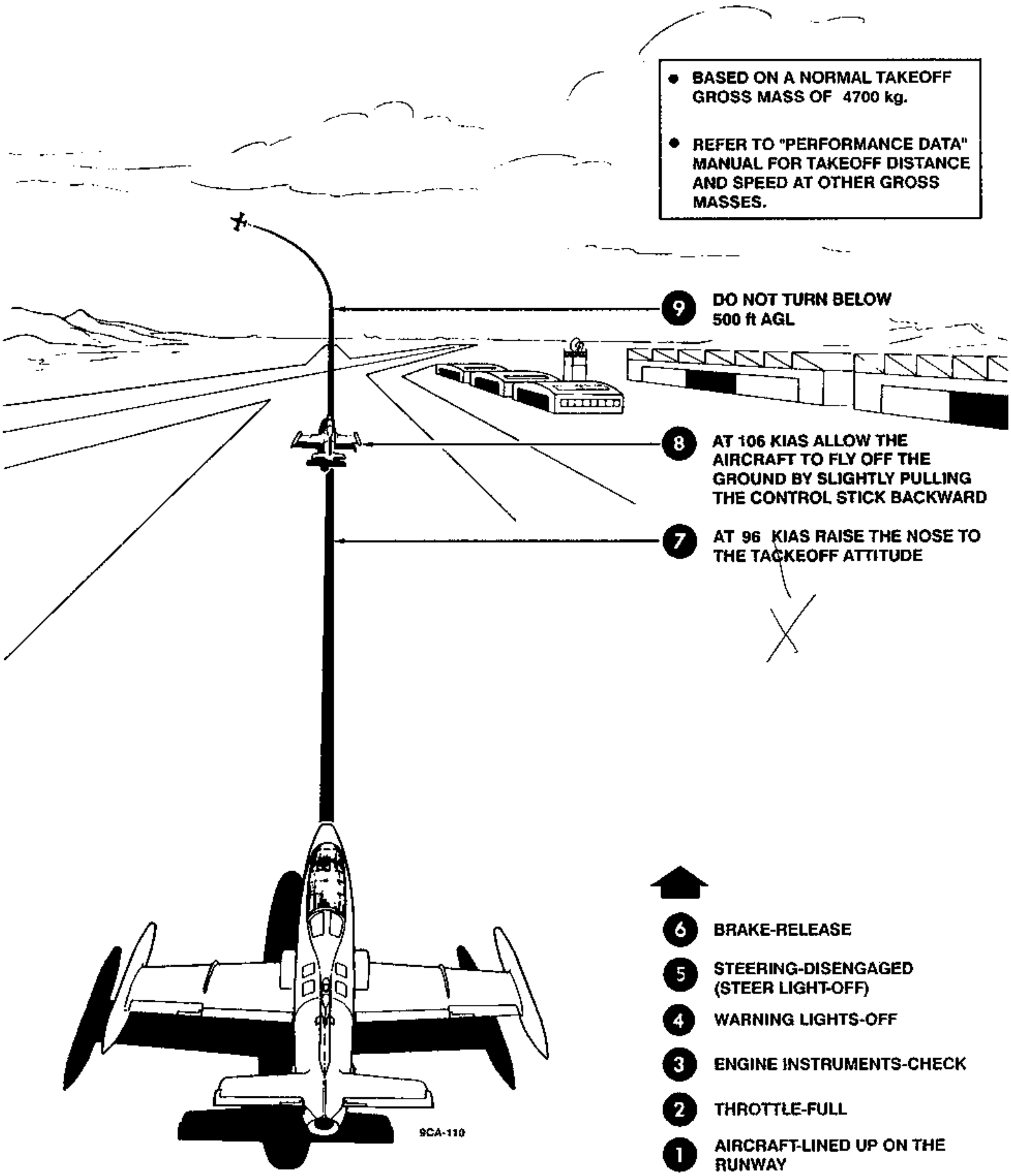
7. Disengage nosewheel steering - Check "STEER" indicator light off.
8. Release the brakes.
9. Maintain directional control by differential braking. The rudder becomes effective at approximately 45 to 50 KIAS.

CAUTION

Do not engage the steering during the takeoff run.

10. About 10 KI~~as~~AS below the computed lift off speed raise the nose with gentle back pressure on the control stick.

TAKEOFF (TYPICAL)



- BASED ON A NORMAL TAKEOFF GROSS MASS OF 4700 kg.
- REFER TO "PERFORMANCE DATA" MANUAL FOR TAKEOFF DISTANCE AND SPEED AT OTHER GROSS MASSES.

❾ DO NOT TURN BELOW 500 ft AGL

❽ AT 106 KIAS ALLOW THE AIRCRAFT TO FLY OFF THE GROUND BY SLIGHTLY PULLING THE CONTROL STICK BACKWARD

❼ AT 96 KIAS RAISE THE NOSE TO THE TACKEOFF ATTITUDE

❻ BRAKE-RELEASE

❺ STEERING-DISENGAGED (STEER LIGHT-OFF)

❹ WARNING LIGHTS-OFF

❸ ENGINE INSTRUMENTS-CHECK

❷ THROTTLE-FULL

❶ AIRCRAFT-LINED UP ON THE RUNWAY

Figure 2-4

11. At lift off speed lift the aircraft off the ground with a further back pressure on the control stick.
12. Carry out the after-takeoff checks at safe altitude and allow the aircraft to accelerate to normal climb speed maintaining a correct angle of climb.
13. Check hydraulic pressure for readings within the limits.
14. Check engine intruments for readings within the limits.

CROSS-WIND TAKEOFF

Refer to cross-wind takeoff and landing chart in the "Performance Data" manual for the effect of cross-wind. During a cross-wind takeoff, use the same procedure as for normal takeoffs. It is however recommended that the control stick be moved into wind and the nosewheel lifted off at the speed recommended in the "Performance Data" manual to improve aircraft control. During the ground run, the aircraft tends to take a nose upwind attitude. Be prepared to apply rudder pressure after nosewheel lift-off to keep the takeoff roll straight down the runway until the aircraft is airborne. After breaking ground, be prepared to counteract the aircraft drift.

WARNING

The crosswind effect increases when the external stores are carried.

TAKEOFF FROM WET RUNWAYS

Takeoff from wet runways may result in compressor stalls or flame out due to ingestion of water splashed by the nosewheel into the air intakes. To prevent such occurrences, the following precautions should be taken.

a. Taxi at the lowest possible speed, avoiding puddles and water-covered areas.
b. Lift the nosewheel from the ground as soon as possible.

CAUTION

At speeds below 50 KIAS, forward vision may be reduced by the water splashed by the nosewheel.

WARNING

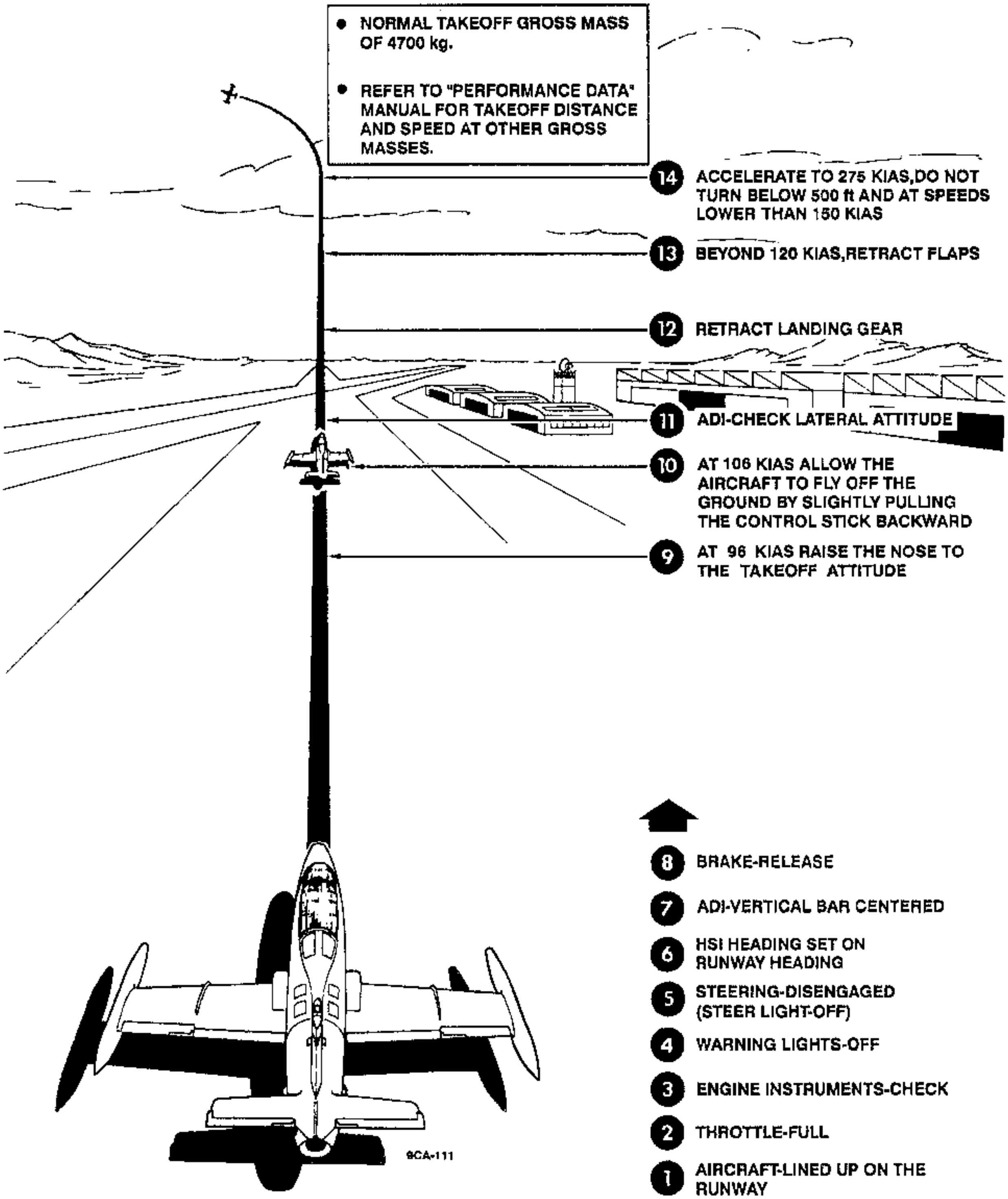
Check the instruments and close throttle to abort takeoff if compressor stall is suspected. The symptoms of a typical stall are low frequency noise and engine vibration, a considerable deceleration of the aircraft and a possible rapid drop of engine rpm to 70 to 80%, with JPT increase after approx 1 second.

INSTRUMENT TAKEOFF (HEAD DOWN) (Figure 2-5)

Carry out the normal takeoff procedure up to steering disengagement then proceed as follows:

1. With the "HEADING SET" knob of the HSI, set a heading consistent with the aircraft heading when aligned for takeoff.
2. Press the "FREE/CGE" key, on the DEP, to cage the velocity vector and check the aircraft symbol to appear on the PDU.
3. Press the "HDG" push-button on the "FDC/HSI" control panel and check that the ADI vertical bar is centered and the "tad pole", on the PDU, is centered on the aircraft symbol.
4. Release the brakes.
5. Maintain direction by differential braking up to approx 50 KIAS referring to runway markings and lights.

INSTRUMENT TAKEOFF (TYPICAL)



- NORMAL TAKEOFF GROSS MASS OF 4700 kg.
- REFER TO "PERFORMANCE DATA" MANUAL FOR TAKEOFF DISTANCE AND SPEED AT OTHER GROSS MASSES.

⑭ ACCELERATE TO 275 KIAS,DO NOT TURN BELOW 500 ft AND AT SPEEDS LOWER THAN 150 KIAS

⑬ BEYOND 120 KIAS,RETRACT FLAPS

⑫ RETRACT LANDING GEAR

⑪ ADI-CHECK LATERAL ATTITUDE

⑩ AT 106 KIAS ALLOW THE AIRCRAFT TO FLY OFF THE GROUND BY SLIGHTLY PULLING THE CONTROL STICK BACKWARD

⑨ AT 96 KIAS RAISE THE NOSE TO THE TAKEOFF ATTITUDE

⑧ BRAKE-RELEASE

⑦ ADI-VERTICAL BAR CENTERED

⑥ HSI HEADING SET ON RUNWAY HEADING

⑤ STEERING-DISENGAGED (STEER LIGHT-OFF)

④ WARNING LIGHTS-OFF

③ ENGINE INSTRUMENTS-CHECK

② THROTTLE-FULL

① AIRCRAFT-LINED UP ON THE RUNWAY

Figure 2-5

6. About 10 KIAS below computed lift off speed, apply back pressure on the stick to raise the nose, establishing a 7-degree nose-up attitude on the PDU.
7. When lift off speed is attained in a 7-degree nose-up attitude, the aircraft will become airborne. Maintain lateral and longitudinal control by using the ADI as main reference.
8. When the vertical velocity indicator indicates a climb and the altimeter indicates a gain of altitude, retract the landing gear. Above 120 KIAS retract the wing flaps.
9. Maintain the attitude and allow the aircraft to accelerate up to 275 KIAS. Standard turns (max bank angle of 30°) can be performed during acceleration provided airspeed is above 150 KIAS and altitude is above 500 feet AGL.
10. "FRE/CGE" key, on DEP - Press,when return to V/V indication is desired.

AFTER TAKEOFF CHECKS

When the aircraft is airborne, proceed as follows:

1. Check that the "TAKEOFF TRIM" lights are off.
2. Landing gear lever - LG UP.

Check that the green landing gear position lights and the red light in the lever grip are out. Retraction of the landing gear takes approx 5 seconds.

CAUTION

The landing gear should be completely up and locked before reaching the limit airspeed or excessive air loads may damage the landing gear doors and prevent their subsequent operation.

3. Wing flap lever - UP. Wing flaps up between 120 and 175 KIAS. The trim change is negligible. Check retracted.

CAUTION

During touch and go landings do not exceed the full flap limitations of 150 KIAS.

4. Check hydraulic pressure within the limits.
5. Trim - As required.
6. Attitude - Maintain a 7-degree nose-up attitude until the best initial climb speed of 275 KIAS is attained.
7. Oxygen diluter lever - N (if 100% oxygen was used for takeoff).

CLIMB/AIRMANSHIP CHECKS

Refer to the "Performance Data" manual for the table of the climbing speed, distance travelled in climb, time to climb and fuel consumption. Maintain the best climb speed for minimum time to altitude.

1. Start climb at 275 KIAS (rpm as required).
2. Cabin pressurization - Check the cabin altimeter above 8000 ft (see figure 1-37). A brief operational check-out of the pressurization system can be carried out by observing the cabin altimeter and proceeding as follows:
    a. From 8000 to 16 000 ft (aircraft altitude), the cabin altimeter reading should remain almost constant at 8000 ft.

   b. Between 16 000 ft and 24 000 ft the cabin altimeter should read half the aircraft altitude ± 500 ft.
   c. Above 24 000 ft the cabin altimeter should read half of the aircraft altitude plus 1000 to 2000 ft.
3. Flight instruments:
   a. HSI/ADI check.
   b. Cross check with HUD.

WARNING

A cross-check of the HUD attitude bars, the ADI and the stand-by attitude indicator must be made throughout all phases of flight. If indications are at variance, immediately refer to the other flight instruments to determine which of the indicators is reading correctly.

4. Engine indications within limits:
   - oil pressure at 95% rpm: 2.1 bar
   - minimum JPT during flight: 200°C.

NOTE

If the JPT is below 200°C and the RPM are falling, assume that engine flame-out has occured.

5. Fuel contents and transfer - Check.
6. Oxygen:
   a. Pressure - Check.
   b. "OXY FLOW" indicator - Check operation.
7. Pitot heating - Check (ON indication).
8. Hydraulic pressures - Within limits.
9. Loadmeters - Normal reading.

For cruise data, refer to publication PI 1T-MB339C-1-1 "Performance Data". The throttle may be slammed open, when required, for a rapid acceleration but the engine life and characteristics will be maintained longer if the throttle is operated slowly and abrupt rpm variations are kept to a minimum.

CAUTION

Ensure that the engine throttle is not moved beyond the "IDLE" position when retarded.

10. "WINDSHIELD/DEMIST" switch - As required.
11. "WINDSHIELD/RAIN RMVL" switch - As required.
12. "CABIN TEMP" selector - AUTO and at the desired temperature.

FLIGHT CHARACTERISTICS

For information regarding the aircraft flight characteristics, refer to Section VI.

IN-FLIGHT PROCEDURE

POSITION UPDATE OR MARK

Updating or marking of the present position can be performed in flight whatever the selected RDU display mode, provided that the "RNAV" push-button light, on the "HSI" control panel, is pressed. Three forms of update/mark are available with the same entry sequence used for each:

- Present position fix to a stored waypoint (any waypoint except 00 and from 90 to 99).
- Direct update (fix) of the present position (waypoint 00 only). See figure 2-6.
- Mark of present position into a waypoint store (waypoint from 90 to 99 only). See figure 2-7.

In all three cases the entry sequence is initiated by pressing the update push-button on the control stick grip. Entry can be performed whichever of the POS, WPT, STR, FPL or TEST modes are currently being displayed on the RDU. Any other entry sequence in process and not completed is interrupted by pressing the update switch. On pressing the push-button to start the sequence, the current position is memorized and displayed on the DEP. This fixed value will be retained on the DEP until the update/mark entry is cancelled by pressing any of the DEP navigation mode keys. If the update push-button is pressed again the DEP displayed position will be replaced with the next instantaneous present position.

NOTE

> Present position updates are used to correct indipendent navigation errors when either Inertial or Doppler or air data navigation reversionary mode is operating (i.e. radio navigation mode not available). If a radio navigation mode is operating, then the position update will not be accepted by the NCU. Mark operation is available at all times.

PRESENT POSITION FIX TO A STORED WAYPOINT

This method allows the NCU stored data base of waypoint, airfields and beacons to be used to update (fix) the present position. See figure 2-6.

DIRECT FIX OF PRESENT POSITION

This fix method is used to update the present position by overflying a known point which is not stored as a waypoint, or to update the present position from a reported ground radar (or other) position fix. Enter the fix using the procedure detailed in figure 2-7. Entry is allowed in latitude-longitude or UTM grid coordinates, whichever is currently selected. When the "ENT" key is pressed to complete the sequence, the NCU present position is updated to correct for the position error between the value temporarily stored when the update push-button was pressed and the inserted value.
The corrected position will be displayed on the RDU when the "POS" push-button is pressed.

MARK OF PRESENT POSITION

This facility allows the transfer of the coordinates of a point of tactical interest into the NCU waypoint store (WPT 90 to 99 only) for later retrieval, during debriefing or for subsequent use during navigation. The procedure is detailed in figure 2-8. Until the "ENT" key is pressed to complete the sequence, the mark position will not be transferred to the designated waypoint store in the NCU. The mark waypoint can be displayed on the RDU by pressing the "WPT" key and entering the mark waypoint number.

PILOT'S CHANGE OF STEERPOINT (USE)

Manual change of a steerpoint can be made at any time by:

1. Selecting the WPT mode and displaying on the RDU the waypoint which is to be the next steerpoint: this is obtained selecting the desired waypoint with the alphanumerical keys and then pressing the "ENT" key.

PRESENT POSITION FIX

ACTION	DEP DISPLAY	RDU DISPLAY	REMARKS
When overhead the way-point press the navigation fix-mark push-button on the control stick	Istantaneous present position (latitude/longitude or UTM whichever currently selected)	No change	NCU temporarily stores the-present position and dislays this on the DEP. This is retained until the entry is completed or until button is again pressed or another made is selected
Press **SET**	WP ----	No change	Waypoint identify pro;mted on DEP
Press **3, 7**	WP 37 ER 03.7	No change	If stored beacon or airport is to be used then each key is held pressed until the correct letter appears. When the last identify character is inserted the position error is displayed on the DEP
Press **ENT**	Blank	Range, bearing time, fuel used and position when shown, will change according to the update introduced	NCU present position is updated. Updated position is displayed on RDU if PP is selected

NOTE 1: Waypoint numbers 00 and 90 to 99 cannot be used.

NOTE 2: Until the **ENT** key is pressed to complete the fix sequence, the NCU present position will not be updated. The updated present position can be displayed on the RDU by pressing **PP** key.

NOTE 3: If the inserted waypoint identify is not stored, the error display shows ER *** and the **ENT** key must not be pressed.

Figure 2-6

DIRECT FIX OF PRESENT POSITION

ACTION	DEP DISPLAY	RDU DISPLAY	REMARKS
When overhead the defined position press the navigation fix-mark push-button on the control stick	Istantaneous present position (latitude/longitude or UTM whichever currently selected)	No change	NCU temporarily stores the present position and dislays this on the DEP. This is retained until the entry is completed or until button is again pressed or another mode is selected
Press **SET**	WP ----	No change	Waypoin identify prompted on DEP
Press **0, 0**	WP 00	No change	Direct present position (WPT 00) update selected
Press **ENT**	N --° --- E ---° ---	No change	Latitude/longitude position insertion prompted on DEP (if LL selected)
Press **4, 5, 5, 1, 8, 0, 0, 8, 5, 2, 9**	N45°51.8 E008°52.9	No change	As each character is entered it replaces a dash (-)
Press **ENT**	Blank	Range, bearing time, fuel used and position when shown, will change according to the update introduced	NCU present position is pdated. Updated position is displayed on RDU if PP is selected

Figure 2-7

MARK OF PRESENT POSITION

ACTION	DEP DISPLAY	RDU DISPLAY	REMARKS
When overhead the mark point press the navigation fix-mark push-button on the control stick	Istantaneous present position (latitude/longitude or UTM whichever currently selected)	No change	NCU temporarily stores the-present positio and diplays this on the DEP. This is retained until the entry is completed or until button is again pressed or another mode is selected
Press **SET**	WP ----	No change	Waypoin Identify prompted on DEP
Press **9, 4**	WP 94 MARK	No change	On inserting the second ident numeral the choice of a mark waypoint is annunciated
Press **ENT**	Blank	No change	Stored position is stopred in the NCU as waypoint 94

Figure 2-8

2. Pressing the "USE" key, on the DEP, at the required point of waypoint changeover. On pressing the "USE" key, the manual navigation mode commences with steering guidance given from the aircraft present position to the new steerpoint. If the flight plan navigation mode is currently operating, manual selection of a new steerpoint results in the termination of the flight plan navigation mode

SELECTION FOR USE OF THE FLIGHT PLAN

The prestored flight plan can be called into use at any time starting at sequence number F0 by the following procedure:

1. Press "FPL" key on the DEP to select and display the flight plan navigation mode on the RDU from present position to F0 displayed.
2. Press the "USE" key on the DEP.
   On pressing the "USE" push-button, the flight plan navigation mode commences, annunciated by the display of the F sequence number of the new steerpoint (F0), with steering guidance given direct from present position to the F0 waypoint. On reaching F0, the steerpoint is automatically changed to F1, and so on until the flight plan sequence is complete.

DESCENT/REJOIN CHECKS

Refer to the "Performance Data" manual for the recommended descent speeds, time required, fuel consumed and distances travelled in descent. Refer to Section VI for the chart of altitude lost during dive recovery.

CAUTION

> Ensure that the engine throttle is not moved beyond the "IDLE" position when retarded.

1. UHF and VHF radio equipment - Set frequencies/channels.
2. "LDG LT/TAXI-NOSE LT" switch - TAXI-NOSE LT.
3. Master armament switch, on "SMS" control panel - SAFE.
4. Flight instruments:
   a. HSI/ADI - Check.
   b. Cross check with HUD.
5. Altimeter - Adjust.
6. "ANTI-ICE" indicator panel:
   a. "PITOT" indicator - ON.
   b. "ENG" indicator - As required.
7. Fuel quantity - Check.
8. Hydraulic pressures - Check.
9. Navigation equipment - Set as required.
10. "WINDSHIELD/DEMIST" switch - ON.

NOTE

> To prevent misting of the canopy and windshield interior surfaces during rapid descents from high altitude, select maximum cockpit temperature several minutes before starting descent.

11. Harness - Locked.

INSTRUMENT APPROACH

HOLDING, PENETRATION AND TACAN APPROACH (Typical) (Figure 2-9)

Holding Pattern (Any Altitude)

1. Configuration - Cruise.
2. Airspeed - 180 KIAS.
3. Throttle - 75% to 80% rpm.

Penetration Descent

4. Airspeed - 250 KIAS.
5. Speedbrake - Extend.
6. Throttle - 75% rpm.

Penetration Turn

7. Bank - 30° max.

Level-off

8. 1000 feet above the desired altitude, halve the pitch attitude.
9. Level off allowing the speed to reduce below 175 KIAS with throttle unchanged and speedbrake still extended.
10. Below 175 KIAS:
    a. Landing gear - Down.
    b. Speedbrake - Retract.
    c. Wing flaps - T/O.
    d. Airspeed - 140 KIAS.
    e. Throttle - As required to maintain speed (approx 80% rpm).

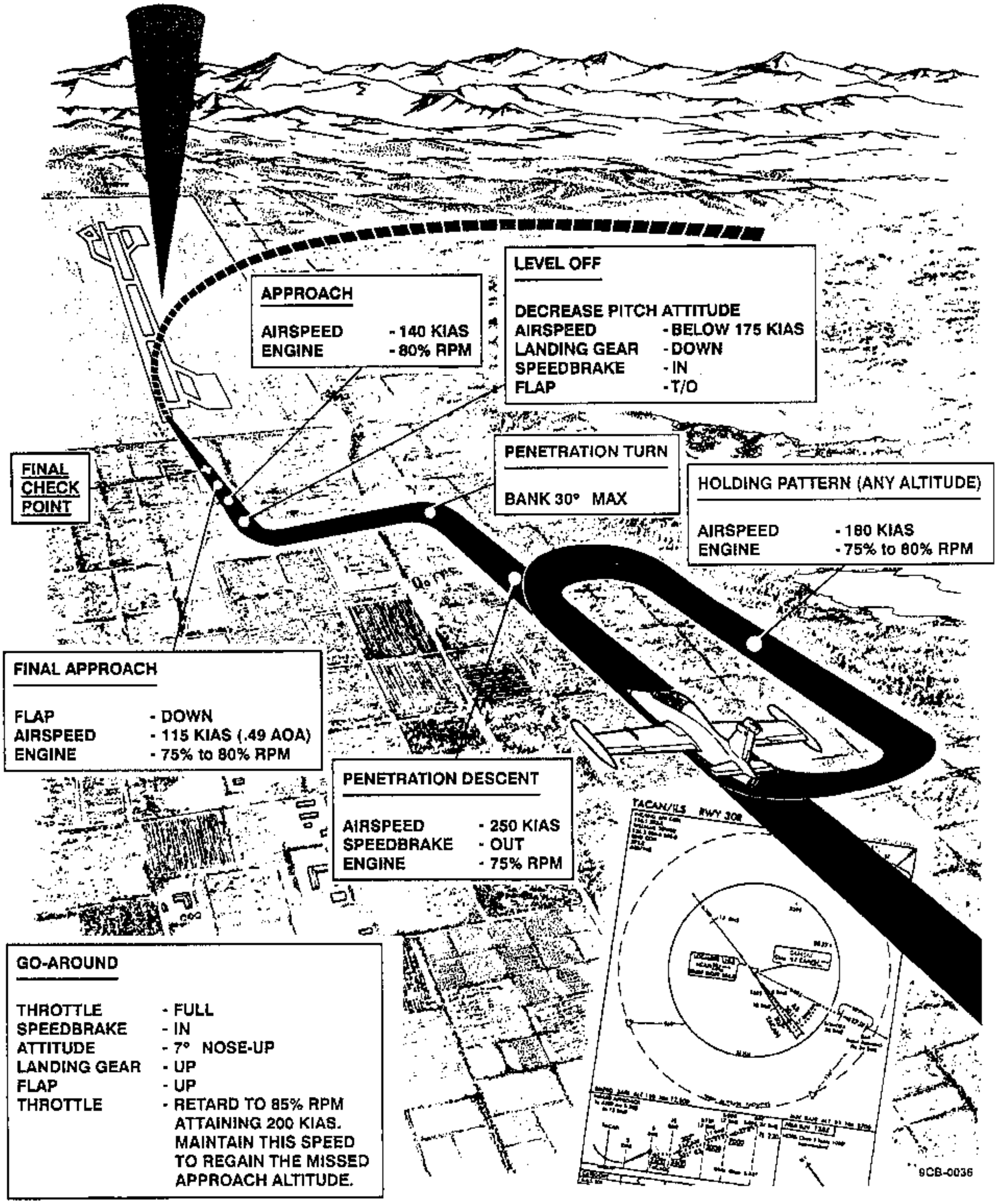
Approach

11. Airspeed - 140 KIAS.
12. Landing gear - Down.
13. Wing flaps - T/O.
14. Speedbrake - Retracted.
15. Throttle - As required (approx 80% rpm).

Final Approach

16. Wing flaps - Down (starting descent).
17. Airspeed - 115 KIAS (.49 AOA).
18. Landing gear - Check down.
19. Speedbrake - Check retracted.
20. Throttle - As required (75% to 80% rpm).

HOLDING, PENETRATION AND TACAN APPROACH (TYPICAL)



HOLDING PATTERN (ANY ALTITUDE)

AIRSPEED - 180 KIAS
ENGINE - 75% to 80% RPM

PENETRATION DESCENT

AIRSPEED - 250 KIAS
SPEEDBRAKE - OUT
ENGINE - 75% RPM

PENETRATION TURN

BANK 30° MAX

LEVEL OFF

DECREASE PITCH ATTITUDE
AIRSPEED - BELOW 175 KIAS
LANDING GEAR - DOWN
SPEEDBRAKE - IN
FLAP - T/O

APPROACH

AIRSPEED - 140 KIAS
ENGINE - 80% RPM

FINAL CHECK POINT

FINAL APPROACH

FLAP - DOWN
AIRSPEED - 115 KIAS (.49 AOA)
ENGINE - 75% to 80% RPM

GO-AROUND

THROTTLE - FULL
SPEEDBRAKE - IN
ATTITUDE - 7° NOSE-UP
LANDING GEAR - UP
FLAP - UP
THROTTLE - RETARD TO 85% RPM ATTAINING 200 KIAS. MAINTAIN THIS SPEED TO REGAIN THE MISSED APPROACH ALTITUDE.

Figure 2-9

Go-around

1. Throttle - FULL.
2. Speedbrake - Retracted.
3. Attitude - 7-degree nose-up, wings level.
4. Landing gear - UP (with positive climb indications).
5. Wing flaps - UP between 120 and 150 KIAS.
6. Throttle - Retard to 85% rpm approaching 200 KIAS. Maintain this speed until reaching the missed approach altitude.

RADAR APPROACH (Typical) (Figure 2-10)

Entry

1. Configuration - Cruise.
2. Airspeed - 200 KIAS.
3. Engine - 75% to 80% rpm.

Downwind

4. Configuration - Cruise.
5. Airspeed - 200 KIAS.
6. Throttle - 75% to 80% rpm.
7. Speedbrake - Retracted.

Base Leg

8. Speedbrake - Extend.
9. At 175 KIAS:
    a. Landing gear - Down.
    b. Speedbrake - Retract.
    c. Wing flaps - T/O.
    d. Airspeed - Allow to reduce to 140 KIAS.
10. Throttle - As required to maintain 140 KIAS (approx 80% rpm).

Final Turn

11. Speed - 140 KIAS.
12. Landing gear - Check down.
13. Wing flaps - Check T/O.
14. Speedbrake - Check retracted.
15. Throttle - As required to maintain 140 KIAS (approx 80% rpm).

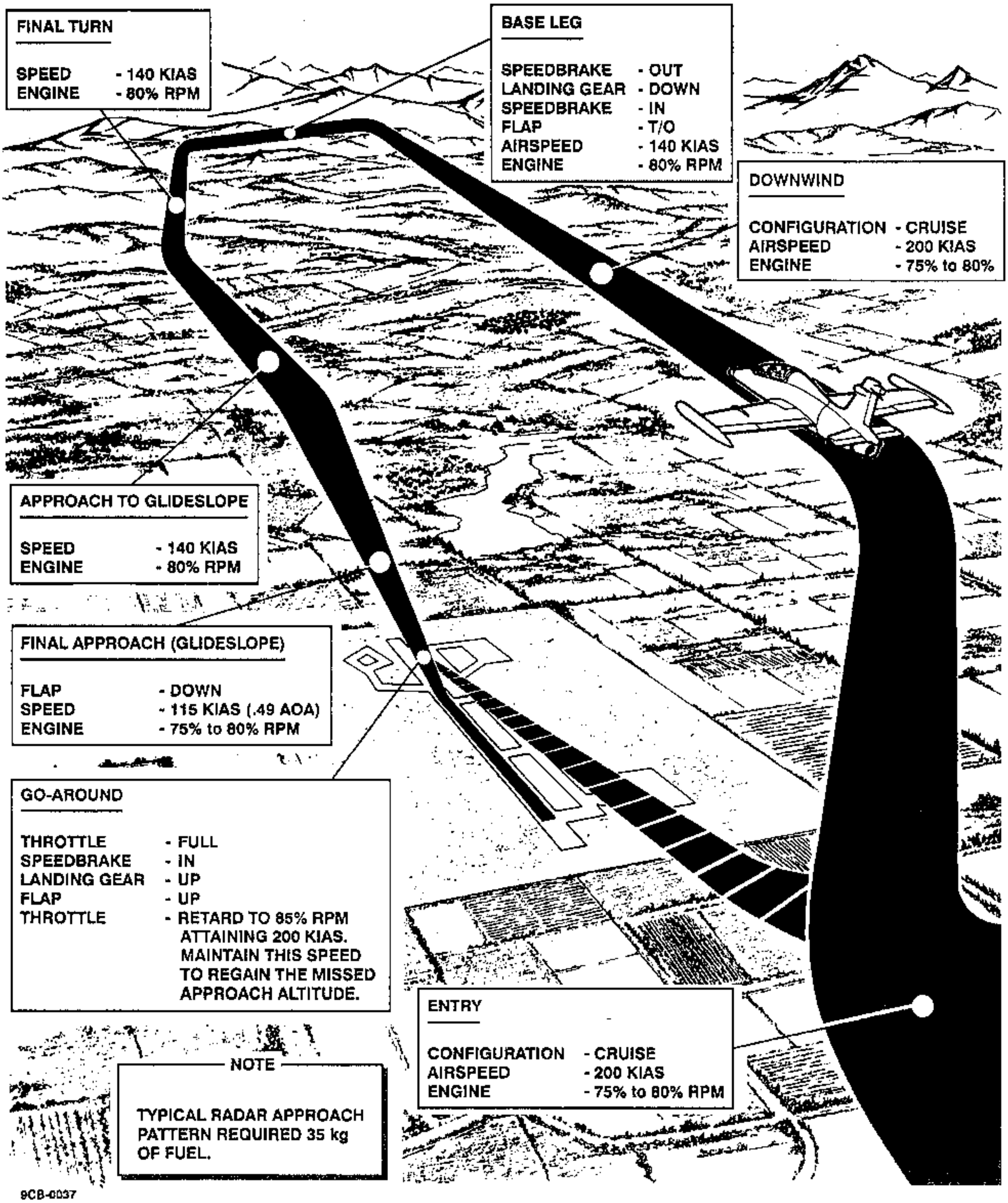
Approach to Glideslope

16. As in final turn.

Final Approach (Glideslope)

17. Wing flaps - Down (starting descent).

RADAR APPROACH (TYPICAL)



FINAL TURN

SPEED - 140 KIAS
ENGINE - 80% RPM

BASE LEG

SPEEDBRAKE - OUT
LANDING GEAR - DOWN
SPEEDBRAKE - IN
FLAP - T/O
AIRSPEED - 140 KIAS
ENGINE - 80% RPM

DOWNWIND

CONFIGURATION - CRUISE
AIRSPEED - 200 KIAS
ENGINE - 75% to 80%

APPROACH TO GLIDESLOPE

SPEED - 140 KIAS
ENGINE - 80% RPM

FINAL APPROACH (GLIDESLOPE)

FLAP - DOWN
SPEED - 115 KIAS (.49 AOA)
ENGINE - 75% to 80% RPM

GO-AROUND

THROTTLE - FULL
SPEEDBRAKE - IN
LANDING GEAR - UP
FLAP - UP
THROTTLE - RETARD TO 85% RPM ATTAINING 200 KIAS. MAINTAIN THIS SPEED TO REGAIN THE MISSED APPROACH ALTITUDE.

ENTRY

CONFIGURATION - CRUISE
AIRSPEED - 200 KIAS
ENGINE - 75% to 80% RPM

NOTE

TYPICAL RADAR APPROACH PATTERN REQUIRED 35 kg OF FUEL.

Figure 2-10

18. Airspeed - 115 KIAS (.49 AOA).
19. Landing gear - Check down.
20. Speedbrake - Check retracted.
21. Throttle - As required to maintain speed (75% to 80% rpm).

Go-around

1. Throttle - FULL.
2. Speedbrake - Retracted.
3. Attitude - 7-degree nose-up, wings level.
4. Landing gear - UP (with positive climb indications).
5. Wing flaps - UP between 120 and 150 KIAS.
6. Throttle - Retard to 85% approaching 200 KIAS. Maintain this speed until reaching the missed approach altitude.

ILS APPROACH (Typical) (Figure 2-11)

Entry

1. Configuration - Cruise.
2. Airspeed - 200 KIAS.
3. Throttle - As required to maintain speed (75% to 80% rpm).

Approach to Glideslope

4. Speedbrake - Extend.
5. At 175 KIAS:
   a. Landing gear - Down.
   b. Speedbrake - Retract.
   c. Wing flaps - T/O.
   d. Speed - Allow to reduce to 140 KIAS.
6. Throttle - As required to maintain 140 KIAS.
7. Maintain speed and configuration until the glideslope is intercepted.

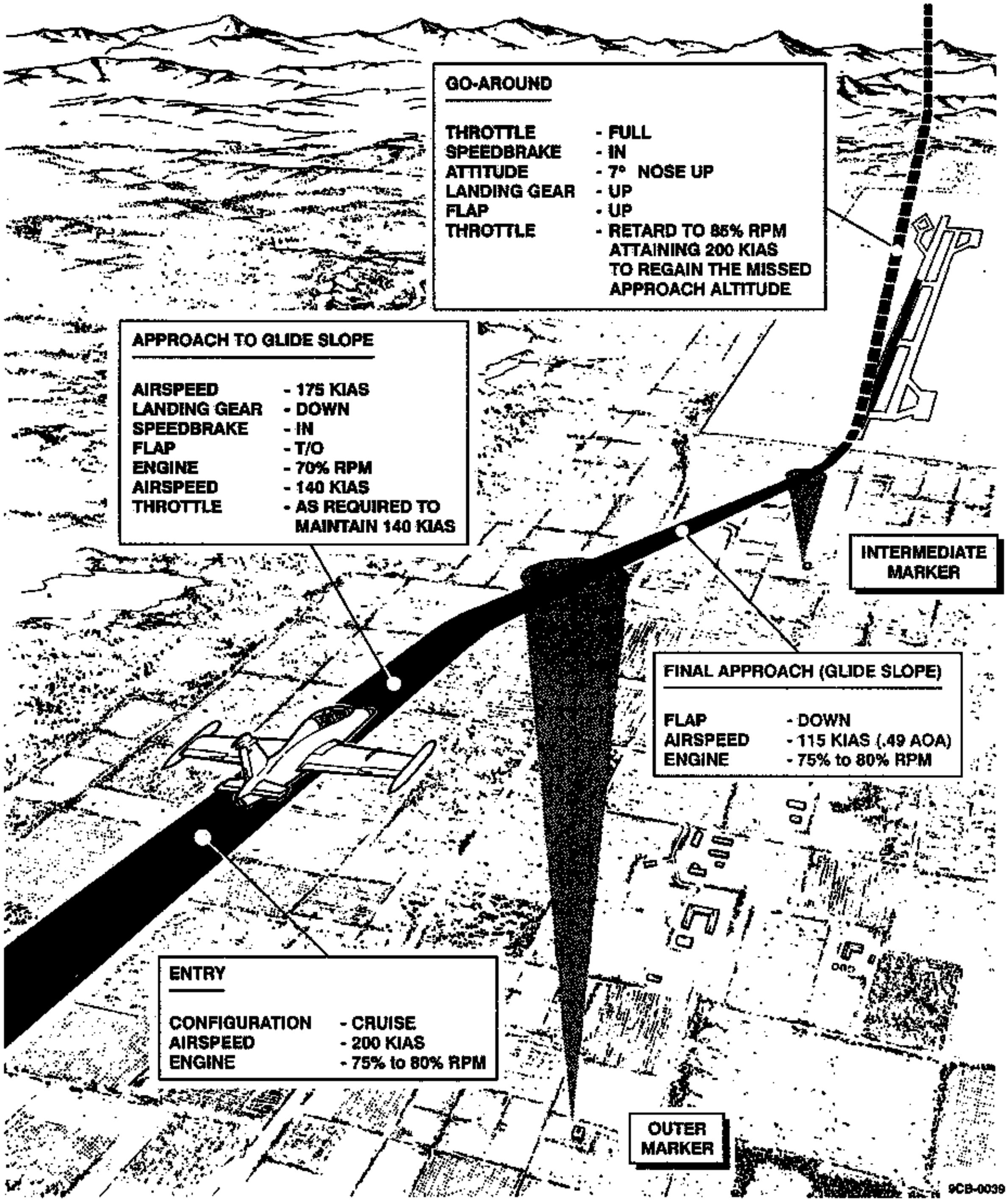
Final Approach (Glideslope)

8. Wing flaps - Down (starting descent).
9. Speed - 115 KIAS (.49 AOA).
10. Landing gear - Check down.
11. Speedbrake - Check retracted.
12. Throttle - As required to maintain speed (75% to 80% rpm).

Go-around

1. Throttle - FULL.
2. Speedbrake - Retracted.
3. Attitude - 7-degree nose-up, wings level.
4. Landing gear - UP (with positive climb indications).

ILS APPROACH (TYPICAL)



GO-AROUND

THROTTLE	- FULL
SPEEDBRAKE	- IN
ATTITUDE	- 7° NOSE UP
LANDING GEAR	- UP
FLAP	- UP
THROTTLE	- RETARD TO 85% RPM ATTAINING 200 KIAS TO REGAIN THE MISSED APPROACH ALTITUDE

APPROACH TO GLIDE SLOPE

AIRSPEED	- 175 KIAS
LANDING GEAR	- DOWN
SPEEDBRAKE	- IN
FLAP	- T/O
ENGINE	- 70% RPM
AIRSPEED	- 140 KIAS
THROTTLE	- AS REQUIRED TO MAINTAIN 140 KIAS

FINAL APPROACH (GLIDE SLOPE)

FLAP	- DOWN
AIRSPEED	- 115 KIAS (.49 AOA)
ENGINE	- 75% to 80% RPM

ENTRY

CONFIGURATION	- CRUISE
AIRSPEED	- 200 KIAS
ENGINE	- 75% to 80% RPM

Figure 2-11

5. Wing flaps - UP between 120 and 150 KIAS.
6. Throttle - Retard to 85% rpm approaching 200 KIAS. Maintain this speed until reaching the missed approach altitude.

APPROACH AND LANDING (Figure 2-12)

Initial

1. Speed - 250 KIAS.
2. Altitude - 1500 ft (AGL).

Break

5. Throttle - 60% rpm.
6. Speedbrake - Extend.

Prelanding

5. Master armament switch, on "SMS" control panel - Check SAFE position.
6. Harness - Locked.
7. Landing gear - Down (below 175 KIAS). Check the three green advisory lights for illumination and ensure that the speedbrake, if extended, retracts to half way.

NOTE

The illumination of the taxi light is dependant on the locking of the landing gear in the down position. To permit the control tower to check for landing gear down, move the "LDG LT-TAXI/ /NOSE LT" switch to TAXI/NOSE LT.

8. Speedbrake - Retract. Check the indicator.
9. Wing flaps - T/O (below 175 KIAS). Check the flap indicator for corresponding position.
10. Hydraulic pressures - Check.
11. Throttle - As required to maintain 140 KIAS.

Base Turn - Final

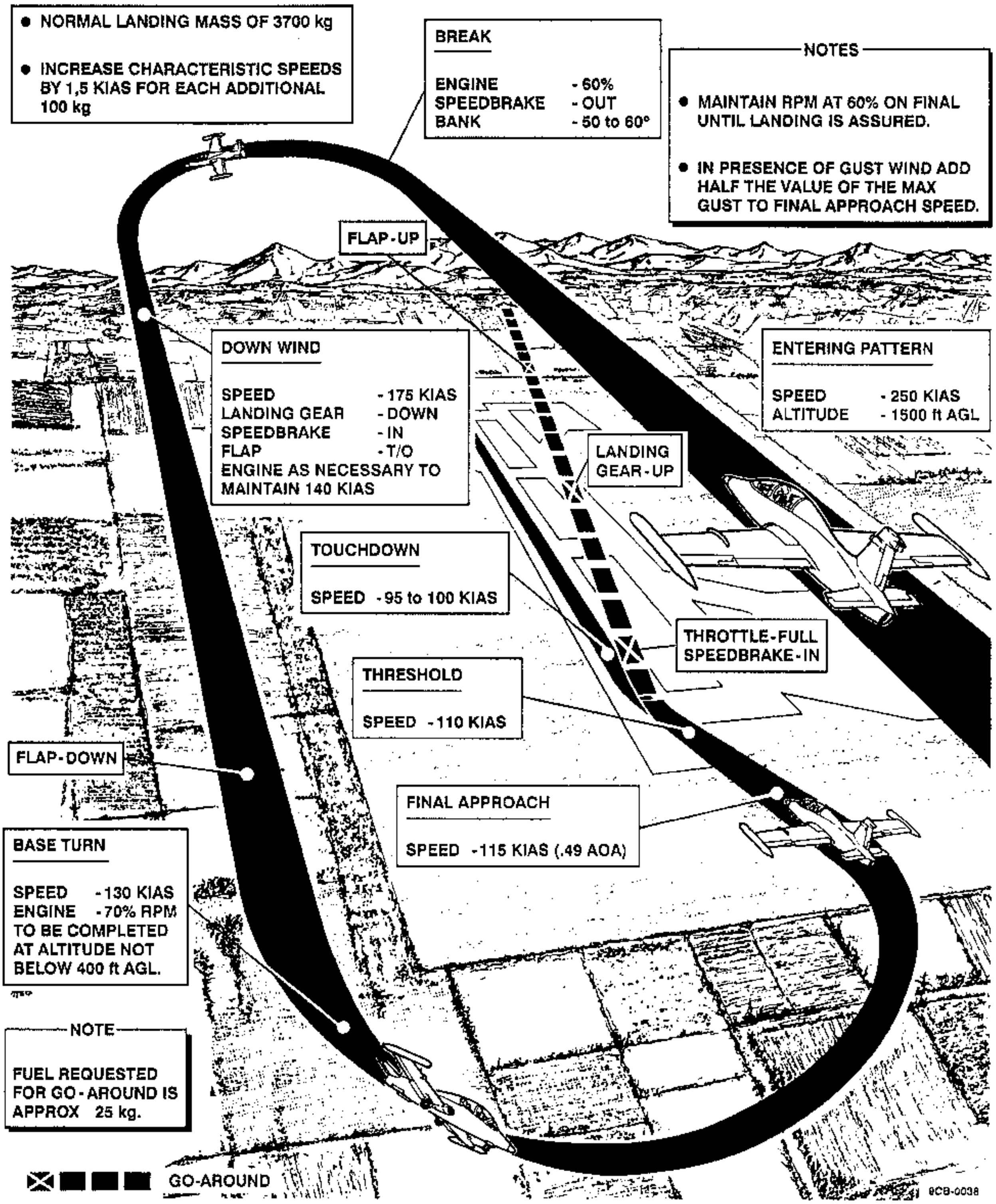
12. Before starting base turn: wing flaps - Down. Check full extension of flaps on the indicator.
13. Base turn - Maintain 130 KIAS plus corrections (approx 70% rpm).

NOTE

- On approach (until landing is assured) it is recommended that at least 60% rpm be maintained in order to obtain the optimum engine acceleration time in the event of an overshoot. The acceleration time increases by approx. 0.5 second for every 5% rpm below 60%
- The landing gear down position can be confirmed to the control tower by operating the "UNCAGE" push-button on the engine throttle.

14. Complete turn at not less than 400 feet AGL.
15. On final - Maintain 115 KIAS plus corrections (.49 AOA).
16. Landing light - As required.

LANDING AND GO AROUND (TYPICAL)



- NORMAL LANDING MASS OF 3700 kg
- INCREASE CHARACTERISTIC SPEEDS BY 1,5 KIAS FOR EACH ADDITIONAL 100 kg

BREAK

ENGINE - 60%
SPEEDBRAKE - OUT
BANK - 50 to 60°

NOTES

- MAINTAIN RPM AT 60% ON FINAL UNTIL LANDING IS ASSURED.
- IN PRESENCE OF GUST WIND ADD HALF THE VALUE OF THE MAX GUST TO FINAL APPROACH SPEED.

FLAP-UP

DOWN WIND

SPEED - 175 KIAS
LANDING GEAR - DOWN
SPEEDBRAKE - IN
FLAP - T/O
ENGINE AS NECESSARY TO MAINTAIN 140 KIAS

ENTERING PATTERN

SPEED - 250 KIAS
ALTITUDE - 1500 ft AGL

LANDING GEAR-UP

TOUCHDOWN

SPEED - 95 to 100 KIAS

THROTTLE-FULL
SPEEDBRAKE-IN

THRESHOLD

SPEED - 110 KIAS

FLAP-DOWN

FINAL APPROACH

SPEED - 115 KIAS (.49 AOA)

BASE TURN

SPEED - 130 KIAS
ENGINE - 70% RPM
TO BE COMPLETED AT ALTITUDE NOT BELOW 400 ft AGL.

NOTE

FUEL REQUESTED FOR GO-AROUND IS APPROX 25 kg.

☒■■■ GO-AROUND

Figure 2-12

CAUTION

If installed, the blind flying hood must be kept in the open position in order to ensure safe seat ejection in the case of an emergency.

17. Threshold speed - 110 KIAS plus corrections.
18. Touchdown speed - 95 to 100 KIAS plus corrections.

NOTE

Increase standard speeds by 1.5 KIAS for every 100 kg in excess of 3700 kg.

LANDING

NOTE

The illumination of the "STEER" advisory light when the aircraft is airborne, indicates a failure in the nosewheel steering system. In this case, bear in mind that the nosewheel may or may not be slaved to the rudder pedals.

During landing, use the AOA indication as the primary reference throughout the final approach phase (figure 1-56). For the landing airspeeds and ground rolls, refer to the "Performance Data" manual. If the runway length and conditions permit, aerodynamic braking may be carried out to conserve brakes and tires. To perform aerodynamic braking, increase the aircraft nose-up attitude after touchdown by gradually moving the control stick back to the full aft position. Lower the aircraft nose and bring the nosewheel in contact with the runway before the elevator becomes ineffective (at about 70 KIAS). As soon as the nosewheel is in contact with the runway, raise the flaps and apply the brakes smoothly and progressively. Maintain directional control during the landing roll by use of the rudder. Do not engage nosewheel steering. As the speed reduced below 50 KIAS maintain directional control by differential braking. At the end of the landing roll, engage the nosewheel steering ("STEER" indicator light on), then use the rudder pedals for directional control.

CAUTION

- Prior to engaging the nosewheel steering control, ensure that the rudder pedals are centered.
- Be prepared to disengage the nosewheel steering in case of a system malfunction.

CROSS-WIND LANDING

Cross-wind landings may be performed by using the normal landing procedures. However, while using normal approach speeds, counteract the drift by crab method, by the wing down method or by a combination of both, to keep the aircraft track aligned with the runway, levelling the wings just prior to touchdown. In the case of strong crosswinds and/or with gusty winds with the possibility of wind shear, it is recommended to land with T/O flap. This is to improve the aircraft lateral control and to obtain a quicker increase of airspeed with engine thrust, if needed. After touchdown, keep the control stick into wind and lower the nosewheel smoothly to the runway as soon as practical, maintaining a centerline track with rudder and, if needed, moderate use of brakes.

NOTE

Refer to the cross-wind takeoff and landing chart in the "Performance Data" manual for the effect of cross-wind.

LANDING AT HIGH MASS

When a landing at high mass must be made, for the aircraft structural integrity, bear in mind that the maximum sink rate at touchdown is much lower with high mass than with normal landing mass (See limitations chart in Section V). A straight-in approach should, therefore, be flown at the airspeed specified in the "Performance Data" manual, using power to control the sink rate. The flare should be gradual and the touchdown smooth. A stall prior to touchdown could result in an abrupt and uncontrollable increase in sink rate and the permissible limits being exceeded.

CAUTION

The vertical velocity indicator readings are subject to lag, therefore they are reliable during approach under constant conditions, but not in transient phases such as flare and touch-down.

NORMAL ANTISKID BRAKING, DRY RUNWAY

During a normal landing, the use of maximum aerodynamic braking and of the full length of the runway to stop the aircraft will conserve the wheel brakes. However, when a minimum landing run stopping the aircraft in the shortest possible distance is required, the correct final approach and touchdown speeds should be closely monitored. After touchdown the nosewheel should be lowered, and the control stick moved fully forward. Apply the brakes firmly and fully and allow the anti-skid system to provide the maximum deceleration. The antiskid system will function to give maximum performance braking. Be prepared to release the brakes in the event of an anti-skid system failure. Maximum performance braking at high mass and high speed may result in fuzed brakes. Releasing the brakes before coming to a full stop will minimize the chance of this happening.

CAUTION

- Maximum performance braking at high mass will result in hot brakes. The aircraft should be parked in an isolated area with the wheel axis pointed in a safe direction.
- If brake overheating is discovered when the aircraft is stopped, it is advisable to wait for the brakes and tires to cool down before flying again (approx. 30 min).

MANUAL BRAKING, DRY RUNWAY (ANTISKID DISCONNECTED OR NOT OPERATIONAL)

To obtain optimum braking action with the antiskid system disconnected or not operational, apply brakes in a single, smooth application with constantly increasing pedal pressure. Exercise care after touchdown at any time when there is still considerable lift on the wings to prevent skidding and possibly blown tires. For maximum performance manual braking, attempt to hold the brake pressure just short of wheel skidding. If skidding occurs, momentarily release all the brake pressure and reapply the brakes. This procedure will provide the shortest stopping distance possible from wheel braking action without the antiskid system. Nose wheel steering should be engaged to maintain directional control after the rudder becomes ineffective or whenever deemed necessary by the pilot.

LANDING ON WET/ICY RUNWAY

The technique for a landing on a wet or icy runways is essentially the same as for a normal landing. Particular attention must be paid to maintaining the final approach speed and to touching down as close to the end of the runway as safety permits. As with the normal landing technique, reduce power to IDLE immediately upon touchdown, and gradually increase back stick to obtain the full effect of aerodynamic braking throughout the landing roll. Apply full brakes as the nose falls through. The antiskid system provides protection against a locked wheel and can effectively and safely produce the maximum deceleration possible for the existing runway conditions. During the high speed portion of the landing roll, little braking deceleration is obtained because the braking potential is very low. As the braking potential increases with decreased speed, the antiskid system increases deceleration accordingly.

Nosewheel steering will be required to maintain directional control due to aircraft fishtailing. Use a crosswind landing procedure if a crosswind exists. Manual braking on a wet or icy runway requires more care. The most effective braking technique is to apply the brakes intermittently. The brakes should be momentarily released and reapplied when a skid is felt. Once locked, a wheel remains locked for as long as brake pressure is maintained. This procedure provides the shortest stopping distance possible for wheel braking action without the antiskid system. Manual braking will probably result in locked wheels. Nosewheel steering is required to maintain directional control if the aircraft begins skidding during manual braking.

GO-AROUND (Figure 2-12)

Before Touchdown

The decision to go-around should be made as early as possible using full power, if required. If conditions do not permit a go-around, do not try to keep the aircraft off the ground: continue to fly the aircraft to touchdown and follow this procedure:

1. Advance the throttle to FULL.
2. Retract the speedbrake if extended.
3. Continue normal approach (or descent) until the engine is at full power and the aircraft speed increases.
4. Establish the takeoff attitude.
5. When a positive rate of climb is established, retract the landing gear.
6. Between 120 and 150 KIAS - Flaps to UP.
7. Landing light - Retract, if out.
8. Longitudinal trim - As required.
9. Check the landing gear, speedbrake and flap position indicators.

NOTE

If a touchdown is made, lower the nose slightly and accelerate to takeoff speed, then establish the takeoff attitude and allow the aircraft to fly off the ground.

Touch-and-Go Landing

The following procedure is to be adopted when a normal landing has been attempted, the wheels are in contact with the runway, and it is necessary to takeoff again, before allowing the aircraft to come to a stop:

1. Advance throttle to FULL.
2. Retract the speedbrake, if extended.
3. Check engine instruments.
4. Leave the flaps in the position selected for landing.
5. Accelerate to takeoff speed, then establish the takeoff attitude and allow the aircraft to fly off the ground.
6. Retract the landing gear.
7. Between 120 and 150 KIAS - Flaps to UP.
8. Landing light - Retract, if out.
9. Longitudinal trim as required.
10. Check the landing gear, speedbrake and flap position indicators.

WARNING

Touch-and-go landings encompass all aspects of the landing and takeoff procedures in a relatively short time span. Be constantly alert for possible aircraft malfunctions or incorrect procedures during these two critical phases of flight.

AFTER LANDING

After completion of the landing roll and when clear of the runway:

1. Wing flap and speedbrake controls - Check UP and IN. Check the indicators.
2. Trims - In neutral position.
3. Landing light - Turn off, if illuminated.
4. Taxi light - As required.
5. Stand-by attitude indicator - Caged.
6. Hydraulic pressure - Within the prescribed values.
7. "IFF" control panel - Master selector OFF.
8. "TCN" control panel - Function selector OFF.
9. "VOR/ILS/DME" control panel - Function selector OFF.
10. "ADF" control panel - Function selector OFF.
11. "WINDSHIELD/DEMIST" and "WINDSHIELD/RAIN RMVL" switches - OFF.
12. "ANTI-ICE/ENGINE" and "ANTI-ICE/PITOT" switches - OFF.
13. Seat safety pin - In place.
14. "SEAT" warning light - Illuminated.
15. Canopy - As desired.

CAUTION

- Care should be exercised when opening the canopy in a strong wind.
- During taxiing, the canopy must be closed or open to the intermediate position. If the canopy is kept in the intermediate position,the safety pin of the seat firing handle must be inserted.

ENGINE SHUT-DOWN

1. Taxi light - Off prior to entering line (night only).
2. Parking brake - Applied.

CAUTION

Avoid applying the parking brakes if the brakes are suspected of being overheated.

3. On crew chief's signal:
   a. Speedbrake - Extended.
   b. Wing flaps - Down.

NOTE

Following prolonged running at high power, with the aircraft stationary, the engine should be run at 60% rpm for at least 5 minutes prior to shut-down except in an emergency.

4. Throttle - Approx 60% rpm.
5. Throttle - STOP.

NOTE

Do not wait for JPT stabilization before shutting down the engine.

6. "IRS" control panel - Mode selector knob OFF.
7. UHF and VHF sets - Off.
8. MFD - "BRT/OFF" knob to OFF.
9. PDU - Off ("PWR" switch in lower position).
10. "BCN" switch - OFF.
11. When the engine has stopped turning:
    a. "ENG/MSTR" switch - OFF.
    b. "GEN 1" and "GEN 2" switches - OFF.
    c. "BATT" switch - OFF.

CAUTION

Keep clear of the tail pipe and do not move the aircraft into a hangar for at least 15 minutes after engine shutdown because of the possibility of explosion from fuel vapor accumulation.

BEFORE LEAVING THE AIRCRAFT

CAUTION

When performing the following operations, avoid placing bulky material on top of the instrument panel as these may damage the windshield interior surface.

1. Wheel chocks - In place.
2. "PARK & EMER BK" handle - Released, if previously pulled out.
3. Check that the safety pin is in place in the seat firing handle.
4. Disconnect the following:
    a. Oxygen supply line and mask.
    b. Radio connections.
    c. Anti-g suit hose.

NOTE

Fasten the oxygen supply line end to the aircraft side by use of the special snap fastener.

5. Move the oxygen supply lever to OFF.

6. Release the harness by rotating the quick-release fitting disc 90° and pressing smartly.
7. Operate the leg restraint lines release lever and slide the lines out of the garters.
8. Disconnect the survival pack lowering line from the lifejacket.
9. Leave the aircraft.

WARNING

> When leaving the aircraft, exercise care to ensure you are clear of the hooks protruding from the canopy sill.

10. Close and lock the canopy.

WARNING

> Use the special handle when closing the canopy from the outside to prevent personal injury. Only minimum clearance is afforded between the left canopy breakers of the seat and the canopy rim.

11. Enter any discrepancies found, and the limitations exceeded during flight in the aircraft log book.

SECTION III

EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION

This section covers the operation of the aircraft during emergency/abnormal conditions. It includes a discussion of problem indications and corrective actions as well as procedural steps, when applicable. Adherence to these guidelines will insure maximum safety for the pilot and/or aircraft. However multiple emergencies, weather, or other factors may require modifications of the recommended procedures.

NOTE

The most important steps are written in capital letters and must be committed to memory.

When dealing with emergency/abnormal conditions, it is essential that the pilot determine the most correct course of action by using sound judgment and a full understanding of the applicable system(s). The following rules are basic to all emergency/abnormal conditions and should be throughly understood and applied by the pilot:

1. Mantain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as possible or as soon as practical.

The "Land as soon as possible" and "Land as soon as practical" sentences used in this emergency procedures section have the following meaning:

Land as soon as possible.

Requirement arising from a well defined emergency condition. A landing shall be accomplished at the nearest suitable airfield.

Land as soon as practical.

Emergency conditions are less urgent and, although the mission must be aborted, an immediate landing may not be necessary.

For most emergency situations an appropriate radio call should be made on the channel in use or, if contact is not made, on the guard channel. Under these circumstances it is recommended that the "MASTER" switch of the IFF be also set to EMER.

CONTROL AVAILABILITY IN THE TWO COCKPITS

The procedures given in this section refer to the pilot in the front cockpit. The controls in the front cockpit are not fully duplicated in the rear cockpit. Therefore the rear pilot, when in control must instruct the front pilot to actuate the following controls, available in the front cockpit only:

- Power supply switches: "BATT", "GEN 1", "GEN 2", "AC POWER", "SEC BUS RESET".
- Engine switches: "START", "JPT LMTR" and "MSTR".
- "FUEL TRANSFER" selector switch.
- Air-conditioning control panel: "CABIN TEMP" selector switch, "CABIN PRESS", "WINDSHIELD/DEMIST" and "WINDSHIELD/RAIN RMVL" switches.
- "NAV", "BCN" and "LDG LT/TAXI-NOSE LT" switches.
- "FORM LIGHTS" knob.
- "IFF" control panel.
- "SMS" control panel.

TABLE OF WARNING AND CAUTION LIGHTS

WARNING LIGHTS

LIGHT ON	CONDITION	CORRECTIVE ACTION
FIRE	FIRE IN THE FORWARD SECTION OF THE ENGINE COMPARTMENT.	REFER TO THE PROCEDURES DEFINED IN THIS SECTION.
OHEAT	OVERTEMPERATURE CONDITION OR FIRE IN THE AFT SECTION OF THE ENGINE COMPARTMENT.	REFER TO THE PROCEDURES DEFINED IN THIS SECTION.
CANOPY	THE CANOPY IS NOT LOKED IN THE CLOSED POSITION.	ON THE GROUND , CLOSE AND LOCK THE CANOPY. IN FLIGHT, REFER TO THE PROCEDURES SET FORTH IN THIS SECTION.
MASTER CAUTION	ONE OR MORE CAUTION LIGHTS ON THE PANEL ARE ILLUMINATED.	CHECK THE CAUTION LIGHTS PANEL AND PRESS TO EXTINGUISH THE "MASTER CAUTION" WARNING LIGHT.
SEAT	THE SAFETY PIN IS INSERTED IN THE FIRING HANDLE.	REMOVE THE SAFETY PIN DURING THE PRE-TAXIING CHECKS.

CAUTION LIGHTS

LIGHT ON	CONDITION	CORRECTIVE ACTION
NO 1 DC GEN	GENERATOR No. 1 INOPERATIVE POWER IS SUPPLIED TO ESSENTIAL AND PRIMARY BUSSES. DISCONNECTED BUSSES ARE: SECONDARY BUS AND ANTI - ICE BUS.	MAKE AN ATTEMPT: "GEN 1" SWITCH TO RESET THEN TO ON. "SEC BUS RESET" SWITCH – ON (GUARD AND LEVER UP) IF REQUIRED TO HAVE AVAILABILITY OF SECONDARY BUS TOO.
NO 2 DC GEN	GENERATOR No. 2 INOPERATIVE. POWER IS SUPPLIED TO: ESSENTIAL BUS, PRIMARY BUS, AND SECONDARY BUS. THE ANTI - ICE BUS IS DISCONNECTED.	MAKE AN ATTEMPT: "GEN 2" SWITCH TO RESET THEN TO ON.
AC SEC BUS	INVERTER No. 2 INOPERATIVE. POWER IS SUPPLIED ONLY TO THE ESSENTIAL AND PRIMARY BUSSES.	NONE.
AC ESS BUS	INVERTER No. 1 INOPERATIVE. POWER IS SUPPLIED ONLY TO THE SECONDARY BUSSES.	"AC POWER" SWITCH TO EMERG TO HAVE AVAILABLE ESSENTIAL AND PRIMARY AC BUSSES.

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Figure 3-1 (Sheet 1 of 2)

TABLE OF WARNING AND CAUTION LIGHTS

CAUTION LIGHTS

LIGHT ON	CONDITION	CORRECTIVE ACTION
NO 1 BATT	BATTERY No. 1 INOPERATIVE	NONE.
NO 2 BATT	BATTERY No. 2 INOPERATIVE	NONE.
FUEL LOW	QUANTITY OF AVAILABLE FUEL IS LESS THAN 200 ± 15 KG (NATO F-40 FUEL)	PREPARE FOR LANDING AS SOON AS POSSIBLE.
FUEL PRESS	IRREGULAR FUEL SUPPLY TO ENGINE	REDUCE ENGINE RPM AS FAR AS POSSIBLE.
AIL SERVO	INSUFFICIENT PRESSURE IN THE AILERON SERVO-CONTROL CIRCUIT.	CHANGEOVER TO MANUAL TAKES PLACE AUTOMATICALLY. "AIL SERVO" SWITCH TO OFF (FOR SAFETY REASONS).
OIL PRESS	LOW ENGINE OIL PRESSURE	REFER THE PROCEDURE DEFINED IN THIS SECTION
OXY LOW	SYSTEM PRESSURE HAS DROPPED BELLOW 7 BAR	FLY BELOW 10.000 FT (CABIN ALTITUDE)
DUCT ANTI-ICE	ENGINE AIR INTAKE ANTI - ICE SYSTEM INOPERATIVE	FLY TO ALTITUDES WITHOUT ICE FORMATION CONDITIONS.
ICE	CONDITIONS ARE FAVOURABLE TO ICE FORMATION	"ANTI - ICE / ENGINE" AND "WINDSHIELD / RAIN RMVL" SWITCHES TO ON. DEPART FROM THE ICE FORMATION AREA AS FAST AS POSSIBLE.
BATT HOT	ONE OR BOTH BATTERIES OVERHEATING.	"BATT" SWITCH TO OFF.
STEER ▨ A SKID	• STEERING SYSTEM HAS FAILED • STEERING IS ENGAGED	• REFER THE PROCEDURE DEFINED IN THIS SECTION • NONE.
▨ STEER A SKID	• ANTI - SKID SYSTEM NOT ON • ANTI - SKID SYSTEM INOPERATIVE	• "ANTI - SKID" SWITCH FROM OFF TO NORM • "ANTI - SKID" SWITCH TO OFF
PYL TK EMPTY	ONE OR BOTH UNDERWING PYLON TANKS EMPTY	"FUEL TRANSFER" SWITCH FROM PYL TO TIP WHEN LEVEL IN THE FUSELAGE TANK DECREASES.
FUEL TRANS	FUEL TRANSFER DOES NOT TAKE PLACE REGULARLY OR IS INTERRUPTED	"FUEL TRANSFER" SWITCH FROM PYL TO IF UNDERWING PYLON TANKS ARE CONCERNED: OTHERWISE BEAR IN MIND THAT RANGE IS REDUCED.
TIP TK UNBAL	FOLLOWING AN IRREGULAR TRANSFER,AN ASYMMETRY OF MORE THAN 40 KG IS PRESENT IN THE TIP TANKS.	LAND WITH ASYMMETRIC LOAD PROCEDURE OR DUMP RESIDUAL FUEL BY ROTATING THE "FUEL DUMP" COCK.
CKT BKR	ONE OR MORE CIRCUIT BREAKERS (WITH VALUE UP TO 10A) ARE OUT.	TRY ONCE ONLY TO PUSH THE CIRCUIT BREAKER IN.
IFF	IFF SET DOES NOT OPERATE CORRECTLY OR IS NOT ON. MODE 4 IS INOPERATIVE OR NOT ON.	NONE.
IRU	• INERTIAL REFERENCE UNIT SYSTEM HAS FAILED • MOVE SELECTOR SWITCH ON "IRS" CONTROL PANEL TO AUX	• MOVE THE MODE SELECTOR SWITCH ON "IRS" CONTROL PANEL TO AUX • NONE .

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Figure 3-1 (Sheet 2)

- "IRS" control panel.
- 'LG EMERG SEL" handle"
- "GROUND FIRE" switch.
- "MKR" control panel.
- "PHOTO" control panel (when installed).
- "SMOKE" control panel (when installed).
- "AVTR" control panel.
- "WARN LT/TEST" push-button.
- "ELT" switch.
- "RAM AIR SCOOP" handle.
- "ANTI-ICE/ENGINE" switch.
- Engine throttle friction.
- "MASTER CAUTION" reset.
- "PARK & EMER BK" handle (park function only).

GENERAL PROCEDURES

ABORT - BARRIER ENGAGEMENT PROCEDURE

For a safe arrestment, accomplish as many of the following actions as possible:

1. Call BARRIER-BARRIER-BARRIER.
2. THROTTLE - STOP.
3. SPEEDBRAKE - IN.
4. "FUEL SHUT-OFF" switch - CLOSED.
5. Apply the brakes.

CAUTION

If the anti-skid system is OFF or inoperative the brakes must be applied moderately to prevent possible loss of aircraft directional control from tire blowout.

6. Keep the canopy closed and the nosewheel in contact with the ground.
7. Maintain aircraft directional control with nosewheel steering and braking.

CAUTION

Prior to engaging nosewheel steering, ensure that the rudder pedals are centered.

8. Enter the overrun barrier at the center and at 90°.
9. Abandon the aircraft as soon as possible.

GROUND RETRACTION OF LANDING GEAR

WARNING

Ground retraction of the landing gear is to be carried out only when absolutely necessary as the three legs will retract in an irregular sequence resulting in damage to the aircraft.

If the action of the brakes appears to be insufficient to prevent impact against another aircraft, building, etc. proceed as follows:

1. THROTTLE - STOP.
2. SPEEDBRAKE - IN.
3. "DOWN LOCK OVERRIDE" push-button - Press. Then immediately:
4. Landing gear control lever - LG UP.
5. "BATT" switch - OFF.
6. Leave the aircraft as soon as it stops.

NOTE

Landing gear retraction is impossible when pressure in the main hydraulic system is zero or if the "BATT" switch is OFF.

STORES JETTISON ON RUNWAY

Stores jettison is not possible when the aircraft weight is on the wheels.

GROUND EMERGENCIES

ENGINE FIRE DURING STARTING

If the "FIRE" or "OHEAT" warning light illuminates or there are other indications of fire from outside the aircraft, proceed as follows:

1. THROTTLE - STOP.
2. "FUEL SHUT-OFF" SWITCH - CLOSED.
3. "BATT" SWITCH - OFF.
4. Leave the aircraft as quickly as possible by following the procedure set forth in paragraph "Emergency Egress" in this section.

TAKEOFF EMERGENCIES

ENGINE FAILURE DURING TAKEOFF

If it is possible to stop the aircraft on the runway:

1. Apply the "Abort/Barrier Engagement" procedure.

If it is not possible to stop the aircraft on the runway, but the decision to abort the takeoff has been taken:

1. Apply the "Abort/Barrier Engagement" procedure.
2. Landing gear retraction - If required.

WARNING

If mass, configuration and speed condition do not permit a safe stop, eject.

ENGINE FAILURE AFTER TAKEOFF

If engine failure occurs after takeoff, and altitude permits, proceed as in paragraph "Engine thrust loss". If conditions do not permit a safe landing: EJECT. If the decision is made to perform an emergency landing on the runway, accomplish as many of the following actions as time permits:

1. Throttle - STOP.
2. "SALVO JETT" push-button - Press (if external stores are carried).
3. Landing gear control lever - DOWN.
4. Flap control lever - As reequired.
5. "FUEL SHUT-OFF" switch - Closed (guard and toggle up).
6. "BATT" SWITCH - OFF (if emergency retraction of landing gear is not anticipated).
7. "GEN 1" and "GEN 2" switches - OFF.

WARNING

If a landing cannot be made on the runway or is considered dangerous, eject.

BLOWN TIRE DURING TAKEOFF

MAIN GEAR TIRE BLOWOUT

If it is possible to stop on the runway:

1. Engine throttle - IDLE.
2. Apply the brakes while maintaining directional control with nosewheel steering and braking.

CAUTION

Prior to engaging nosewheel steering, ensure that the rudder pedals are centered.

3. Try to reduce the load on the blown tire by applying full aileron opposite to the blown tire.
4. If the aircraft is expected to roll-off the runway:
   a. Throttle to STOP.
   b. "FUEL SHUT-OFF" switch to CLOSED.
   c. "BATT" switch to OFF (if emergency landing gear retraction is not anticipated).

If it is not possible to stop on the runway:

1. Continue the takeoff run.
2. Do not retract the landing gear and maintain speed below 175 KIAS.
3. Dump and expend as much fuel as possible to reduce the aircraft mass; however do not go below 200 kg.

4. Land on the side of the runway opposite to the blown tire and use the aileron to reduce the weight on the wheel with the blown tire.
5. After touch-down, proceed as specified in the first hypothesis.

NOSE GEAR TIRE BLOWOUT

If it is possible to stop on the runway:

1. Throttle - IDLE.
2. Apply brakes as required and use differential braking to maintain directional control.
3. Reduce weight on the nosewheel by gradually moving the control stick fully aft.
4. If there is a possibility of rolling off the runway:
   a. Throttle at STOP.
   b. "FUEL SHUT-OFF" switch at CLOSED.
   c. "BATT" switch at OFF (if an emergency retraction of the landing gear is not anticipated).

If it is not possible to stop on the runway:

1. Continue the takeoff run.
2. Do not retract the landing gear and maintain speed below 175 KIAS.
3. Dump and expend as much fuel as possible to reduce the aircraft mass; however, do not go below 200 kg.
4. After landing: gently lower the nosewheel before loosing elevator effectiveness.
5. When starting to apply brakes, reduce weight on the nosewheel by progressively applying aft stick.
6. If the runway length allows it, use the brakes moderately so as not to increase the weight on the nosewheel.

FIRE DURING TAKEOFF

The procedure to follow varies with each set of circumstances and depends upon airspeed, length of remaining runway, possibility of going ahead with the takeoff run, location of populated areas, etc. The pilot should take these factors into account and follow, as far as possible, the following procedure:

Illuminated Warning Light before Lift-off

If either the "FIRE" or the "OHEAT" warning light illuminates before lift-off and there is sufficient runway or runway overrun to allow an aborted takeoff, or if a runway overrun barrier is available, proceed as follows:

1. Throttle - STOP.
2. "FUEL SHUT-OFF" switch - Closed (guard and toggle up).
3. Apply the brakes.
4. "BATT" switch to OFF (if emergency retraction of the landing gear is not anticipated).
5. Abandon the aircraft as soon as it stops by following the "Ground Egress " procedure.

If the takeoff cannot be aborted because there is insufficient runway left and an overrun barrier is not available, continue the takeoff and, when airborne, proceed as follows:

Illuminated Warning Light after Lift-off

If the "FIRE" or "OHEAT" warning light illuminates after lift-off and takeoff cannot be safely aborted, proceed as follows:

1. Throttle - Maintain takeoff power and immediately start climb.
2. "SALVO JETT" push-button - Press (if external stores are carried).
3. "FUEL DUMP" knob - Rotate 90°.
4. Attain a safe altitude of at least 1000 ft.
5. ENGINE THROTTLE - REDUCE RPM.

   Retard the throttle to IDLE if altitude is higher than the minimum safe altitude or adjust to the minimum practical power to maintain a safe altitude.
6. WARNING LIGHT - CHECK
   a. If the warning light goes out and engine indications are normal, continue the flight at reduced power and land as soon as possible. Occasionally check the serviceability of the warning circuit by pressing the "WARN LT/TEST" push-button. If this action does not bring the light on, follow the procedure described in step b.
   b. If the light remains on, check for positive indications of fire, such as smoke trails following a turn, reports from the ground or from another aircraft, abnormal engine instrument readings (rpm, JPT, oil pressure), unusual engine noise or vibration, fumes, heat or smoke in the cockpit.
7. IF FIRE IS NOT CONFIRMED, CONTINUE THE FLIGHT AT REDUCED POWER AND LAND AS SOON AS POSSIBLE.
8. IF FIRE IS CONFIRMED - EJECT.

EJECTION DURING TAKEOFF

The MK IT-10LK ejection seat allows ejection at all speeds and altitudes, and hence during the takeoff run. Follow the same "Ejection Procedure" as described in paragraph "In-flight Ejection" in this section.

WARNING

If the aircraft shows a tendency to tilt, hold the wings level by grasping the control stick with one hand and operate the ejection handle with the other hand.

CANOPY UNLOCKED ON TAKEOFF

If, for any reason, the canopy is unlocked and it is possible to stop on the runway:

1. ABORT THE TAKE-OFF.

If the aircraft is already airborne or it is not possible to stop on the runway:

1. CONTINUE THE TAKEOFF RUN..
2. Maintain the flaps in T/O position.
3. Reduce speed to 120 KIAS but not below the takeoff speed plus 20 KIAS.
4. Avoid abrupt maneuvers, the application of significant load factors, sideslips.

WARNING

Do not attempt to lock the canopy in flight.

5. Prepare for landing with a long final.

NOTE

If the information provided by the airspeed indicator appears unreliable, refer to AOA for landing.

Consideration should be given to severing a partially or fully open canopy to reduce the aerodynamic effects.

BIRD INGESTION

If the aircraft should encounter a flock of small birds and one or more birds are ingested by the engine but the engine does not stall, the throttle MUST NOT be moved after the ingestion until the aircraft has reached a safe altitude as difficulty in engine control may be experienced.

NOTE

> If a flame-out occurs, and the engine conditions and altitude permit, carry out the "Relighting in Flight" procedure.

Immediately prepare for landing by entering one of the key points of the flame-out landing pattern and selecting the required engine speeds with slow and progressive movements of the throttle.

IN-FLIGHT EMERGENCIES

RELIGHTING IN FLIGHT

IMMEDIATE HOT RELIGHT

NOTE

> An immediate hot relight can be attempted at any altitude and airspeed. The most favorable conditions are however found at altitudes below 20 000 ft and airspeeds between 120 and 200 KIAS.

On engine flame-out (JPT below 200°C):

1. IMMEDIATELY MOVE THE THROTTLE TO IDLE.

CAUTION

> When closing the throttle take the utmost care to avoid inadvertently selecting it to STOP.

2. PRESS AND HOLD THE "RELIGHT" PUSH-BUTTON.
3. The simultaneous rise of JPT and rpm will indicate a successful relight.

NOTE

> Abnormal noises may be heard on engine relighting during the acceleration phase. Such noises will stop when the "RELIGHT" button is released.

4. Release the "RELIGHT" button when rpm reach 40%.

Unsuccessful Immediate Relight

If no relight occurs within 30 seconds or if the engine relights but the JPT rises rapidly towards the limit:

1. Move the throttle to STOP.
2. Release the "RELIGHT" button.
3. Wait for one minute to allow excess fuel to drain and then carry out the "Cold Relight" procedure.

COLD RELIGHT

NOTE

The most favorable conditions for a cold relight are below 20 000 ft and between 120 and 200 KIAS (minimum windmilling rate: 8 to 10% rpm depending upon altitude).

1. Check throttle at STOP.
2. Check for:
   a. "BATT" switch - ON.
   b. "ENG/MSTR" switch - ON.
   c. "FUEL SHUT-OFF" switch - OPEN (guard down).
   d. "FUEL PRESS" caution light - Off.
3. "JPT LMTR" switch - OFF.
4. Move the throttle to IDLE, press and hold the "RELIGHT" button.
5. The simultaneous rise of JPT and rpm will indicate a successful relight.
6. Release the "RELIGHT" button when rpm has risen above 40%.
7. "JPT LMTR" switch - ON.

CAUTION

- Do not advance the throttle from the IDLE position until the rpm has stabilized at idle.
- Do not select the "JPT LMTR" switch back to ON if failure of the system is suspected. Monitor JPT throughout the remaining part of the flight.

Unsuccessful Cold Relight

If no relight occurs within 30 seconds or if the engine relights but the JPT rises rapidly toward the limit:

1. Move the throttle to STOP and release the "RELIGHT" button.
2. Wait for one minute, then repeat the "Cold Relight" procedure.

NOTE

If possible, reduce altitude by 3000 ft before a further relight attempt is made.

3. If the engine does not relight and the altitude is not sufficient to repeat the cold relight procedure, prepare for a forced landing on a runway or for ejection.

LOSS OF CONTROL

For stall and spin characteristics, refer to Section VI "Flight Characteristics".

RECOVERY FROM OUT-OF-CONTROL CONDITION

In case of an out-of-control condition, proceed as follows:

1. Neutralize all controls.

NOTE

Under any flight condition, returning all controls to neutral will normally bring the aircraft into a nose-down attitude with increasing speed.

RECOVERY FROM SPIN

The aircraft resists spin entry and can only be forced into a spin by the pilot (see para "Spin and Unusual Attitudes" in Section VI). Spin entry may however result as a consequence of control mishandling. If the aircraft enters a normal, erect spin:

1. Apply full rudder opposite the direction of spin and maintain the ailerons neutral.

CAUTION

In poor visibility conditions, it may be difficult to determine the direction of spin rotation. The direction of rotation will always be correctly indicated by the turn indicator on the ADI. In case of disorientation, it is recommended that all controls be neutralized. This action will result in spin recovery within two turns.

2. Move stick forward to neutral.

NOTE

Rotation stops in approx 2 seconds after recovery is initiated in 1/2 to 1 residual turn.

3. Neutralize the rudder as rotation stops.

NOTE

Approximately 2000 ft are lost in the pullout to level off.

If the aircraft enters an inverted spin:

1. Stick at neutral and rudder opposite the direction of rotation.

CAUTION

It can be difficult to determine the direction of rotation in an inverted spin. This is because the aircraft is aircraft is yawing in one direction but rolling in the opposite direction. The direction of rotation will always be correctly indicated by the turn indicator on the ADI. In case of disorientation, it is recommended that all controls be neutralized. This action will result in spin recovery within two turns.

2. Neutralize the rudder as rotation stops.

IF AIRCRAFT IS STILL OUT-OF-CONTROL PASSING 6000 FT AGL:

3. EJECT.

IN-FLIGHT EJECTION (Figures 3-2 and 3-3)

NOTE

The minimum altitude above the ground for a safe ejection, either with the aircraft nose-down with no bank or in banked level flight, is shown in the chart in figure 3-2.

MK IT-10LK SEAT MINIMUM EJECTION ALTITUDE ABOVE GROUND

SINGLE SEAT EJECTED (NO SEAT DELAY)

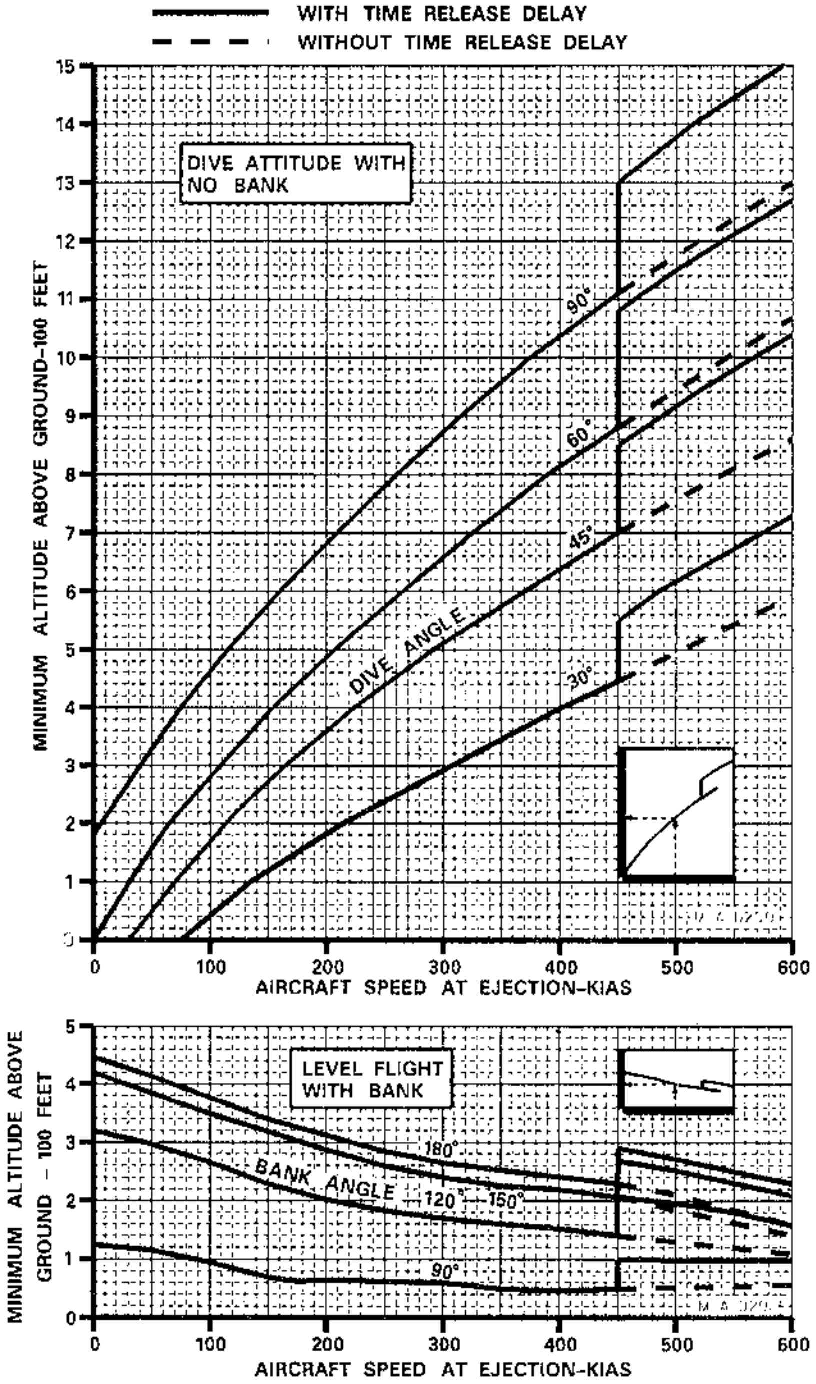


Figure 3-2 (Sheet 1 of 2)

MK IT-10LK SEAT MINIMUM EJECTION ALTITUDE ABOVE GROUND

FRONT SEAT EJECTED AFTER SEQUENCE INITIATED FROM REAR SEAT (REAR SEAT DELAY =0, FRONT SEAT DELAY =0.35)

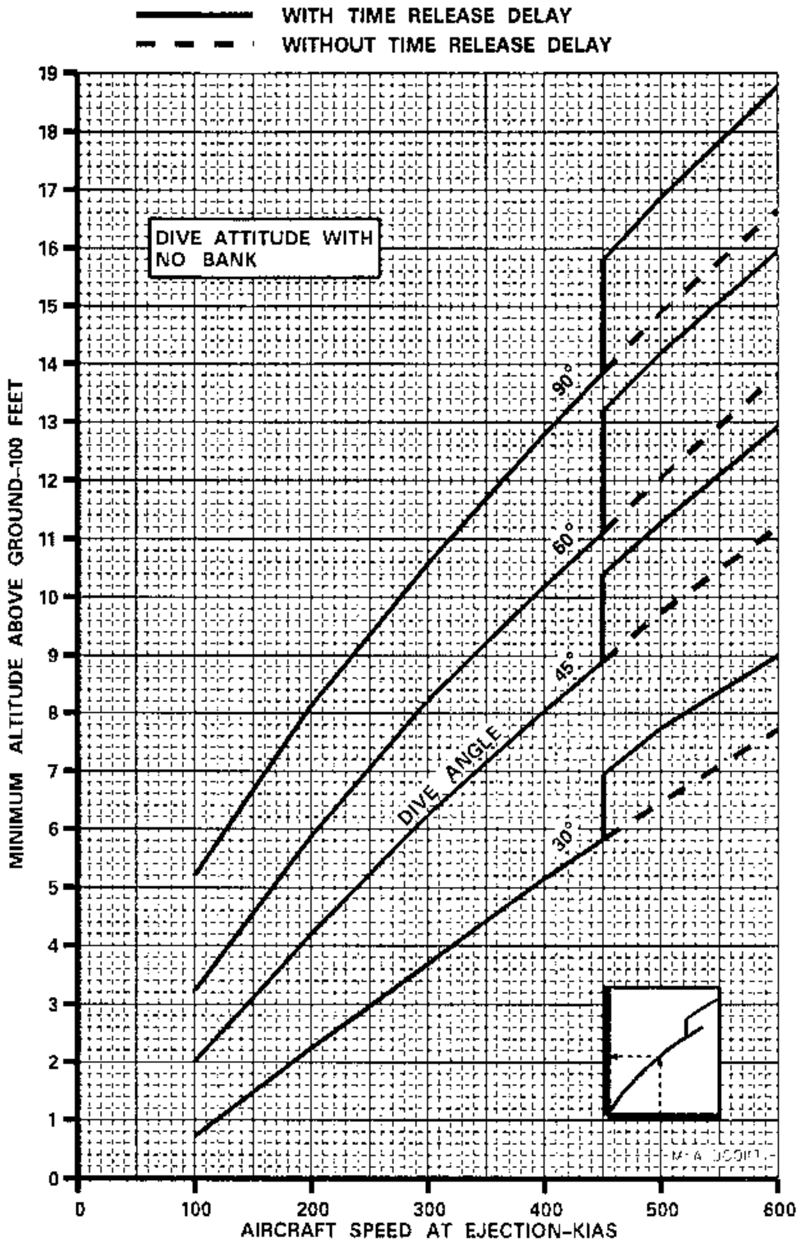


Figure 3-2 (Sheet 2)

BEFORE EJECTION

When time and conditions permit, carry out the following operations before leaving the aircraft:

1. Head the aircraft towards an unpopulated area.
2. Move the "MASTER" switch on the IFF control panel to EMER. The set will transmit emergency reply signals when interrogated.
3. Make a MAY DAY call on the channel in use (if contact is not made,select the guard channel).
4. Move the "lever lock" switch on the ELT control panel to ON.
5. Reduce airspeed below 250 KIAS and fly in straight and level or climbing flight.

Rear cockpit only:

6. Open the blind flying hood, if installed, and fold it down on both sides.

CAUTION

> If the command firing lever is selected ON (up), advise the occupant in the front cockpit that ejection is imminent.

EJECTION PROCEDURE

LOWER THE VISOR, SIT ERECT AND CLOSE THE EYES TIGHTELY.
GRASP THE SEAT FIRING HANDLE WITH BOTH HANDS (see figure 3-3), WHEN POSSIBLE, STRETCH THE LEGS OUT FORWARD OF THE SEAT, KEEP THE BACK AS STRAIGHT AS POSSIBLE AND THE HEAD LOCATED HARD BACK AGAINST THE HEADREST. PULL THE HANDLE SMARTLY UPWARDS TO ITS FULL EXTENT AND RETAIN THE GRIP ON THE HANDLE UNTIL THE HARNESS RELEASE MECHANISM FUNCTIONS. THIS ACTION WITHDRAWS THE SEAR FROM THE SEAT FIRING UNIT AND INITIATES SEAT EJECTION.

Missed Man-Seat Separation

Extraction and deployment of the drogue chutes must take place after ejection, immediately followed, at altitudes below 5000 m (approx. 16 500 ft), by the deployment of the personal parachute and the automatic separation of the occupant from the seat. If seat separation does not occur, pull the manual separation handle located on the right side of the seat.

NOTE

> In the case of an high speed ejection between 2100 m and 5000 m (approx 7000 ft to 16 500 ft) automatic separation will not occur until a deceleration of less than 2.25 "G" is sensed.

WARNING

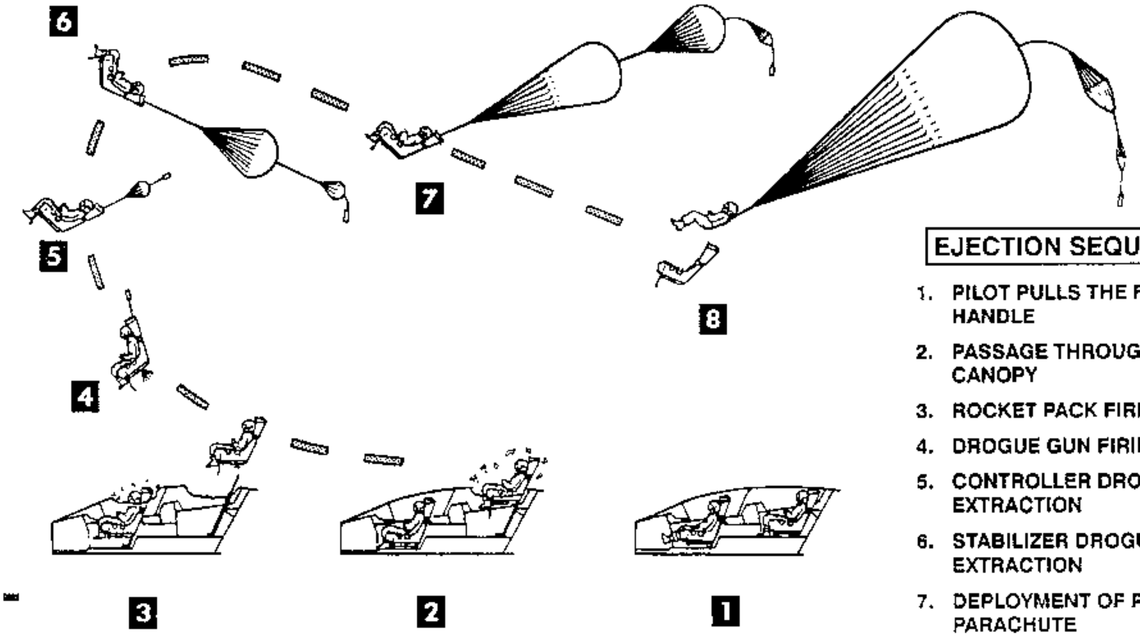
- Operation of the manual separation handle is possible only after actuation of the firing handle. Therefore, if the front seat is ejected via the command firing system, the front seat occupant must pull the firing handle before pulling the manual separation handle.
- Actuation of the manual separation handle ends the ejection sequence at any altitude.

AFTER EJECTION

Over Water (Figure 3-4)

1. Check the parachute for correct deployement.

MK IT-10LK SEAT EJECTION SEQUENCE



EJECTION SEQUENCE

1. PILOT PULLS THE FIRING HANDLE
2. PASSAGE THROUGH THE CANOPY
3. ROCKET PACK FIRING
4. DROGUE GUN FIRING
5. CONTROLLER DROGUE EXTRACTION
6. STABILIZER DROGUE EXTRACTION
7. DEPLOYMENT OF PERSONAL PARACHUTE
8. PILOT SEAT SEPARATION

EJECTION PROCEDURE

① IF POSSIBLE, GRASP THE SEAT FIRING HANDLE BOTH HANDS (AS SHOWN IN THE FIGURE)

② STRETCH THE LEGS OUT FORWARD OF THE SEAT

③ KEEP THE BACK AS STRAIGHT AS POSSIBLE AND HEAD LOCATED HARD BACK AGAINST THE HEADREST

④ PULL THE HANDLE SMARTLY UPWARDS TO ITS FULL EXTENT

⑤ RETAIN THE GRIP ON THE HANDLE UNTIL THE HARNESS RELEASE MECHANISM FUNCTIONS

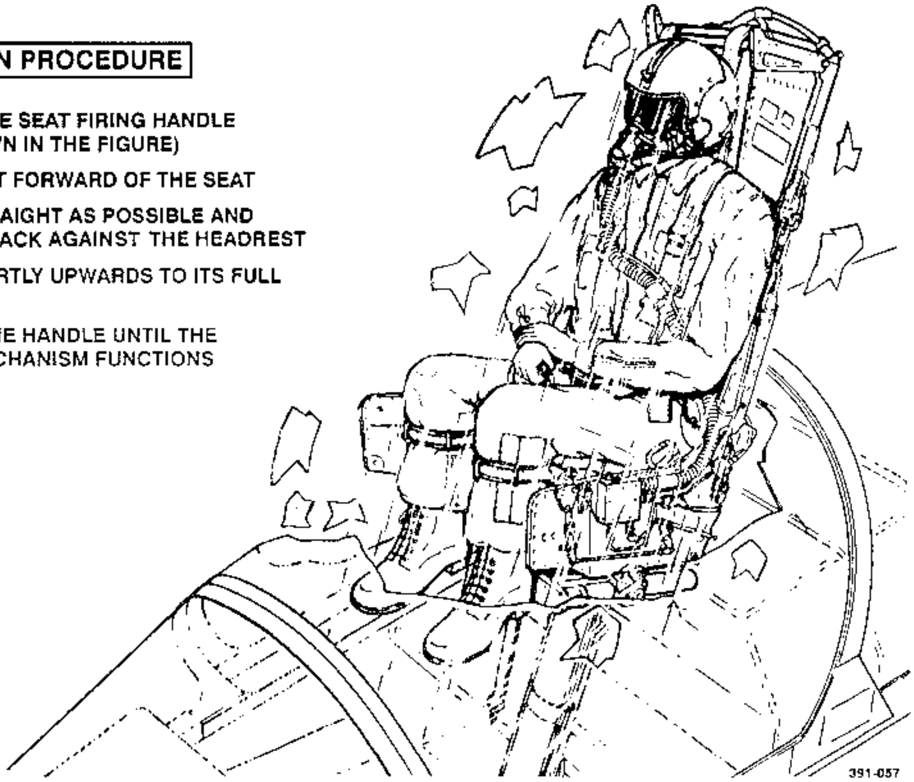
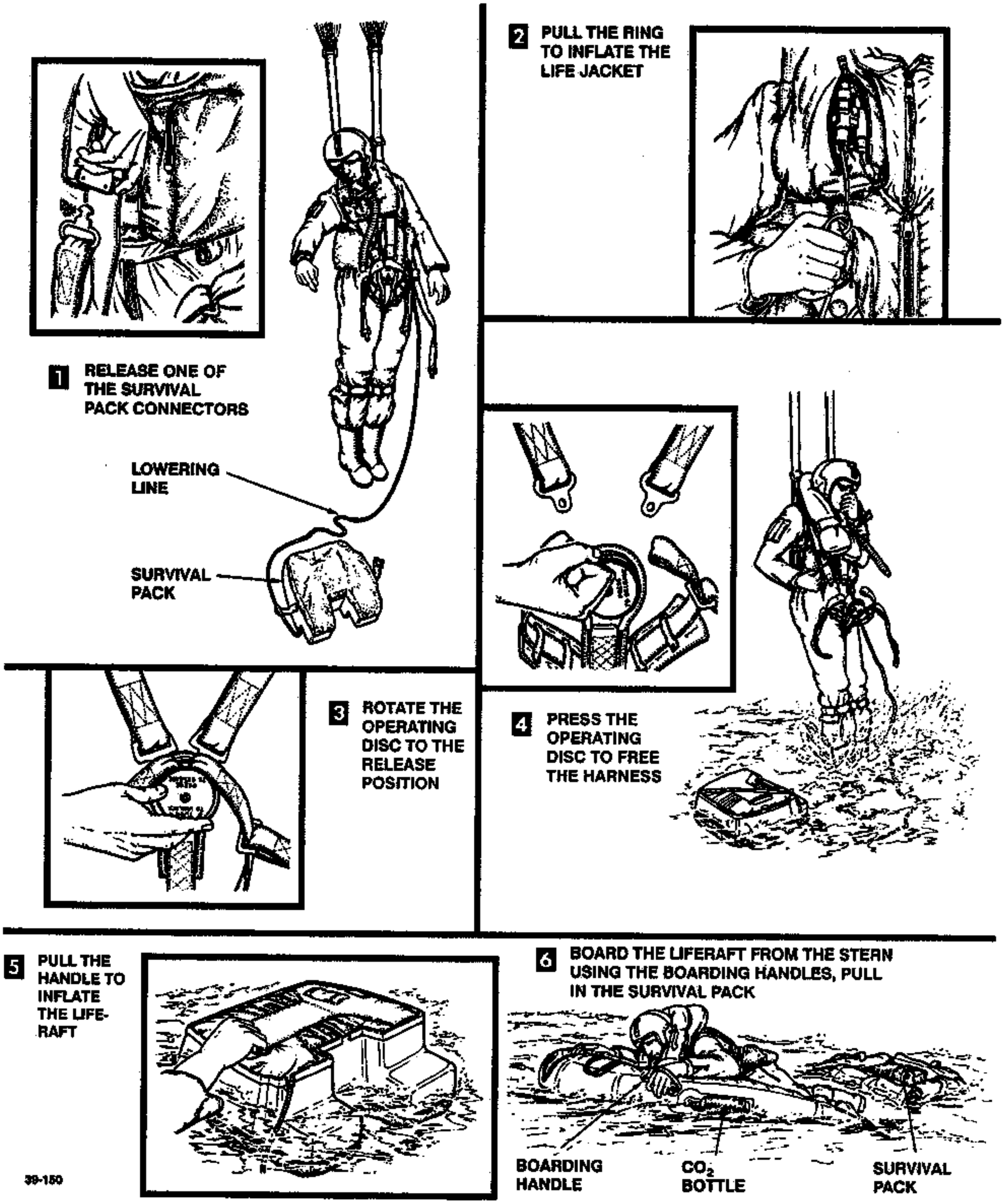


Figure 3-3

AFTER EJECTION OVER WATER



1 RELEASE ONE OF THE SURVIVAL PACK CONNECTORS

2 PULL THE RING TO INFLATE THE LIFE JACKET

3 ROTATE THE OPERATING DISC TO THE RELEASE POSITION

4 PRESS THE OPERATING DISC TO FREE THE HARNESS

5 PULL THE HANDLE TO INFLATE THE LIFE-RAFT

6 BOARD THE LIFERAFT FROM THE STERN USING THE BOARDING HANDLES, PULL IN THE SURVIVAL PACK

Figure 3-4

2. Remove the oxygen mask and discard it.
3. Pull the ring to inflate the lifejacket.
4. Check the survival pack is connected to the lifejacket and then release one of the rear survival pack connectors.
5. Rotate the quick-operating disc to the release position when about 30 m above water.
6. Press the quick-operating disc to free the harness as soon as the survival pack touches the water.

CAUTION

Due to the difficulty in judging height above water the quick-release mechanism should not be operated until the survival pack touches the water.

7. Pull the handle to inflate the liferaft.
8. Board the liferaft from the stern using the boarding handles. Pull in the survival pack.

Over Land

1. Examine the nature of the terrain prior to releasing the survival pack. If trees, buildings or rocks are present, it is recommended that the survival pack be left connected to the parachute harness for protection. It is also recommended that the oxygen mask be left in place for face protection. Inflate the lifejacket to provide support and protection for the head and neck.
2. On approaching the ground, rotate the operating disc, of the harness quick-release mechanism.
3. Upon contact with the ground, press the operating disc of the harness quick release mechanism to release the parachute harness.

ENGINE LOSS-OF-THRUST

WARNING

If engine thrust loss is accompanied by rpm falling to zero or very close to zero, move the throttle to STOP and do not attempt a relight.

ENGINE FLAME-OUT

The symptoms of engine flame-out are: JPT below 200° C and rpm falling. The most common causes of this are:

- No fuel supply due to a choked LP filter.
- "FUEL SHUT-OFF" switch CLOSED ("FUEL PRESS" caution light on).
- Ice on the engine fuel pump inlet ("FUEL PRESS" caution light out).
- Compressor stall at low IAS and high altitude.
- Fuel starvation due to prolonged inverted flight ("FUEL PRESS" caution light on).
- Ice, water or bird ingestion.

If the engine flames out:

1. Immediately retard the throttle to IDLE.
2. Carry out the "Immediate Hot Relight" procedure.

RESTRICTION OF MAXIMUM RPM (WITH NO OTHER SYMPTOMS)

Abnormal restriction of rpm may be caused by:

A. Failure of the JPT limiter system.
  1. Engine throttle - Retard to a minimum practicable.
  2. "JPT LMTR" switch - OFF.

CAUTION

With the JPT limiter system switched off the JPT must be monitored during throttle movement to ensure the limitations are not exceeded.

B. Failure of the fuel system.
  1. Operate the throttle slowly over the full range several times.

C. Ice formation in engine.
  1. Leave the icing conditions as quickly as possible.

NOTE

Engine rpm should be maintained above 55% if operating continuously under icing conditions, but is permissible for rpm to fall below 55% for a max time of three minutes.

COMPRESSOR STALL

Compressor stall is indicated by a low or falling rpm with an higher than normal or rapidly rising JPT. These symptoms are sometimes accompanied by abnormal noises.

CAUTION

The abnormal noises can be erroneously interpreted as mechanical failures.

Compressor stall may take place under the following conditions:

- Slam throttle opening at low IAS and the compressor blow-off valve (BOV) or AFRC maladjusted or defective.
- Ice, water or bird ingestion.

Immediate corrective action should be taken to prevent exceeding of the JPT limit, turbine damage and possible engine flame-out.
Proceed as follows:

1. Immediately move the throttle to idle.. A successful stall recovery will be indicated by a falling JPT.
2. If the stall condition appears to have cleared, slowly advance the throttle and monitor the engine instruments.

WARNING

Do not advance the throttle if the engine is stalled.

If stall persists:

3. Retard the throttle to STOP.
4. Carry out the "Relighting in Flight" procedure.

5. Land as soon as practical.

CAUTION

> Reducing the angle-of-attack to increase airspeed assists recovery from a locked engine stall.

ENGINE MECHANICAL FAILURE

Mechanical failure is normally indicated by vibration, abnormal noises and increased JPT or loss of thrust (possibly followed by flame-out without "FUEL PRESS" pressure warning). If these symptoms are experienced, proceed as follows:

a. If the engine has not flamed out, land as soon as possible using the lowest practical rpm. Adopt a precautionary landing pattern.

b. If symptoms of mechanical failure are observed but engine continues to run, land as soon as possible. If the symptoms become severe, move the throttle to STOP and the "FUEL SHUT-OFF" switch to CLOSED.

CAUTION

Do not attempt to relight.

c. If a flame-out has occurred but the engine is windmilling normally (no abnormal noise or vibration), an immediate relight may be attempted. If successful, the engine can be used to land the aircraft as soon as possible using minimum throttle movements.

d. If the engine rpm drops to zero (i.e. the engine has seized), a relight must not be attempted; the throttle must be moved to STOP and the "FUEL SHUT-OFF" switch to CLOSED.

CAUTION

Do not attempt to relight.

In all cases, if the symptoms of mechanical failure are severe and sudden and include rapidly falling rpm, the throttle must be moved to STOP and the "FUEL SHUT-OFF" switch to CLOSED.

FIRE DURING FLIGHT/SEVERE DAMAGE

If the "FIRE" or the "OHEAT" warning light illuminates during flight, proceed as follows:

1. THROTTLE - REDUCE RPM.
   Retard to IDLE if altitude is above the minimum safe altitude or adjust to the minimum practical power to maintain a safe altitude.
2. Land as soon as possible using minimum practical power.
3. WARNING LIGHT - CHECK:
   a. If the light goes out and engine indications are normal, occasionally check the serviceability of the detector circuit by pressing the "WARN LT/TEST" push-button during aircraft recovery and landing.
   b. If the light remains on, with no evidence of fire, check for positive indications of fire such as smoke trails,reports from the ground or from other aircraft, abnormal engine instrument readings (rpm, JPT, oil pressure), unusual engine noise or vibration, fumes, heat or smoke in the cockpit.
4. IF FIRE IS CONFIRMED - EJECT.

VAPOUR OR SMOKE IN THE COCKPIT

WATER VAPOUR

1. "CABIN TEMP" selector - HOT.
2. "WINDSHIELD/DEMIST" switch - ON.

SMOKE

1. OXYGEN REGULATOR - 100%.
2. "CABIN PRESS" SWITCH - OFF (guard and toggle up).

CAUTION

> At altitudes above 8000 feet, wait until the cabin altitude equals the actual altitude before carrying out the following operation.

3. "RAM AIR SCOOP" HANDLE - PULL.
4. "WINDSHIELD/DEMIST" SWITCH - OFF.
6. If smoke persists, turn the "BATT", "GEN 1" and "GEN 2" switches to OFF.

CAUTION

> This last action results in the loss of both attitude indicators and of the turn indicator; it is therefore essential to consider the flight conditions before carrying out this part of the procedure.

ENGINE OIL PRESSURE LOW

If during normal flight the "OIL PRESS" caution light illuminates, check the oil pressure gauge reading:

1. If zero oil pressure is indicated:
   a. Engine throttle - Advance to 85% rpm.
   b. Land as soon as possible.

NOTE

- 85% is the rpm at which the front bearing axial loading is at its minimum; therefore, this rpm should be maintained until a safe recovery is assured.
- Any necessary power changes should be made slowly and smoothly and kept to an absolute minimum.

2. If 0.35 bar, or less, is indicated:
   a. Engine throttle - Advance to 95% rpm (max) to obtain the min oil pressure of 0.35 bar.

   If 0.35 bar cannot be achieved or maintained at 95% rpm (max):

   b. Engine throttle - Adjust to 85% rpm.
   c. LAND AS SOON AS POSSIBLE.
3. If the reading of the oil pressure gauge fluctuates by more than 0.2 bar.
   a. LAND AS SOON AS PRACTICAL.

If following zero or negative "G" flight the oil pressure fails to recover to a minimum of 0.35 bar within 5 seconds:

1. Engine throttle - Advance to 95% rpm for 10 seconds.

If the oil pressure still fails to recover:

2. Engine throttle - Adjust to 85% rpm.
3. LAND AS SOON AS POSSIBLE.

ENGINE FUEL PRESSURE LOW/SUCTION FEED CONDITIONS

Illumination of the "FUEL PRESS" caution light indicate a booster pump failure or a chocked filter. Prolonged negative "G" conditions may also cause temporary illumination of the caution light. If the "FUEL PRESS" caution light remains on:

1. Check (in the front cockpit) that the "FUEL PUMP" circuit breaker on the "CKT BKR PNL No. 2" panel is set.
2. Check that the "ENG MSTR" switch is ON.
3. ENGINE THROTTLE - REDUCE RPM TO MINIMUM REQUIRED.
4. Descend to minimum safe altitude.
5. LAND AS SOON AS POSSIBLE.

CAUTION

- Under the above conditions the engine is likely to continue operating for at least 15 minutes.
- The time the engine has operated with the "FUEL PRESS" caution light on must be recorded and reported after flight.
- If the booster pump fails during flight while operating on gasoline (emergency fuel), reduce power to a practicable minimum and descend to minimum safe altitude. Land as soon as possible. The hp fuel pump must be replaced before the next flight.

EMERGENCY SPEEDBRAKE RETRACTION

If an electrical failure prevents retraction of the speedbrake, a retraction by aerodynamic effect can be obtained by proceeding as follows:

1. Reduce airspeed to below 175 KIAS.
2. Move the landing gear control lever to LG DOWN.
3. If it is suspected that the failure to retract is not due to lack of power to the speedbrake selector valve, but it is the latter which has remained energized in the speedbrake out position, it is recommended that the "SPD BRAKE" circuit breaker on "CKT BKR PNL No. 2" panel be pulled out to prevent further extension of the speedbrake.
4. Pull the "LG EMERG SEL" handle.

NOTE

In addition to opening the doors of the already extended landing gear, this operation will relieve pressure in the speedbrake circuit and will therefore produce the almost total retraction of the speedbrake by aerodynamic effect.

5. Engage the "LG EMERG SEL" handle.

NOTE

> The landing gear doors are closed and the speedbrake remains in the attained position.

6. Return the landing gear control lever to LG UP.

NOTE

> A minimum quantity of hydraulic fluid is taken from the emergency system for the opening of the doors.
> The pressure remaining in the emergency system is still sufficient to allow landing gear lowering and emergency brake application.

OXYGEN SYSTEM FAILURE

If difficulties are experienced in breathing, unusual odors are noticed or the blinker does not operate correctly, proceed as follows:

1. "EMG" lever - Press to EMG.
2. Check: connections, mask attachment, pressure and blinker.

If correct operation cannot be restored, or oxygen pressure is insufficient:

1. Pull the emergency oxygen cylinder operating knob on the left side of the seat.
2. Descend below 10 000 feet (cabin altitude).
3. Move the "MASTER" selector switch on the IFF control panel to the EMER position.
4. When the emergency oxygen cylinder is empty, the oxygen mask must be released.

WARNING

> Whenever hypoxia is suspected, immediately activate the emergency oxygen cylinder, move the supply lever to OFF, select the IFF set to EMER and descend below 10 000 ft (cabin altitude) while checking the oxygen line connections.

LOSS OF CABIN PRESSURIZATION

Loss of pressurization is indicated by high cabin altitude values. It may also be determined from physical sensations or from the increase in the oxygen pressure to the mask. In this case, proceed as follows:

1. Oxygen system - Check for correct operation.
2. Descend below 25 000 ft.
3. Check the position of the "CABIN PRESS" switch and of the "RAM AIR SCOOP" lever.
4. Land as soon as practicable.

LANDING EMERGENCIES

Because of the many variables encountered, the final decision whether to attempt a flame-out landing or to eject must remain with the pilot. It is impossible to establish a predetermined set of rules providing the pilot with a ready-made decision applicable to all emergencies of this nature. The listed basic conditions, combined with the pilot's analysis of the condition of the aircraft, type of emergency and his proficiency, are of prime importance in determining whether to attempt a flame-out landing or to eject. These variables make a quick and accurate decision difficult. If the decision is made to eject, before ejection the pilot should attempt to turn the aircraft toward an area where injury or damage to people or property on the ground or water is least likely to occur. When attempting a flame-out landing, the following basic conditions should be met:

a. An adequate runway must be available.

WARNING

Eject rather than attempt a forced landing.

b. Weather and terrain conditions must be favorable. Cloud cover, ceiling, visibility, turbulence, surface wind, etc. must not unduly affect the flame-out pattern.

c. Flame-out landings should only be attempted when either a satisfactory "High key" or "Low key" position can be achieved.

WARNING

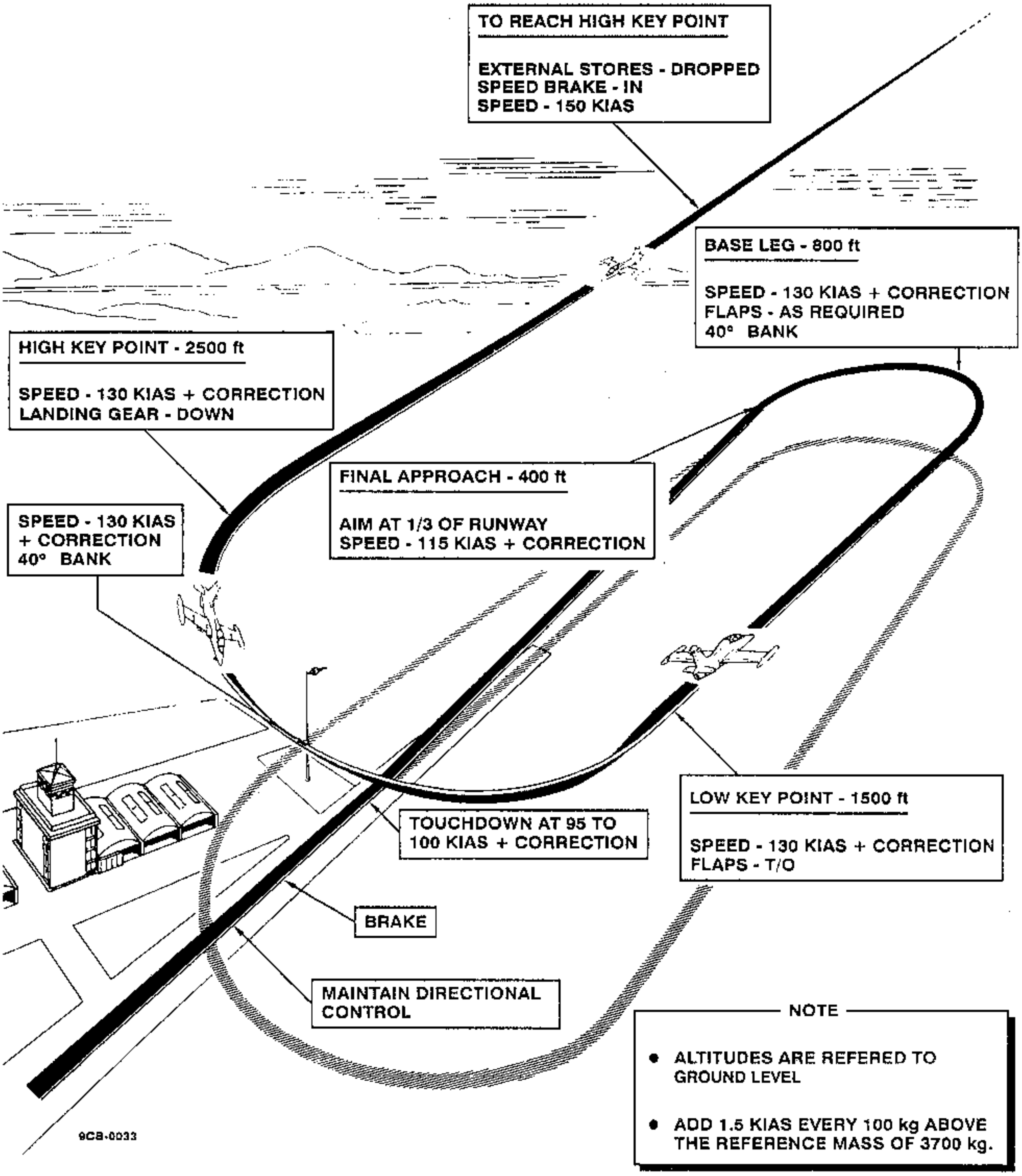
If, at any time during the flame-out approach, conditions do not appear ideal for a successful completion of landing, eject.

FLAME-OUT LANDING ON RUNWAY (Figure 3-5)

1. L.G., flaps and speedbrake - Retracted.
2. Airspeed - 150 KIAS.
3. Check that the throttle is at STOP. Glide to the field, while carrying out the following operations:
4. "SALVO JETT" push-button - Press (if external stores are carried, and if required).
5. "FUEL DUMP" knob - Rotate clockwise to dump the tip tanks.
6. "FUEL SHUT-OFF" switch - CLOSED (guard and toggle up).
7. "ENG MSTR" switch - OFF.
8. **High key point:** 2500 feet above the ground.
   a. Extend the landing gear.

      If pressure in the system is insufficient, proceed in accordance with the "Landing gear emergency lowering" procedure.
   b. Airspeed - 130 KIAS plus corrections.
9. **Low key point (downwind):** 1500 feet.
   a. Wing flaps - T/O. Only if there is sufficient pressure in the system.
   b. Airspeed - 130 KIAS plus corrections.
   c. "FUEL DUMP" knob - Rotate counterclockwise.

FLAME - OUT LANDING



TO REACH HIGH KEY POINT

EXTERNAL STORES - DROPPED
SPEED BRAKE - IN
SPEED - 150 KIAS

BASE LEG - 800 ft

SPEED - 130 KIAS + CORRECTION
FLAPS - AS REQUIRED
40° BANK

HIGH KEY POINT - 2500 ft

SPEED - 130 KIAS + CORRECTION
LANDING GEAR - DOWN

FINAL APPROACH - 400 ft

AIM AT 1/3 OF RUNWAY
SPEED - 115 KIAS + CORRECTION

SPEED - 130 KIAS
+ CORRECTION
40° BANK

LOW KEY POINT - 1500 ft

SPEED - 130 KIAS + CORRECTION
FLAPS - T/O

TOUCHDOWN AT 95 TO
100 KIAS + CORRECTION

BRAKE

MAINTAIN DIRECTIONAL
CONTROL

NOTE

- ALTITUDES ARE REFERED TO GROUND LEVEL
- ADD 1.5 KIAS EVERY 100 kg ABOVE THE REFERENCE MASS OF 3700 kg.

Figure 3-5

10. **Base turn:** 800 ft.
    - a. Flaps - As required (only if there is sufficient pressure in the system).
    - b. Airspeed 130 KIAS plus corrections.

NOTE

The initial aim point should be 1/3 into the runway. When making this point is guaranteed, flaps may be used to move the landing point back towards the runway threshold.

WARNING

If the landing is considered unsafe; EJECT

11. **Final:**
    - a. Airspeed - 120 KIAS plus corrections.
12. Touch down at 95 to 100 KIAS plus corrections.
13. Prepare to apply the emergency brake or to a possible engagement of the overrun barrier.

FORCED LANDING ON UNPREPARED SURFACE

WARNING

Eject rather than attempt a landing on an unprepared surface.

Landing on unprepared surfaces is not recommended. However, if an emergency landing on an unprepared surface is unavoidable, it should be made, whenever possible, with the landing gear extended. Investigations have revealed that landings made on unprepared surfaces with the landing gear down have resulted in less pilot injury and less damage to the aircraft than those made with the landing gear up.

1. "SALVO JETT" push-button - Press (if external stores are carried).
2. "FUEL DUMP" knob - Rotate clockwise to dump the tip tank fuel.
3. Expend as much fuel as possible to reduce the aircraft mass, but do not go below 200 kg.
4. "FUEL DUMP" knob - Rotate counterclockwise.
5. Make a normal approach.
6. Speedbrake - Retract.
7. Landing gear control lever - LG DOWN.
8. Flap control lever - D/N, for final approach.
9. Throttle - STOP, when landing is assured.
10. "FUEL SHUT-OFF" switch - CLOSED (guard and toggle up).
11. "GEN 1" and "GEN 2" switches - OFF.
12. Just before touchdown, move the "BATT" switch to OFF.
    This operation must be carried out last to allow actuation of the "FUEL SHUT-OFF" switch.
13. Touch down in normal landing attitude.
14. Leave the aircraft immediately after it stops by following the "Ground Egress" procedure.

WARNING

Advise the ground personnel assigned to the handling of the aircraft that the ejection seat is not safe, so that safety pins can be installed on the seat as soon as possible, prior to any other action.

PRECAUTIONARY PATTERN

The precautionary pattern (Figure 3-6) has the same ground pattern and the same characteristics as the flame-out pattern (Figure 3-5) with the following exceptions:

1. Throttle - 60% rpm.
2. Speedbrake - Out.

If a flame-out occurs during the precautionary pattern:

1. Continue with the pattern using the actual flame-out procedure (speedbrake retracted).

WARNING

If 60% rpm cannot be maintained, vary the aircraft drag configuration (landing gear, flap, speedbrake) to maintain the pattern. This allows conversion to a flame-out pattern at any stage.

LANDING GEAR EMERGENCY LOWERING

1. AIRSPEED - BELOW 175 KIAS.
2. As a precaution, move the landing gear control lever to the LG DOWN position.
3. SMARTLY PULL THE "LG EMERG SEL" HANDLE FULLY OUT.

NOTE

This action lowers the landing gear and reduces the speedbrake hydraulic pressure to zero. The speedbrake retracts by aerodynamic affect.

4. Ensure that the green landing gear position indicator lights illuminate.

CAUTION

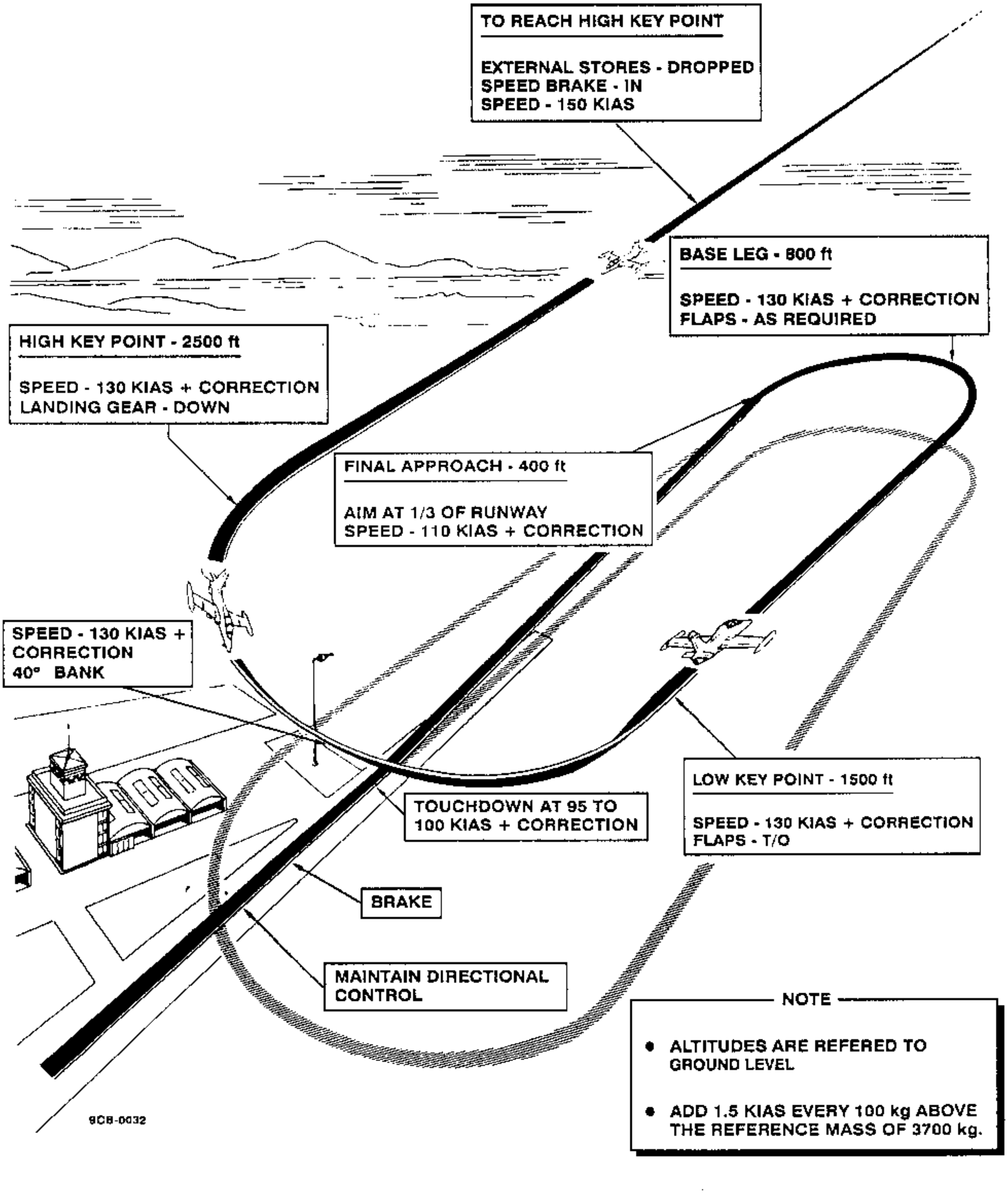
Do not reselect the "LG EMERG SEL" handle as this will set the pressure in the landing gear hydraulic actuating cylinders to zero.

BELLY LANDING OR LANDING WITH LANDING GEAR PARTIALLY EXTENDED

A belly landing or a landing with the landing gear partially extended must only be made on prepared surfaces or runways. Contact the ground personnel to have extinguishing foam spread on the runway over a minimum length of 300 meters, if possible.

1. "SALVO JETT" push-button - Press (if external stores are carried).

PRECAUTIONARY PATTERN



TO REACH HIGH KEY POINT

EXTERNAL STORES - DROPPED
SPEED BRAKE - IN
SPEED - 150 KIAS

BASE LEG - 800 ft

SPEED - 130 KIAS + CORRECTION
FLAPS - AS REQUIRED

HIGH KEY POINT - 2500 ft

SPEED - 130 KIAS + CORRECTION
LANDING GEAR - DOWN

FINAL APPROACH - 400 ft

AIM AT 1/3 OF RUNWAY
SPEED - 110 KIAS + CORRECTION

SPEED - 130 KIAS + CORRECTION
40° BANK

LOW KEY POINT - 1500 ft

SPEED - 130 KIAS + CORRECTION
FLAPS - T/O

TOUCHDOWN AT 95 TO 100 KIAS + CORRECTION

BRAKE

MAINTAIN DIRECTIONAL CONTROL

NOTE

- ALTITUDES ARE REFERED TO GROUND LEVEL
- ADD 1.5 KIAS EVERY 100 kg ABOVE THE REFERENCE MASS OF 3700 kg.

Figure 3-6

CAUTION

- If empty underwing tanks are carried with other external stores, selective jettison of the other stores should be made and the tanks kept in position. This will reduce aircraft damage at touchdown.
- If smoke tanks are carried it is advisable to land on the tanks to alleviate damage to the aircraft, first consuming, if possible, the smoke generating liquid.

2. "FUEL DUMP" knob - Rotate clockwise to dump the tip tank fuel.
3. Expend as much fuel as possible to reduce the aircraft mass, but do not go below 200 kg.
4. "FUEL DUMP" knob - Rotate counterclockwise.
5. Make a normal approach.
6. Check that the speedbrake is retracted.
7. Flap control lever - D/N.

Before touchdown:

8. Throttle - STOP.
9. "FUEL SHUT-OFF" switch - CLOSED (guard and lever up).
10. "BATT" switch - OFF.
11. Contact the runway at the beginning of the foam coat.
12. For a belly landing:
    a. Contact the runway with wings parallel to the ground.
13. When landing with one of the main gear up or not locked down:
    a. Touch down on the side of the down-locked gear.
    b. Hold the wing opposite the retracted or unlocked gear off the runway, then gently lower this wing to the ground before aileron effectiveness is lost.
    c. Try to maintain directional control when the tip tank comes in contact with the ground by acting on the only brake available.
14. For nose gear up landing:
    a. Lower the aircraft nose to the ground gently before elevator control is lost.
    b. When the aircraft nose touches the ground, hold stick full aft and apply brakes smoothly and steadily until the aircraft comes to a stop.
15. Leave the aircraft immediately after it stops by following the "Ground Egress" procedure.

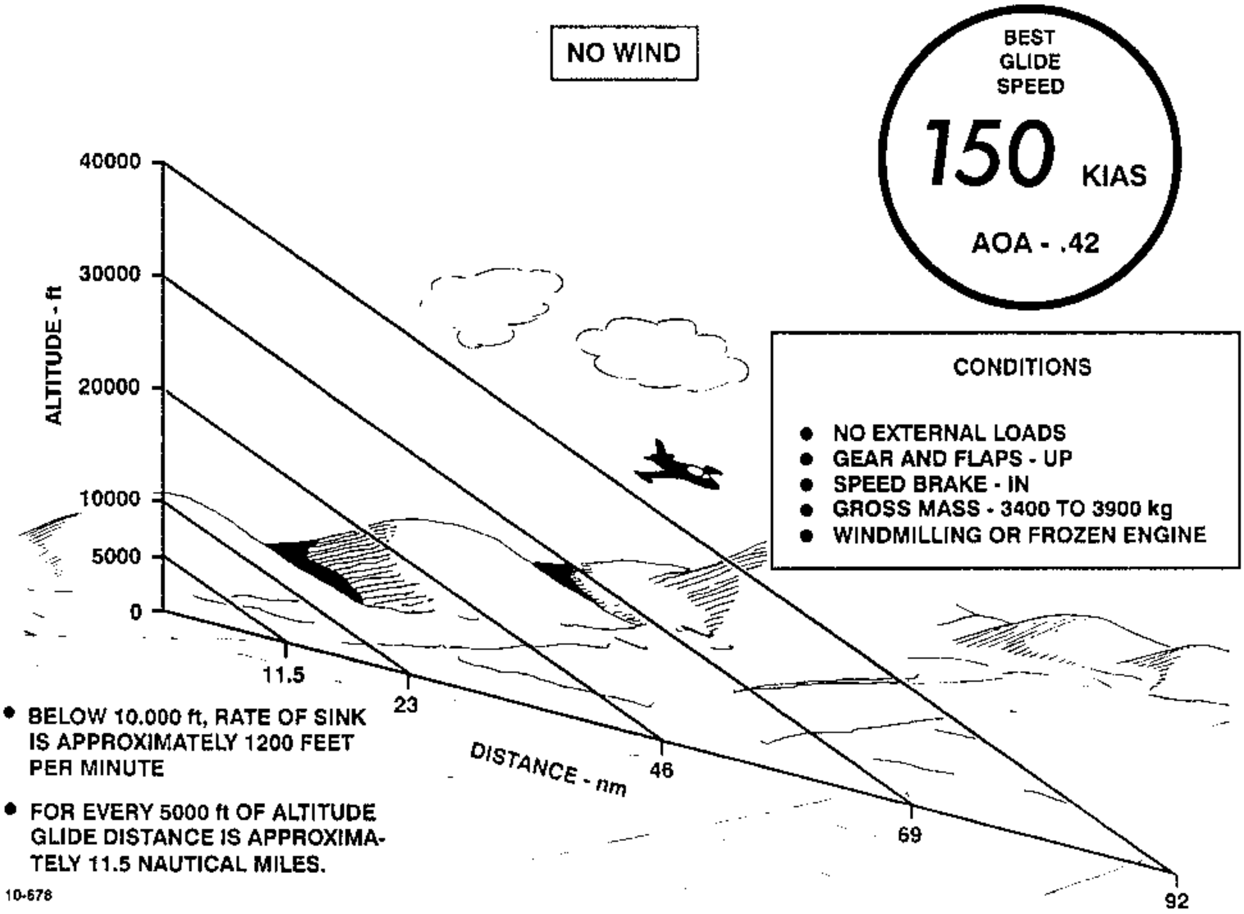
WARNING

Advise the ground personnel assigned to the handling of the aircraft that the ejection seat is not safe, so that safety pins can be installed in the seat as soon as possible, prior to any other action.

EJECTION DURING LANDING

The MK IT-10LK seat allows pilot's ejection at any speed and altitude, and hence during the landing run. Carry out the same ejection procedure as set forth in paragraph "In-flight ejection" in this section.

MAXIMUM GLIDE DISTANCE



CONDITIONS

- NO EXTERNAL LOADS
- GEAR AND FLAPS - UP
- SPEED BRAKE - IN
- GROSS MASS - 3400 TO 3900 kg
- WINDMILLING OR FROZEN ENGINE

- BELOW 10.000 ft, RATE OF SINK IS APPROXIMATELY 1200 FEET PER MINUTE
- FOR EVERY 5000 ft OF ALTITUDE GLIDE DISTANCE IS APPROXIMATELY 11.5 NAUTICAL MILES.

Figure 3-7

LANDING WITH STEERING ENGAGED

If moving the landing gear control lever to LG DOWN brings on the "STEER" advisory light before the aircraft touches the ground and with no action on the steering push-button by the pilot, a failure has occured in the steering hydraulic circuit (selector valve locked in the open position). In this case, proceed as follows:

1. Make a normal approach and landing.
2. Ensure that the rudder pedals are centered on contact with the ground.

CAUTION

> Upon contact of the nosewheel with the runway, if the rudder pedals are not centered, the aircraft will develop a sudden tendency to yaw.

3. Use nosewheel steering while applying brakes symmetrically for directional control.

EMERGENCY USE OF WHEEL BRAKES

To obtain braking, pull the "PARK & EMER BK" handle metering the movement in relation to the braking requirements, and bearing in mind that the hydraulic pressure acts concurrently and to the same extent on both brakes. It must be borne in mind that, as a consequence of the landing gear emergency lowering, the pressure indicated by the emergency circuit pressure gauge may drop below 59 bar (8609 psi), which is the emergency accumulator charge pressure, due to the temperature decrease that may have occurred during flight at altitude. Even if pressure in the emergency circuit should be lower than 50 bar (700 psi), a minimum of ten brake applications is still possible by use of the "PARK & EMER BK" emergency brake handle.

ANTI-SKID SYSTEM FAILURE

If the "A/SKID" advisory light comes on with the anti-skid system engaged, proceed as follows:

1. "ANTI-SKID" switch - OFF.
2. Apply brakes bearing in mind that the anti-skid system is inoperative. If the anti-skid system failure does not permit brake application by use of the pedals, use the "PARK & EMER BK" handle.

NO-FLAP LANDING

If the wing flaps should fail to extend, it is recommended that a landing be made from long final. Should this be impossible, proceed as follows:

1. Fly a pattern slightly wider than normal.
2. Extend the landing gear.
3. Lengthen the downwind leg to perform a longer than normal approach.
4. Maintain 140 KIAS plus corrections during the base turn.
5. Maintain 130 KIAS plus corrections during final approach.
6. Reduce speed down to 120 KIAS during very short final.
7. Touch down at 100 to 110 KIAS plus corrections.
8. After touch-down, make use of aerodynamic braking.

CAUTION

> During aerodynamic braking, do not raise the aircraft nose excessively or a tail strike will occur.

9. As soon as the nosewheel touches the ground, apply the wheel brakes as required.

CAUTION

> If the inability to lower the wing flaps is due to a failure of the hydraulic system, the speedbrake is also unavailable. In this case it is necessary to extend the landing gear by following the "Landing Gear Emergency Lowering" procedure, and to use the "PARK & EMER BK" handle for braking.

LANDING WITH ASYMMETRIC LOAD

NOTE

> The cleared underwing load configurations will produce no uncontrolled emergency situation when a single failure occurs (example: hangup of any store or failure of one

underwing tank to transfer), since the corresponding lateral imbalance is lower than the limit permitted for normal landing.

For general information on the landing technique under asymmetric load conditions, refer to Section VI "Flight with Asymmetric Load". In case of an asymmetric load produced by a failure (failure of fuel to transfer from one wing or failure of underwing stores to release), which is greater than the value permitted for intentional landing, proceed as follows:

1. Try to balance the aircraft laterally by jettisoning the asymmetric stores prior to landing. This can be obtained by using the "SEL JETT" and the "SALVO JETT" push-buttons, in that order. If fuel fails to transfer from one tip tank, dump fuel using the the "FUEL DUMP" control (see para "Fuel System Failure" in this Section).
2. If step 1 is successful, landing can be accomplished in accordance with the normal procedure.
3. In the case that the aircraft can be rebalanced within the permitted value, it is recommended that a slow speed handling check be carried out at safe altitude (10000 ft AGL) in the landing configuration, to ensure lateral control using a maximum of 3/4 stick deflection.

WARNING

The maneuver must be executed with the utmost graduality, being prepared to stop it in any moment in loss of aircraft control is approached.

4. After the above check, landing can be executed with flaps at T/O and at a touchdown speed corresponding to the speed determined by the aircraft mass or to the previously established controllability speed, whichever is the greater.

Under heavy unbalance conditions, near the max. unbalance value permitted for emergency landing, the decision to land or to abandon the aircraft will be made by taking into account the pilot's experience, the runway characteristics (length and width), and the weather conditions (visibility, crosswind, gusts, etc.). The touchdown speed will in no circumstances be greater than 140 KIAS. During approach and landing, consideration should be given to the fact that the landing distance will be remarkably increased as a consequence of the higher approach and touchdown speeds.

WARNING

Any increase in load factor, however small, will increase the asymmetric effect, thus requiring a higher minimum control speed.

Landing should in all circumstances be executed by attempting to keep the runway side opposite the heavy wing, preferably with crosswind from the load side. After contact, full stick opposite the store should be maintained throughout the landing run.

MISCELLANEOUS EMERGENCIES

ELECTRICAL FAILURE

GENERATOR FAILURES (Figure 3-8)

The failure of either generator is indicated by the illumination of the "NO 1 DC GEN" or "NO 2 DC GEN" caution light, as applicable. In this case, first check that the "GEN 1" or "GEN 2" switch is ON, then check the corresponding "LOAD GEN 1" or "LOAD GEN 2" indicator to ensure that failure is real and the caution light is not giving a false indication (if the loadmeter reads with a value greater than zero, the generator is operative). If a generator failure is confirmed:

1. Move the relative switch to the RESET momentary position, then back to ON.

NOTE

There is no limit to the number of times the generator "reset" can be operated.

If the caution light remains on:

2. Land as soon as possible bearing in mind the following:

No. 1 Generator Failure ("NO 1 DC GEN" Caution Light On)

Power to the 28 V dc secondary bus (hence to the anti-ice bus) is interrupted. The systems listed in the table at figure 3-8 are inoperative.

No. 2 Generator Failure ("NO 2 DC GEN" Caution Light On)

Power to the 28 V dc anti-ice bus is interrupted. The following system is inoperative.

- Engine air intake anti-ice system.

Failure of Both Generators ("NO 1 DC GEN" and "NO 2 DC GEN" caution lights on)

Power to the secondary bus (as well as to the anti-ice bus), is interrupted. No. 2 and No. 3 inverters are therefore disconnected from loads. Under these conditions only the dc and ac essential and primary busses are powered from the aircraft batteries.

WARNING

After a careful assessment of the situation, all non essential loads should be turned off.

The batteries can support the loads that are essential for flight for a period of time depending upon the battery state-of-charge. In order to increase battery endurance, the "BATT" switch must be set to the "EMERG" position. In this condition, the primary bus is disconnected. Battery endurance under these conditions is approx. as follows:

- "BATT" switch - EMG

STATE-OF-CHARGE	DAY FLIGHT	NIGHT FLIGHT
100%	41'	32'
80%	33'	25'

- "BATT" switch - ON

STATE-OF-CHARGE	DAY FLIGHT	NIGHT FLIGHT
100%	20'	16'
80%	16'	12'

GENERATOR FAILURE

FAILURE	GENERATOR No. 1	GENERATOR No. 2	BOTH GENERATORS	
CAUTION LIGHT ON	NO 1 DC GEN	NO 2 DC GEN	"BATT" SWITCH ON NO 1 DC GEN NO 2 DC GEN	"BATT" SWITCH EMERG
OPERATING BUSSES	ESSENTIAL	ESSENTIAL	ESSENTIAL	ESSENTIAL
	PRIMARY	PRIMARY	PRIMARY	▨ PRIMARY
	▨ SECONDARY*	SECONDARY	▨ SECONDARY*	▨ SECONDARY*
	▨ ANTI - ICE	▨ ANTI - ICE	▨ ANTI - ICE	▨ ANTI - ICE
INOPERATIVE MAIN SYSTEM	• ANTI - ICE • PHOTOGRAPHIC	• ANTI - ICE	• ANTI - ICE • PHOTOGRAPHIC	• ANTI - ICE • PHOTOGRAPHIC • GUNS • ANTI - SKID • LIGHT • IRU • NCU • VOR / ILS • FDC • JPT • STEER • MFD • RADAR ALT • HUDWAC • DEP

▨ Disconnected busses

* Busses reconnected by actuation of "SEC BUS RESET"switch.

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Figure 3-8

Battery Overheating

If the "BATT HOT" caution light comes on during flight, proceed as follows:

1. "BATT" switch - OFF.

NOTE

> Connect the batteries again only in case the caution light goes off, or both generators fail, or the engine flames out.

COMPLETE ELECTRICAL FAILURE

In the event of complete electrical failure, the following essential conditions should be borne in mind:

a. No warning or caution lights are available.

b. The landing gear can be lowered only by use of the emergency circuit as instructed in paragraph "Landing Gear Emergency Lowering".

CAUTION

> Bear in mind that the landing gear position indicator lights are inoperative.

c. The flaps remain as set prior to the electrical failure. Should flaps be up, a landing as indicated in para "No-flap Landing" will be required.

d. Speedbrake remains as set prior to electrical failure. Should speedbrake be fully extended, it will retract by aerodynamic effect during landing gear emergency lowering.

e. Trim tabs, electrical instruments and radio set are inoperative.

f. Nosewheel steering is inoperative.

g. No release of external stores is possible.

h. The following instruments only are available: accelerometer, mach-airspeed indicator, altimeter, clock, cabin altimeter and standby compass.

INVERTER FAILURE

a. If the "AC SEC BUS" caution light illuminates, (while the "NO 1 DC GEN" and/or "NO 2 DC GEN" caution light is off), indicating failure of inverter No. 2, the secondary 115 V ac busses do not receive power.

b. If the "AC ESS BUS" caution light illuminates, indicating failure of inverter No. 1, the "AC POWER" switch must be moved to EMERG. This action restores the availability of the ac equipment connected to the essential and primary busses, the "AC ESS BUS" caution light will therefore go off. The secondary 115 V ac busses are automatically disconnected and the "AC SEC BUS" caution light illuminates.

HYDRAULIC POWER SYSTEM FAILURE

The following circumstances may occur:

Pressure Indication between 70 and 150 Bar on the Main Hydraulic System Pressure Gauge.

This indicates failure of the hydraulic pump. The following conditions will therefore take place:

- Possibility of normal landing gear lowering.

CAUTION

If pressure should become insufficient for the landing gear to be lowered and locked, follow the "Landing Gear Emergency Lowering" procedure.

- Possibility of normal wing flap lowering.
- Possibility of normal wheel brake application.
- Possibility of aileron servo control operation.

CAUTION

Operation of the aileron servo control progressively depletes pressure in the main hydraulic system,thus may prevent flap operation. It is, therefore, advisable that the "AIL SERVO" switch be turned to OFF even if the "AIL SERVO" caution light has not yet come on to indicate insufficient pressure in the circuit.

Zero Reading on the Main Hydraulic System Pressure Gauge and Normal Reading on the Emergency System Pressure Gauge

This indicates a leak of fluid in the main system.

- Necessity of lowering the landing gear through the emergency system following the "Landing Gear Emergency Lowering" procedure.
- Inability to operate the wing flaps.
- The speedbrake, if down, must be retracted by aerodynamic effect.
- Necessity of applying the wheel brakes through the emergency system by following the "Emergency Use of Wheel Brakes" procedure.
- Inability to operate the aileron servo-control; (shift to manual control will take place automatically). Turn the "AIL SERVO" switch to OFF to prevent occasional pressure increases which may result in an undesired resetting of the servo control.

Zero Reading on the Emergency System Pressure Gauge and Normal Reading on the Main System Pressure Gauge

This indicates a leak of fluid in the emergency system. All systems operate normally since they are fed by the main system. It is however necessary to land as soon as practical.

Readings between 190 and 220 Bar on the Main System Pressure Gauge

This indicates a failure of the variable-flow pump. Under these conditions all hydraulic services operate normally, but it is recommended that a landing be made as soon as possible.

FLIGHT CONTROL FAILURES

ELECTRICAL FAILURE OF ELEVATOR TRIM CIRCUIT

If the elevator trim tab cannot be operated and it is locked at either full travel position, proceed as follows:

Full Nose-Down Trim

1. Reduce engine power as required to decelerate.

2. Lower the speedbrake to counteract the nose-down moment and to obtain a more rapid deceleration.
3. Land with a long final.
4. Land with T/O flaps, if possible.

Full Nose-up Trim

1. Oppose the nose-up moment immediately to limit load factor.
2. Reduce speed.
3. Bank the aircraft, maintain it in a turn and extend the speedbrake: this will decelerate the aircraft down to a speed permitting the longitudinal control to be maintained without excessive forces.

NOTE

> The slight load factor increase due to speedbrake extension is largely compensated for by the decelerating effect of the speedbrake.

4. Land with a "long final".

AILERON SERVO CONTROL FAILURE

Illumination of "AIL SERVO" Caution Light

1. Deflect the ailerons to determine whether a failure is actually present in the circuit, and check that the indication of the "MAIN" hydraulic system pressure gauge is within limits.
2. If a failure is ascertained, reduce airspeed below 350 KIAS.

CAUTION

> The stick force required for manual aileron operation increases with an increase in airspeed, thus reducing maneuverability.

3. Move the "AIL SERVO" switch to OFF (guard and toggle up).

Uncontrolled Lateral Stick Deflection

In the unlikely event that the stick, once deflected laterally, may continue its movement and cannot be returned to neutral as result of a servo- control failure, proceed as follows:

1. Immediately move the "AIL SERVO" switch to OFF (guard and lever up).
2. Decrease airspeed below 350 KIAS to reduce stick forces.
3. Land as soon as practical.

FUEL SYSTEM FAILURE

INTERRUPTED TRANSFER

If the "FUEL TRANS" caution light comes on, this means that the selected PYL (underwing tanks) or TIP (tip tanks) tanks are not regularly transferring into the fuselage tank. In such a case the "FUEL TRANS" light comes on when the fuel contained in the fuselage tank is 470 kg. In case of faulty transfer, proceed as follows:

1. Apply positive and negative loads and yaw the aircraft in an attempt to free any stuck valve.

2. Cycle the "FUEL TRANSFER" switch.
3. If fuel does not transfer from the pylon tanks, move the "FUEL TRANSFER" switch to TIP. If fuel does not transfer from the tip tanks, no action is possible.

CAUTION

In both cases bear in mind that the available quantity of fuel, thence the aircraft range, is reduced.

ASYMMETRIC TRANSFER

Illumination of the "TIP TK UNBAL" caution light indicates that one of the two tip tanks fails to transfer or that it transfers irregularly and has created an unbalance greater than 40 kg. Establish which tank is not transferring regularly. Failure of one of the two underwing pylon tanks to transfer is not indicated by a caution light as for the tip tanks, but is indicated by the premature illumination of the "PYL TK EMPTY" caution light and by a progressive lateral unbalance. Failure of one external tank to transfer does not jeopardize the aircraft controllability, however the "Asymmetric Load Landing" procedure is necessary. It must however be borne in mind that:

a. Jettisoning one pylon tank is not recommended unless further asymmetry conditions add up and lateral control becomes difficult.
b. The fuel in the tip tank may be dumped by rotating the "FUEL DUMP" knob 90°.

FAILURE OF ENGINE ANTI-ICE SYSTEM

Failure of the engine anti-ice system is indicated by the illumination of the "DUCT ANTI-ICE" caution light or by the "ANTI-ICE/ENG" indicator. If the indication provided by the latter is not consistent with the position of the "ANTI-ICE/ENGINE" switch, proceed as follows:

1. Avoid flight in areas of possible ice formation.
2. Leave the icing conditions as soon as possible.
3. Reduce rpm below 85% to minimize the rate of ice accretion in the air intakes.
4. Make any throttle movement slowly.
5. After leaving icing conditions, set 70% rpm (if condition permits for five minutes).

NOTE

This procedure will minimize any compressor damage in the event of ice shedding off the airframe and entering the engine.

GROUND EGRESS (Figure 3-9)

Procedure to be followed by the pilot.

1. Fit the safety pin in the seat firing handle, if time permits.
2. Rotate and press the quick-release fitting disc to release the harness straps.
3. Operate the release lever of the leg restraint lines.
4. Actuate the quick-release fitting of the leg garters.
5. Disconnect the quick-release fitting of the survival pack lowering line from the lifejacket.
6. Disconnect the oxygen mask hose from the connector and the radio jack.

7. Unlock and open the canopy.

If the canopy cannot be opened (due to distortion resulting from an abnormal landing), proceed as follows:

8. Remove the safety pin from the canopy severance handle on the right canopy longeron.

WARNING

Prior to operating the canopy severance system, ensure that the elmet is on, the visor down and the oxygen mask and gloves are on.

9. Move the canopy severance handle forward and up to initiate of the severance charge and the severance of the two canopy transparent sections.
10. Evacuate the cockpit.

GROUND EGRESS

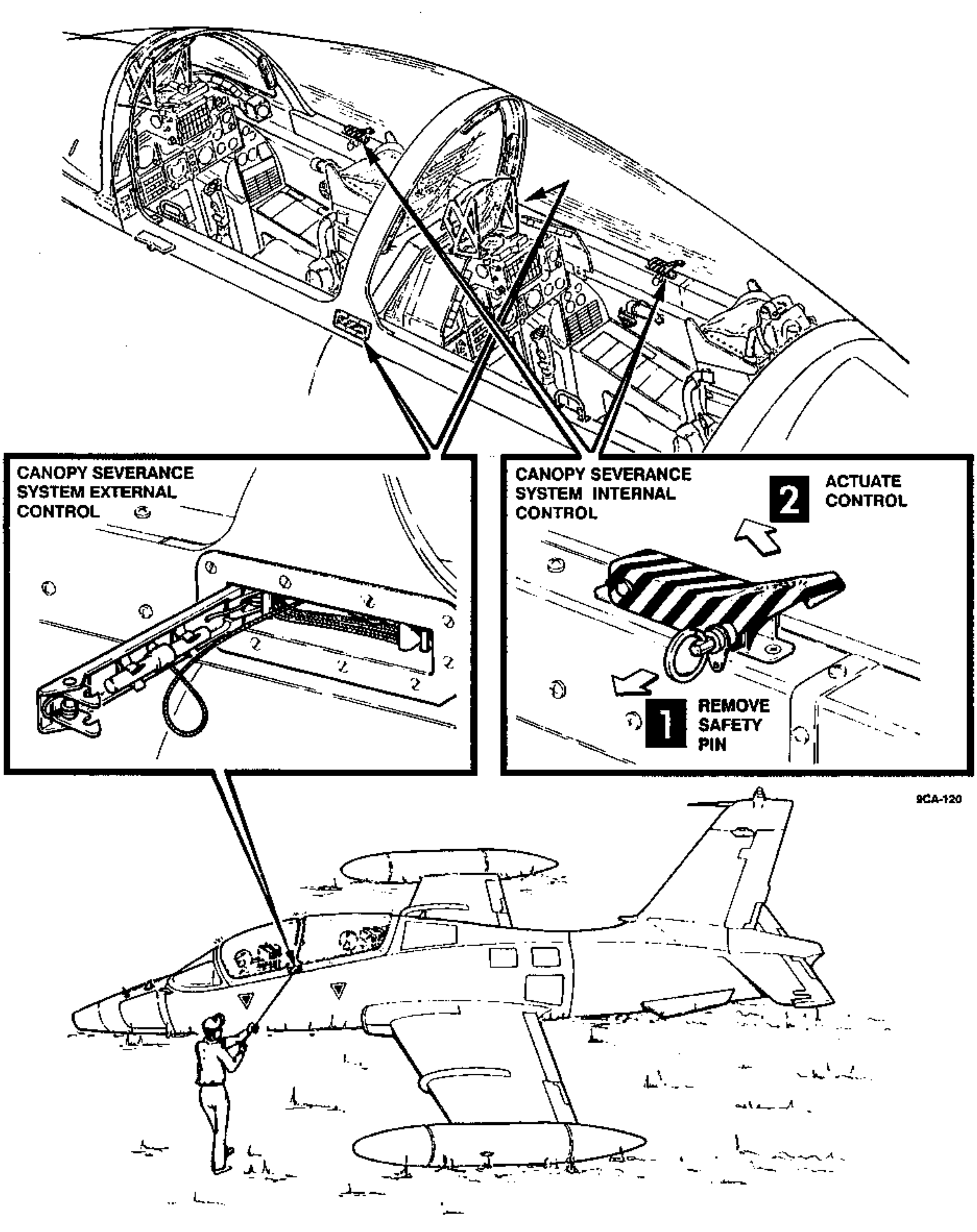


Figure 3-9

SECTION IV

CREW DUTIES

NOT APPLICABLE TO THIS AIRCRAFT

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

INTRODUCTION

This section includes the limitations that must be observed during normal operation of the aircraft. Limitations are based on data from flight testing. Limitations connected with particular operational procedures are given in other sections of this manual. The flight and engine instrument markings giving the operating limitations are shown in figure 5-1. These limitations are not necessarily repeated in the text. Whenever any limitation of temperature and rpm specified in this section is exceeded, the engine must be shut down as soon as possible and the required inspections carried out prior to further operation.

DEFINITIONS

Cruise Conditions

Landing gear and flaps up, speedbrake retracted.

Landing Condition

Landing gear and flaps down, speedbrake retracted.

Clean Configuration

Without external stores.

Configuration with External Stores

External stores carried under the wings.

Symmetrical Flight

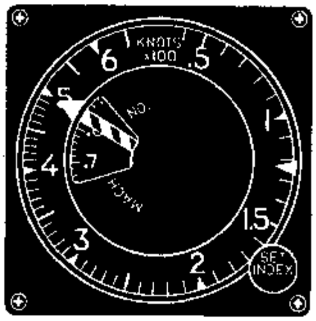
Flight with no rolling tendency or aileron input.

Asymmetrical Configurations

When the configuration (fuel, external stores, etc.) is not equal on both aircraft sides.

INSTRUMENT MARKING

MACH AND AIRSPEED INDICATOR



YELLOW	150 KT	MAXIMUM PERMISSIBLE WITH FLAPS IN DOWN POSITION
▨	500 KT	MAXIMUM PERMISSIBLE (FROM SEA LEVEL TO 5000 ft)
	0.82 MACH	MAXIMUM PERMISSIBLE

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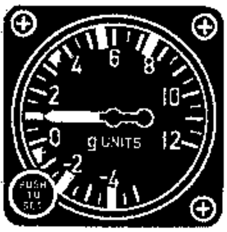
ACCELEROMETER

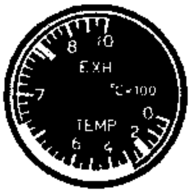


RED	+ 7.33 g	MAXIMUM POSITIVE (CLEAN CONFIGURATION)
RED	+ 5.5 g	MAXIMUM POSITIVE (MAX MASS)
RED	- 2 g	MAXIMUM NEGATIVE (MAX MASS)
RED	- 4 g	MAXIMUM NEGATIVE (CLEAN CONFIGURATION)

Figure 5-1 (Sheet 1 of 2)

INSTRUMENT MARKING

JPT INDICATOR



RED	**200° C**	**MINIMUM TO AVOID FLAME-OUT IN FLIGHT**
GREEN	**300 to 670° C**	**CONTINUOUS OPERATION**
RED	**756° C**	**MAXIMUM PERMISSIBLE FOR 20 MINUTES**

TACHOMETER

GREEN	**75 to 95%**	**CONTINUOUS OPERATION**
RED	**103.5%**	**MAXIMUM PERMISSIBLE FOR 20 MINUTES**

ENGINE OIL PRESSURE INDICATOR

RED	**0.4 BAR**	**MINIMUM TO COMPLETE FLIGHT**
GREEN	**1.4 to 2.4 BAR**	**NORMAL OPERATION**
RED	**2.4 BAR**	**MAXIMUM**

391-050

HYDRAULIC PRESSURE GAUGE

YELLOW	**70 BAR**	**MINIMUM FOR EMERGENCY BRAKING**
GREEN	**150 to 180 BAR**	**NORMAL OPERATION**
RED	**235 BAR**	**MAXIMUM**

Figure 5-1 (Sheet 2)

Configuration with Equal Stores

Approved configuration consisting of underwing stores of the same type (equal).

Configuration with Mixed Stores

Approved configuration consisting of underwing stores of different type.

Partial Configuration

Configuration with underwing stores derived, by subtraction (in accordance with a given sequence), from any of the (approved) configurations with underwing stores.

ENGINE LIMITATIONS

All normal engine limitations are shown in the "Engine Limitations" table at fig. 5-2 and in the graph at figure 5-3.

IGNITION LIMITATIONS

During relight the "RELIGHT" push-button must not be held pressed for more than 30 seconds.

AIRSPEED LIMITATIONS

For the airspeed limitations, refer to figure 5-4.

MANEUVER LIMITATIONS - IN FLIGHT

ROLL LIMITATIONS

Above 25 000 ft, avoid consecutive full stick rolls.

INVERTED FLIGHT LIMITATIONS

Inverted flight or any maneuver resulting in zero or negative "G" is permitted for a maximum of 30 seconds because of the engine oil system limitations. Fuel supply in inverted flight will last approx. 20 to 23 seconds at full throttle, and proportionally longer at reduced power setting.

PROHIBITED MANEUVERS

Intentional spin with asymmetric load.

STRUCTURAL LIMITATIONS (CLEAN CONFIGURATION)

CRUISE CONDITIONS AIRSPEED LIMITATIONS

The maximum allowable accelerations during symmetrical maneuvers are + 7.33 and - 4 g (refer to figure 5-5 (Sheet 1)). The corresponding acceleration limits for rolling pullout maneuvers are equal to -1 and 2/3 of the positive limit permitted for symmetrical maneuvers.

LANDING CONDITIONS

The maximum allowable acceleration with flaps down (T/O or DOWN) is 4 g.

ENGINE OPERATING LIMITATIONS

ENGINE SPEED AND JPT

CONDITIONS	ENGINE SPEED % (100 % = 13760 rpm)	JPT °C	TIME LIMIT (per hour)
Maximum rpm	102 -0.5/+0.2 ▲	756*	20 minutes
Intermediate	98	715	30 minutes Plus any unused time at maximum thrust
Maximum Continuous	95	660	Unlimited
Ground Starting	-	756	-
Relighting	-	800	-
Ground Idling	43 to 46 • (ISA, SEA LEVEL)	-	Unlimited
Maximum Overspeed	105	-	20 seconds

▲ During flight at full throttle maximum rpm may be permitted to increase to 103.5% provided the JPT limitation is not exceeded.

* With the "JPT LMTR" switch in the ON position, this value can be exceeded by + 3 °C due to the tolerance allowed in the automatic temperature control system.

• ISA condition accessories unloaded, warm engine. For other than ISA conditions, refer to the chart in figure 5-3.

NOTE: Slam accelerations may be carried out when necessary however rapid opening of the throttle above 42 000 ft must be avoided.

Figure 5-2

CENTER-OF-GRAVITY LIMITATIONS

The CG limitations in relation to the different aircraft configurations are shown in the graph at figure 5-6.

NOTE

The CG position can be obtained from publication PI 1T-MB339C-5-2 "Loading Data".

MASS LIMITATIONS

The aircraft maximum mass at takeoff and landing is 6150 kg (13 550 lb). The maximum overload takeoff mass for special configurations is 6350 kg (14 000 lb). The maximum overload takeoff mass corresponds to special configurations exceeding the maximum mass which are specifically indicated in figure 5-12.

ENGINE IDLING SPEED

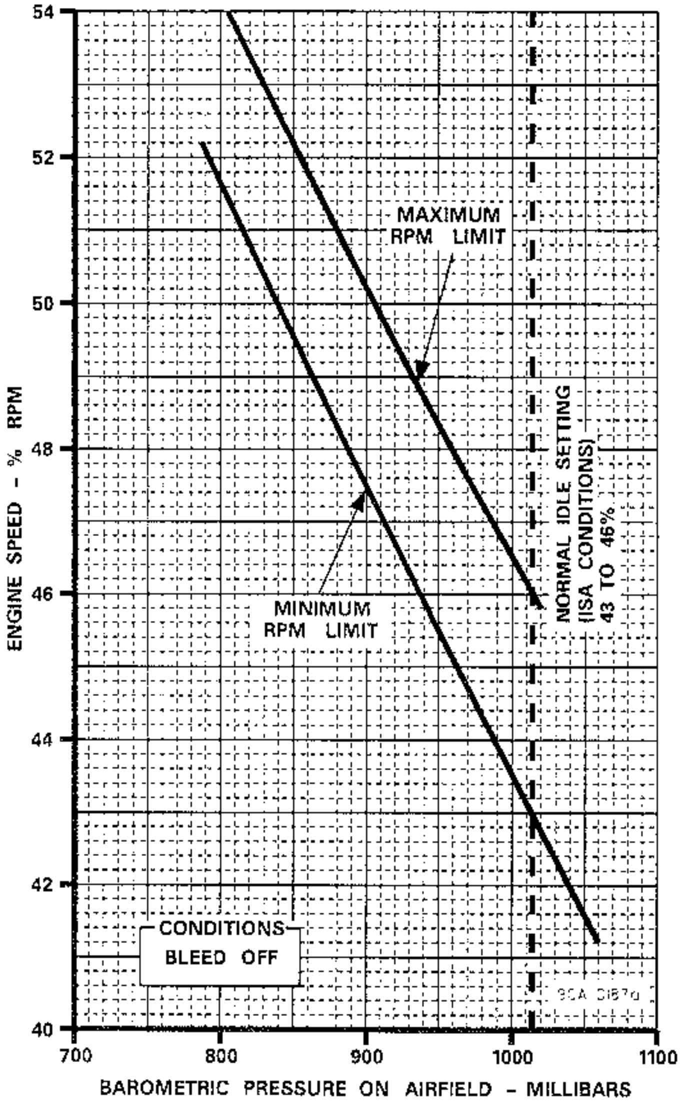


Figure 5-3

AIRSPEED LIMITATIONS

CONDITION	SPEED	REMARKS
Cruise configuration - Without external stores	500 KIAS or 0.82 Mach	
Cruise configuration - With external stores	(See figure 5-5)	
With landing gear locked down or moving	175 KIAS	
With flaps extending or retracting • TAKEOFF position • DOWN position	 175 KIAS 150 KIAS	During maneuvers with flaps down (T/O or DOWN), load factor must be limited between 0 and 4g.
With speed brake extending or retracting	Unlimited	
With landing light down or moving	170 KIAS	
During takeoff and landing (tire limit speed)	139 kt	Ground speed
During taxi (canopy partially open)	60 kt	Sum of aircraft speed and wind speed

Figure 5-4

CAUTION

In some of the approved configurations, it will be necessary to limit the quantity of fuel on board to prevent the maximum limit mass from being exceeded.

LANDING LIMITATIONS

Touchdown should always be "soft", while sinking speed must comprised within the values given in figure 5-7. Special attention should be taken not to exceed the prescribed sinking speed limits when landing at high aircraft mass.

CAUTION

The readings of the vertical speed indicator are not reliable in this phase as they are not instantaneous but subject to a lag.

EXTERNAL STORE LIMITATIONS

INTRODUCTION

Figure 5-8 shows the symbols used to indicate the types of suspension and stores installed at the stations displayed in figure 5-12. The tables at figure 5-12 cover the installation of underwing stores in different configurations. Each configuration can comprise equal or mixed stores, and is displayed to show the wing station at which store installation is cleared, as well as the carriage, jettison and release limitations applicable to each store in the configuration. An index of the tables of the external store limitations is given in figure 5-11.

MANEUVER ENVELOPE

- CLEAN CONFIGURATION
- CRUISE CONDITIONS
- TAKEOFF MASS UP TO 4982 KG WITHIN C.G. LIMITS OF AREA A IN FIGURE 5-6

ZONE A - STALL AREA
ZONE B - SAFETY AREA
ZONE C - DANGER AREA

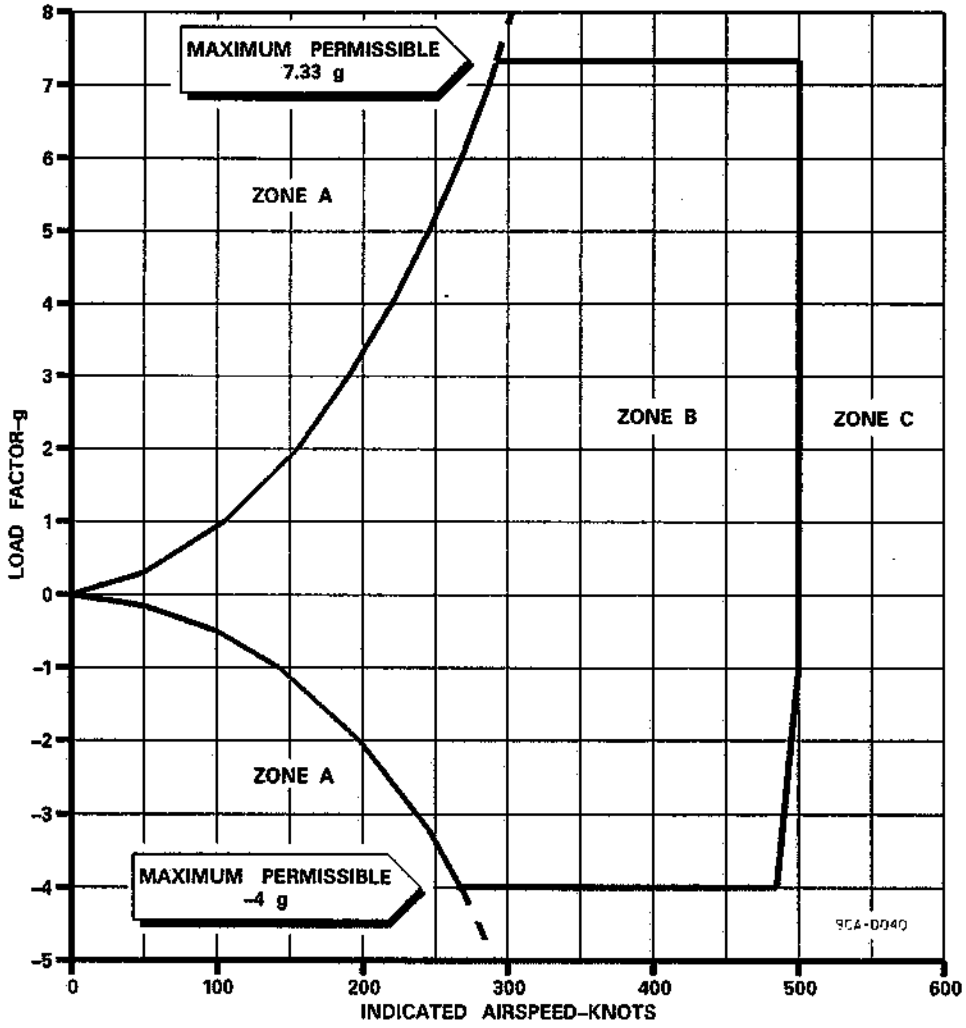


Figure 5-5 (Sheet 1 of 3)

MANEUVER ENVELOPE

- CRUISE CONDITIONS
- TAKEOFF MASS UP TO 5577 + 50 KG (EXTERNAL STORES MASS BELOW 595 KG) WITHIN C.G. LIMITS OF AREA B IN FIGURE 5-6

ZONE A - STALL AREA

ZONE B - SAFETY AREA

ZONE C - DANGER AREA

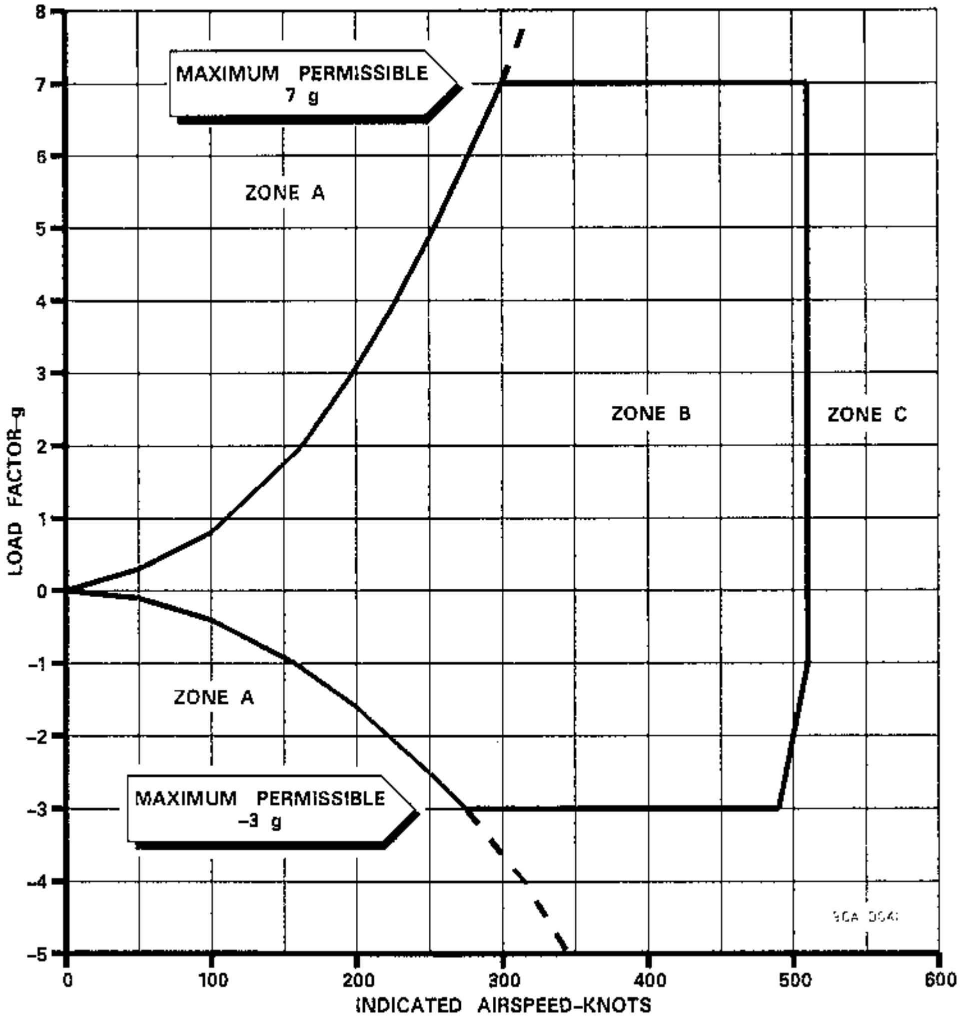


Figure 5-5 (Sheet 2)

MANEUVER ENVELOPE

- CRUISE CONDITIONS
- TAKEOFF MASS UP TO 6350 KG WITHIN C.G. LIMITS OF AREAS C AND D IN FIGURE 5-6

ZONE A - STALL AREA
ZONE B - SAFETY AREA
ZONE C - DANGER AREA

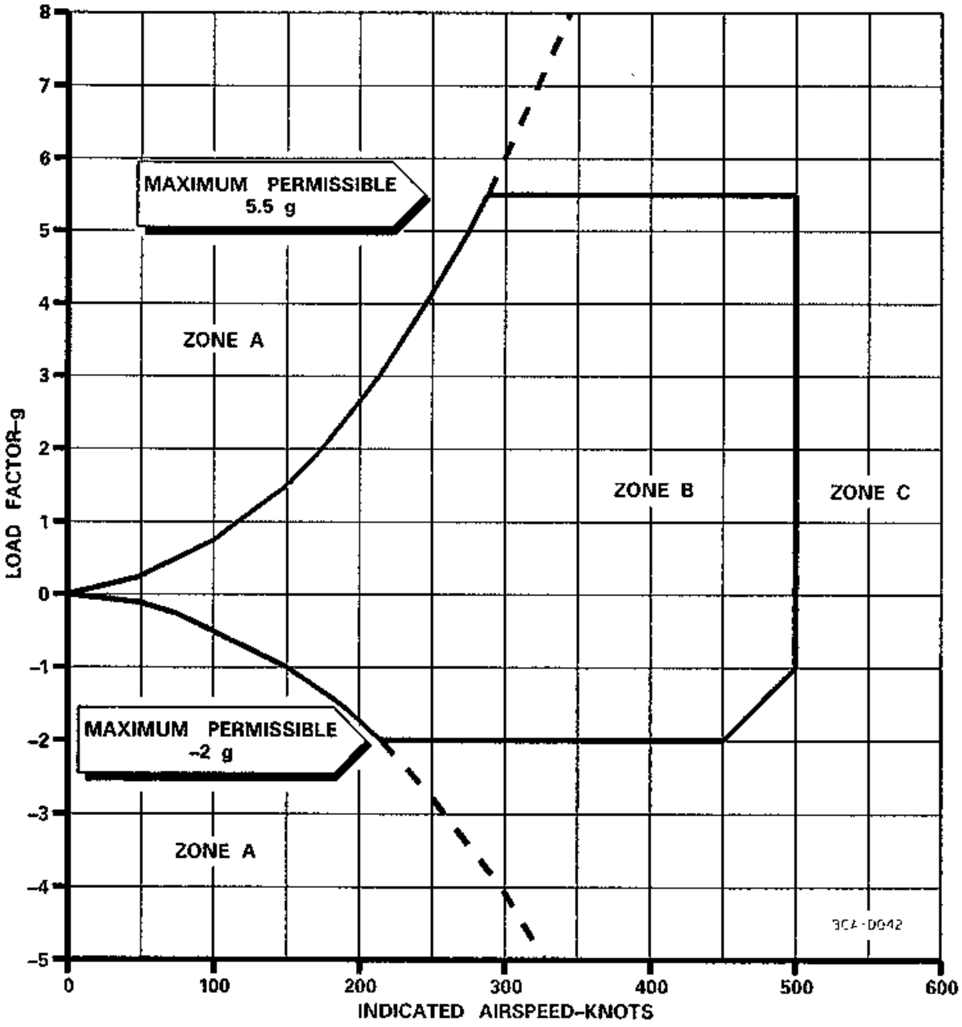


Figure 5-5 (Sheet 3)

CENTER OF GRAVITY LIMITS

CONFIGURATION GROUPS :

— · — · — · WITHOUT EXTERNAL STORES

— — — WITH EXTERNAL STORES :
INBOARD AND MID UNDERWING
STATIONS ONLY, UP TO 595 kg.

———— WITH EXTERNAL STORES

· — — · — — · — — OVERLOAD

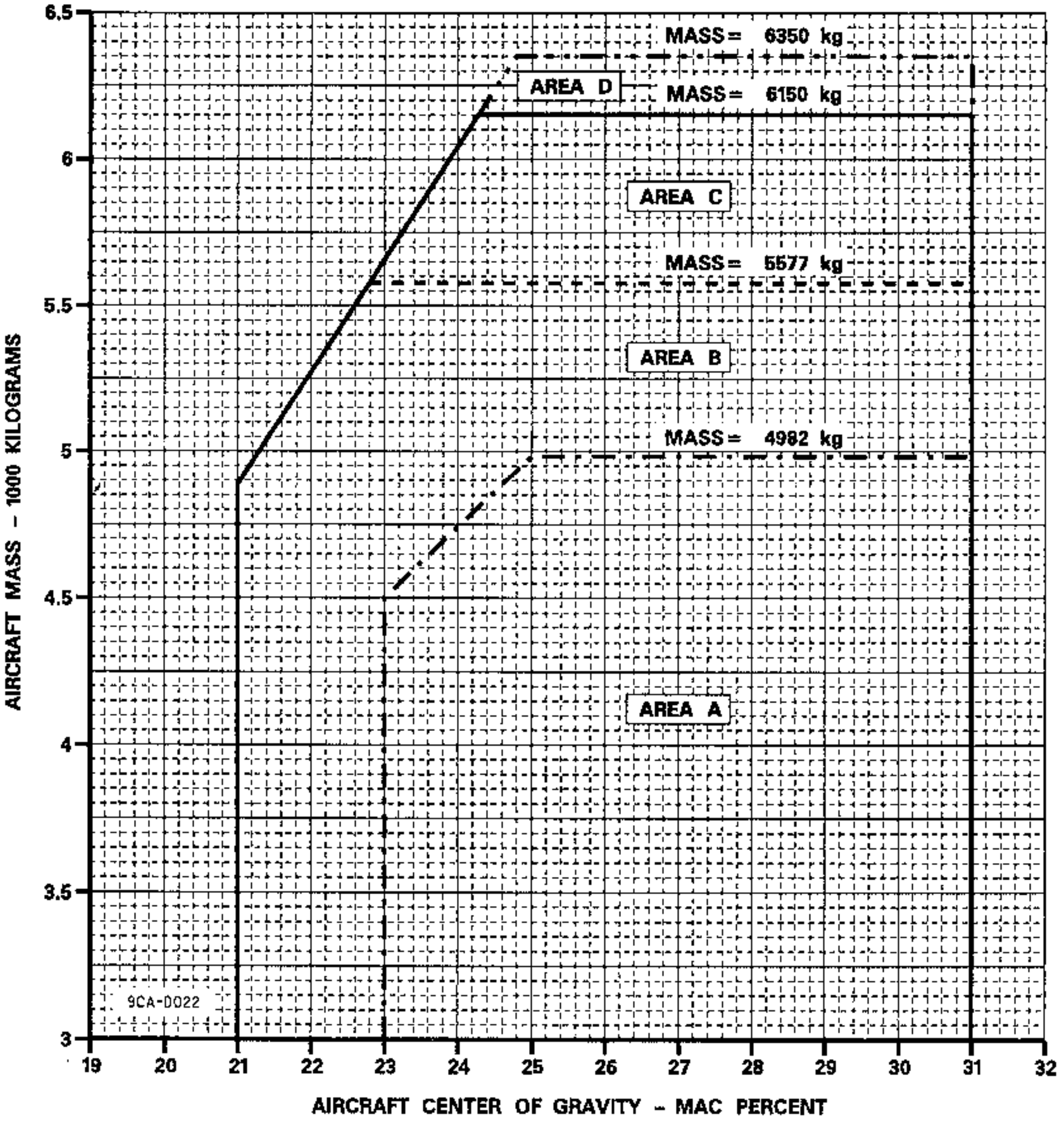


Figure 5-6

SINKING SPEED AT TOUCH DOWN

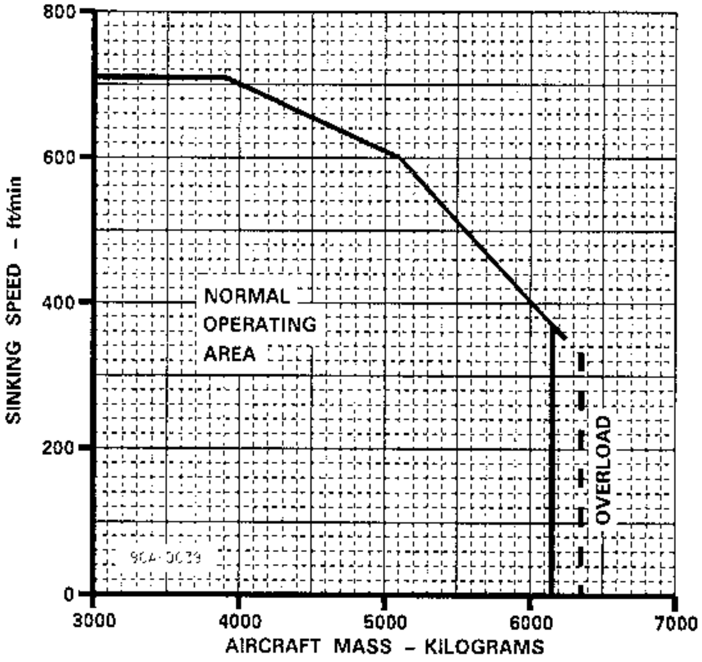


Figure 5-7

SYMBOLS USED IN TABLES OF EXTERNAL STORES LIMITATIONS

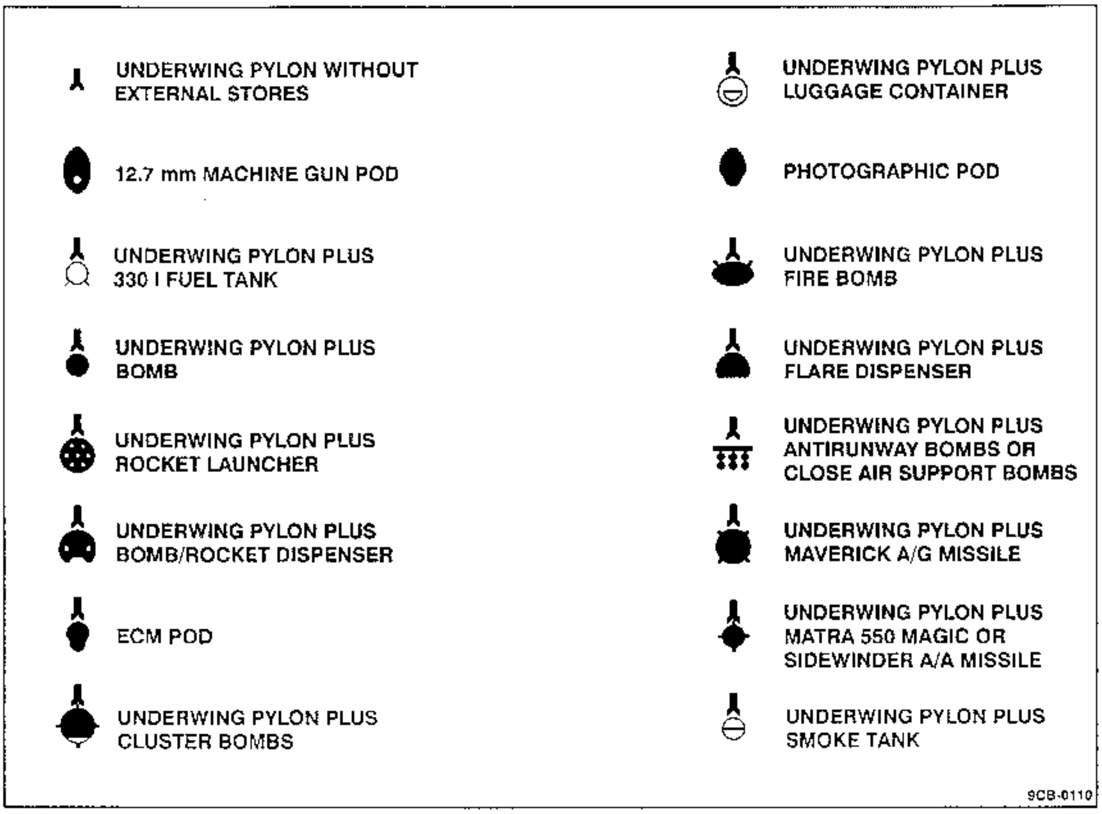


Figure 5-8

WARNING

The only configurations cleared for carriage, jettison and release are the configurations given in figure 5-12 or partial configurations properly obtained by subtraction from the displayed configurations.

GENERAL LIMITATIONS

The following paragraphs describe the limitations applicable to carriage, jettison, firing, launching and normal and emergency release of the configurations displayed in figure 5-12 and of the partial configurations derived therefrom.

1. For mixed store configurations, the limitations are given for each type of store. The most severe limitations for a store apply as long as the store is present.
2. The given values represent the operating limits applicable to the specific displayed aircraft/store configuration.

CARRIAGE OF STORES

1. The symbols used in figure 5-12 in the store station columns define the only position authorized for the carriage of the store. No exceptions are possible.
2. The airspeed limits for the carriage of each external store configuration are given in KIAS and IMN. The carriage speed is limited to the most restrictive value of the two.
3. The carriage acceleration limits indicated in figure 5-12 are applicable only to symmetrical maneuvers. The corresponding acceleration limits for rolling pullout maneuvers are equal to -1 and 2/3 of the positive limit permitted for symmetrical maneuvers. For example, if the positive limit for symmetrical maneuvers is 5.5 g, the limits for rolling pullout are -1 and 3.7 g.

Partial Configuration

Partial configurations are obtained from the configurations presented in figure 5-12 by subtracting the stores from the approved existing configurations. Remarks on partial stores are contained in the following paragraphs.

NOTE

Flight limitations and limits applicable to all partial configurations are the same as applicable to the original configuration.

1. **Equal Stores** - Partial configurations of equal stores will be obtained by subtracting the stores in the normal release sequence. This rule must be observed to ensure that only configurations analyzed and tested in flight are used. Figure 5-9 illustrates the normal release sequence for typical configurations of equal stores.
2. **Mixed Stores** - Partial configurations of mixed stores are obtained as follows:
   a. Any type of store can be subtracted regardless of the other types of carried stores.
   b. Subtraction of the selected type of store must take place in the normal release sequence (figure 5-9).

NOTE

Configurations of equal stores that can be obtained by subtracting all other types of store from a mixed configuration fall under the "Equal Stores" sub- paragraph.

Asymmetrical Configurations

Figure 5-12 comprises a limited number of asymmetrical configurations where the number or types of stores under the right wing is different from the number or types of stores under the left wing.

Carriage of Pylons

When an approved configuration envisages the installation of unloaded pylons, speed or acceleration limitations are not applicable to the pylons but the pylon mass and drag index are to be considered during flight planning.

STORE FIRING/LAUNCHING

The acceleration and speed limitations given in the "Firing" column of figure 5-12 are applicable to firing of machine guns and of rockets from rocket launchers or mixed store dispensers.

RELEASE SEQUENCE

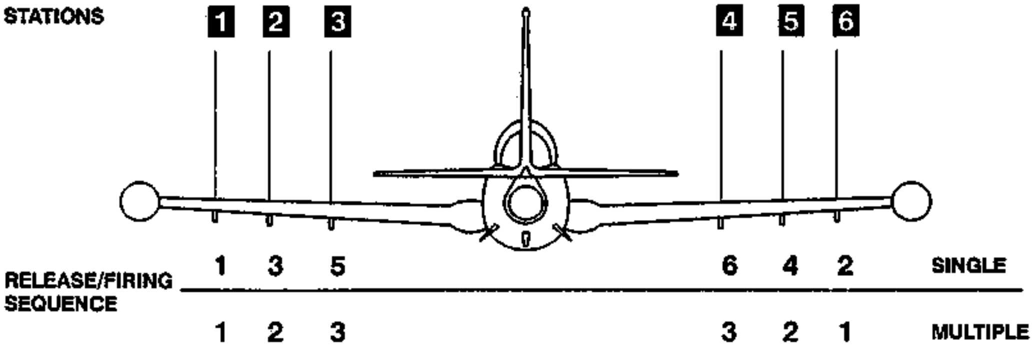


Figure 5-9

STORE RELEASE

The speed and acceleration limitations given in the "Operational release" column of figure 5-12 are applicable to bomb release from pylons or from mixed store containers.

1. When mixed stores are installed, any type of store can be selected for release in its normal sequence.
2. The selected single store must be released first from the outboard pylon.

EMERGENCY JETTISON

The speed and acceleration limitations given in the column "Emergency Jettison" of figure 5-12 are applicable to all types of stores installed under the pylons.

MAXIMUM DELIVERY ANGLE

The dive angle shown in this column of figure 5-12 is the maximum angle approved, based on the results of flight tests, for tactical use of specific stores or configurations, on targets. The values of the angles shown opposite the mixed containers, such as the BRD-4-( ), refer to the ammunition loaded in these containers.

ASYMMETRIC LOAD LIMITS

NOTE

> The authorized underwing store configurations will not produce any imbalances exceeding the limit permitted for landing when a single failure occurs (such as: hangup of any store or failure of fuel to transfer from one underwing tank).

The maximum permitted asymmetric moments are as follows:

- 850 kg.m for intentional takeoff and landing.
- 1100 kg.m for emergency landing.

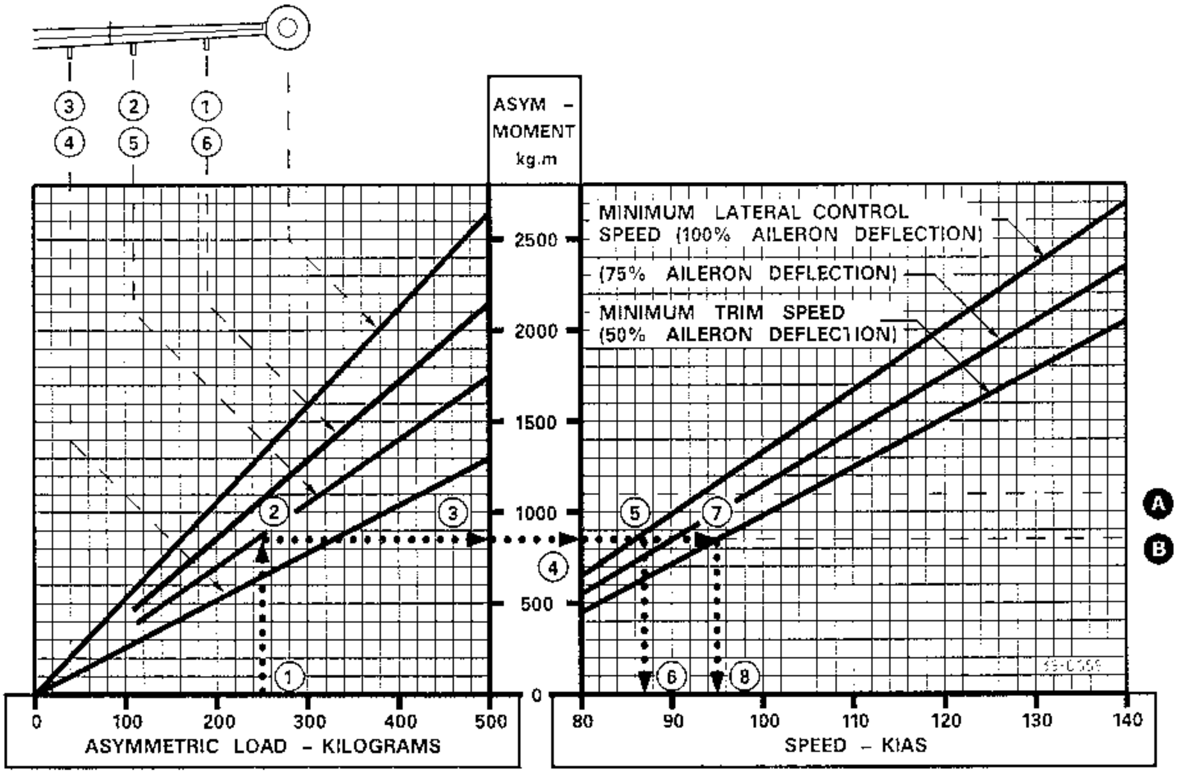
To determine the asymmetric moment due to stores of different mass carried under the pylons or to partial or no fuel transfer from underwing or tip tanks, refer to the chart at figure 5-10. This chart permits the minimum speeds for aileron trim out and lateral control under asymmetric load conditions to be determined. For the flight characteristics with asymmetric load, refer to section VI.

MINIMUM LATERAL CONTROL SPEED WITH ASYMMETRIC LOAD

- SPEEDS MAKE NO ALLOWANCE FOR TURBULENCE, GUSTS OR CROSSWIND.
- FOR MULTIPLE STORES, ADD MOMENTS FOR ALL STORES BEFORE DETERMINING MINIMUM AILERON AND AILERON TRIM CONTROL SPEEDS.

Ⓐ MAX. PERMITTED ASYMMETRY FOR EMERGENCY LANDING - 1100 kg.m.

Ⓑ MAX. PERMITTED ASYMMETRY FOR TAKEOFF AND INTENTIONAL LANDING - 850 kg.m.



SAMPLE PROBLEM

DATA

No transfer from 1 x 330 l pylon tank of station 2

FIND:

- Asymmetric moment
- Minimum aileron trim speed
- Minimum lateral control speed

PROCEDURE:

1. Enter the chart at the asymmetric load - 250 kg.
2. Intersect the guideline of underwing station 2.
3. Move horizontally and read the asymmetric moment -870 kg/m.
4. Reenter the chart at the asymmetric moment - 870 kg/m.
5. Intersect the minimum lateral control speed curve.
6. Move vertically down and read the value of 87 KIAS.
7. Intersect the minimum aileron trim speed curve.
8. Move vertically down and read the value of 95 KIAS.

Figure 5-10

INDEX OF TABLES OF EXTERNAL STORE LIMITATIONS

STORES	MIXED STORE CONFIGURATIONS																																												
Sheet No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
12.7 mm MACHINE GUN POD	●	●	●																																										
330l FUEL TANK	●			●		●																																							
LUGGAGE CONTAINER						●	●																																						
DISPENSER BRD-4-2CRV7	●	●																																											
MK82 LOW DRAG BOMB				●	●																																								
LAU 5002 B/A ROCKET LAUNCHER			●	●																																									
SMOKE TANK							●																																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

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NOTE: TO FIND THE CONFIGURATIONS WHERE THE CONCERNED TYPE OF STORE IS PRESENT, LOCATE THE COLUMN (OR COLUMNS) CONTAINING THE BLACK DOT AND READ THE NUMBER OF THE APPLICABLE TABLE

Figure 5-11

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

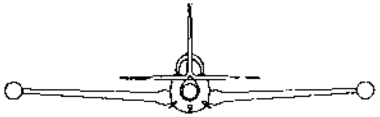
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
12.7 mm MACHINE GUN POD	1			●	●			450 0.75	425 0.7 Gun pods 400 0.75 Rkt	NA	NA	From – 3 to +7	From – 1 to + 4 Gun pods From +0.5 to +1.5 Rkt	NA	NA	From 0° to – 45° Rkt BDU33 and BDU76 Bombs From 0° to – 15° BDU48 Bombs	30	150 Empty 228 Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ °2 . Level flight (max dive/climb 5°). Flaps and speed–brake up. (3) –2xCRV7 rockets plus 4 x BDU33 or MK76 bombs = 147 kg –2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg –2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
	2A			●													15	75 Empty 114 Full	
	2B				●														
12.7 mm MACHINE GUN POD AND BOMB/ROCKET DISPENSER BRD–4–2CRV7	3A			●	THROT SET 100 / 75					420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 (2)			From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 Fuel tanks and BRD (2)		60 Empty 55 Full	195 Empty 145 plus (3) Full	
	3B			THROT SET 100 / 75	●														
330 l FUEL TANK 12.7 mm MACHINE GUN POD AND	4		THROT SET 75 / 75	●	●	THROT SET 75 / 75				NA	From 130 0.17 to 300 0.7 (2)	From – 2 to +5,5		NA			80	278 Empty 876 Full	

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Figure 5-12 (Sheet 1 of 7)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

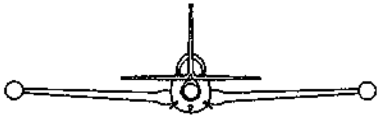
STORE	CONFIGURATION No.	UNDERWING STATIONS						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
								CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
		1	2	3	4	5	6												
12.7 mm MACHINE GUN POD AND BOMB/ROCKET DISPENSER BRD–4–2CRV7	5A		THROT SET 100 /75 	●	●			450 0.75	425 0.7 Gun pods 400 0.75 Rkt	420 0.75 Bombs (1)	From 130 0.17 to 250 0.7 (2)	From – 3 to +7	From – 1 to +4 Gun pods From +0.5 to +1.5 Rkt	From +0.5 to +1.5 Bombs (1)	From +0.5 to +1.5 BRD (2)	From 0° to – 45° Rkt BDU33 and BDU76 Bombs From 0° to – 15° BDU48 Bombs	75 Empty 70 Full	270 Empty 259 plus (3) Full	(1) Max use altitude 35000 ft. (2) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps and speed-brake up. (3) –2xCRV7 rockets plus 4 x BDU33 or MK76 bombs = 147 kg –2xCRV7 rockets plus 4 x BDU48 bombs = 113 kg –2xCRV7 rockets plus 2 x BDU33 or MK76 and 2 x BDU48 bombs = 130 kg
	5B			●	●	THROT SET 100 /75 													

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Figure 5-12 (Sheet 2)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

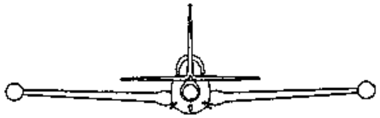
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS – kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
LAU 5002 B/A ROCKET LAUNCHER	6			THROT SET 100 /100 ●	THROT SET 100 /100 ●			430 0.75	400 0.75 Rkt 425 0.7 Gun pods	NA	From 130 0.17 to 250 0.7 Rkt (1)	From - 3 to +7	From +0.5 to +1.5 Rkt From - 1 to +4 Gun pods	NA	From +0.5 to +1.5 Rkt (1)	From 0° to - 45° Rkt	60 Empty 80 Full	120 Empty 250 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2° Level flight (max dive /climb 5°). Flaps, landing gear ang speedbrake up. (2) Avoid abrupt maneuvers with full aileron deflection when stores are installed at stations 1 and 6. (3) Take off is authorized only with tip tanks full to 2/3 max.
	7		THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ●											120 Empty 160 Full	240 Empty 500 Full	
	8	THROT SET 100 /100 ● (2)	THROT SET 100 /100 ●	THROT SET 100 /100 ●	THROT SET 100 /100 ● (3)	THROT SET 100 /100 ●	THROT SET 100 /100 ● (2)					From - 2 to +5.5					180 Empty 240 Full	360 Empty 750 Full	
12.7 mm MACHINE GUN POD AND LAU 5002 B/A ROCKET LAUNCHER	9	THROT SET 100 /100 ● (2)	THROT SET 100 /100 ●	⬮	⬮	THROT SET 100 /100 ●	THROT SET 100 /100 ● (2)										150 Empty 190 Full	390 Empty 728 Full	

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Figure 5-12 (Sheet 3)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

STORE	CONFIGURATION No.	UNDERWING STATIONS						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER-g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS – kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
330 l FUEL TANK AND MK82 LOW DRAG BOMB	10	THROT SET 75 /75 ● (2)	THROT SET 75 /75 ○	THROT SET 75 /75 ● (3)	THROT SET 75 /75 ●	THROT SET 75 /75 ○	THROT SET 75 /75 ● (2)	430 0.75	400 0.75 Rkt	From 130 0.17 to 400 0.7 Bombs (4)	From 130 0.17 to 300 0.7 Fuel tanks (1) From 130 0.17 to 250 0.7 Rkt (1)	From –2 to +5.5	From +0.5 to +1.5 Rkt	From +0.5 to +3 Bombs (4)	From +0.5 to +1.5 Fuel tanks and Rkt (1)	From 0° to – 45° Rkt From + 30° to – 50° Bombs (4)	94 Empty 118 Full	252 Empty 1672 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps, landing gear and speedbrake up. (2) Avoid abrupt maneuvers with full aileron deflection when stores are installed at stations 1 and 6. (3) Limit the fuel quantity on-board not to exceed a max take off mass of 6350 kg. (4) Max operational release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight. Flaps, landing gear and speedbrake up.
330 l FUEL TANK AND LAU 5002 B/A ROCKET LAUNCHER	11		THROT SET 75 /75 ○	THROT SET 100 /100 ⊛	THROT SET 100 /100 ⊛	THROT SET 75 /75 ○											110 Empty 130 Full	248 Empty 898 Full	
	12	THROT SET 100 /100 ⊛ (2)	THROT SET 75 /75 ○	THROT SET 100 /100 ⊛	THROT SET 100 /100 ⊛	THROT SET 75 /75 ○	THROT SET 100 /100 ⊛ (2)										170 Empty 210 Full	368 Empty 1148 Full	

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Figure 5-12 (Sheet 4)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

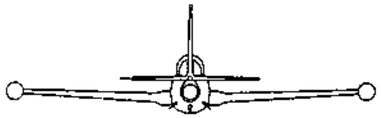
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
								CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
		1	2	3	4	5	6												
MKB2 LOW DRAG BOMB	13			THROT SET 75 /75 ●	THROT SET 75 /75 ●			450 0.75	NA	From 130 0.17 to 400 0.7 (1)	From 130 0.17 to 400 0.7 (1)	From - 3 to +7	NA	From +0.5 to +3 (1)	From +0.5 to +1.5 (2)	From +30° to - 50° (1)	22 Empty 34 Full	62 Empty 512 Full	(1) Max operational and emergency release 35000 ft. Max yaw angle ≤ 2°. Level flight. Flaps, landing gear and speedbrake up. (2) Avoid abrupt maneuvers with full aileron deflection when stores are installed at stations 1 and 6. (3) Limit the fuel quantity on-board not to exceed a max take off mass of 6350 kg.
	14		THROT SET 75 /75 ●	THROT SET 75 /75 ●	THROT SET 75 /75 ●	THROT SET 75 /75 ●						From - 2 to +5,5					44 Empty 66 Full	124 Empty 1024 Full	
	15	THROT SET 75 /75 ● (2)	THROT SET 75 /75 ●	THROT SET 75 /75 ● (3)	THROT SET 75 /75 ●	THROT SET 75 /75 ●	THROT SET 75 /75 ● (2)										66 Empty 102 Full	186 Empty 1536 Full	

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Figure 5-12 (Sheet 5)

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

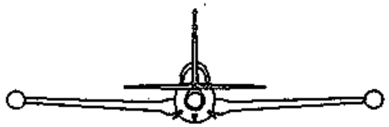
STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER-g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
330 l FUEL TANK AND LUGGAGE CONTAINER (CONFIGURATION No 17B AND 18B (NOT YET CLEARED)	16		THROT SET 75 /75			THROT SET 75 /75		450 0.75	NA	NA	From 130 0.17 to 300 0.7 Fuel tanks From 130 0.17 to 250 0.7 Lug. Cont. (2)	From - 2 to +5,5	NA	NA	From +0.5 to +1.5 (2)	NA	50	128 Empty 648 Full	(1) In case of baggage container at maximum load and failure of fuel to transfer from the unfavourable external tank, there is an imbalance condition greater than 1627 kg. In this condition the asymmetric load exceed the limit permitted for landing; refer to section III "Landing with asymmetric load" (2) Max emergency release altitude 35000 ft. Max yau angle ≤ 2. Level flight (max dive /climb 5°) Flaps and speed-brake up. - Do not place flammable material or explosives in the luggage container
	17A (1)		THROT SET 75 /75		THROT SET 100 /75	THROT SET 75 /75											77	197 Empty 867 Full	
	17B (1)		THROT SET 75 /75	THROT SET 100 /75		THROT SET 75 /75													
	18A				THROT SET 100 /75												27	69 Empty 219 Full	
	18B			THROT SET 100 /75															

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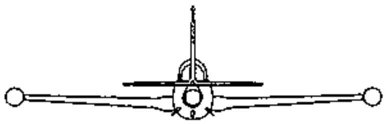
Figure 5-12 (Sheet 6)

EXTERNAL STORE LIMITATIONS

NOTE: THE ONLY CONFIGURATIONS AUTHORIZED FOR CARRIAGE, JETTISON AND RELEASE ARE THE CONFIGURATIONS DEPICTED IN THE FOLLOWING TABLE.
PARTIAL CONFIGURATIONS ARE ALSO AUTHORIZED PROVIDED THEY ARE INDICATED BY SPECIFIC NOTES OR OBTAINED BY LAUNCHING OR RELEASING THE STORES IN THE SPECIFIED SEQUENCES.

STORE	CONFIGURATION No.	UNDERWING STATIONS 						MAX SPEED KIAS OR IMN				ACCELERATION FOR SYMMETRIC MANEUVER–g				MAX DELIVERY ANGLE	TOTAL DRAG INDEX	STORE MASS - kg	REMARKS
		1	2	3	4	5	6	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON	CARRIAGE	FIRING	OPERATIONAL RELEASE	EMERGENCY JETTISON				
LUGGAGE CONTAINER	18C			THROT SET 100 /75 Ⓓ	THROT SET 100 /75 Ⓓ			450 0.75	NA	NA	From 130 0.17 to 250 0.7 (1)	From - 2 to +6,6	NA	NA	From +0.5 to +1.5 (1)	NA	52	138 Empty 438 Full	(1) Max emergency release altitude 35000 ft. Max yaw angle ≤ 2°. Level flight (max dive/climb 5°). Flaps and speed-brake up. - Do not place flammable material or explosiues in the luggage container.
SMOKE TANK (NOT YET CLEARED)	19			⊖	⊖			500 0.8			(2)	From - 3 to +7			(2)		32	79 Empty 191 Full	(2) Tank jettisoning is not possible. In the event of an emergency gear up (or unlocked gear) landing with smoke liquid in the tanks, it is recommended that all smoke liquid be used up.

9CB-0274

Figure 5-12 (Sheet 7)

SECTION VI

FLIGHT CHARACTERISTICS

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DEFINITIONS

Angle of attack (Angle of aerodynamic incidence)

The angle between the fuselage longitudinal axis and the flight path (relative wind direction). AOA is displayed on the PDU in relative units.

Autorotation

An uncontrolled rotation around the roll axis resulting from aggravated, asymmetric stall.

Stalling angle

The angle of attack corresponding to the maximum usable lift coefficient.

Stalling speed

The minimum speed that can be attained with the aircraft in steady level flight.

Erect spin

Helical path about the vertical axis with more or less oscillatory rotation about all three aircraft axes, at an AOA beyond the stalling angle.

Inverted spin

Helical path about a vertical axis in inverted flight with more or less oscillatory rotation about all three aircraft axes, at an AOA beyond the stalling angle in inverted flight.

GENERAL FLIGHT CHARACTERISTICS

The stability and control characteristics of the aircraft are satisfactory throughout the aircraft flight envelope. When properly trimmed, the aircraft will remain in straight and level flight without requiring constant pilot action. The aircraft provides a stable firing platform.

STALLING

During stall and subsequent recovery, the flight controls remain effective in all configurations: lateral control can be maintained even below the stall speed. Normally there is no wing drop tendency. However, if wing drop occurs, it can be easily controlled by use of aileron and/or rudder.
The charts at figure 6-1 give the aircraft stalling speeds with engine idling in the configurations with and without external stores, for different angles of bank and flap settings.

Stall in Level Flight

Wings-level stall (1 g) with landing gear and flaps retracted is satisfactory and is preceded by a moderate airframe buffeting occuring 5 to 6 knots above the stall speed. With landing gear and flaps extended, even if controls remain fully effective, the warning is less pronounced and starts 2 to 3 knots above the stall speed. For the stalling speeds in the different flight configurations of the aircraft, see the applicable chart in the "Performance Data" manual.

Dynamic Stall

Dynamic stall ("g" stall) is preceded, in the flap and landing gear up configuration, by moderate to heavy buffeting, the intensity of which increases with the increase of the speed at which the "g" stall occurs. Recovery is effected by reducing back pressure on the control stick.

AUTOROTATION

In symmetrical load configurations, the aircraft is resistant to autorotation. For autorotation to take place, the aircraft must in fact be close to the maximum lift limits ("g" stall), while a high roll or yaw rate causing the critical angle-of-attack to be asymmetrically exceeded must concurrently be present. An autorotation can, for instance, be started by applying back pressure on the control stick to bring the aircraft AOA beyond the stalling angle, during a high rate roll. Under these conditions an abrupt increase of the roll rate is obtained, which exceeds the values reachable by the mere use of the lateral control. Autorotation is more pronounced, the higher are the initial airspeed, load factor and roll rate. Recovery from autorotation conditions is however always prompt and effective and is obtained by neutralizing the controls. The longitudinal control application is essential since it stops the "g" stall conditions.

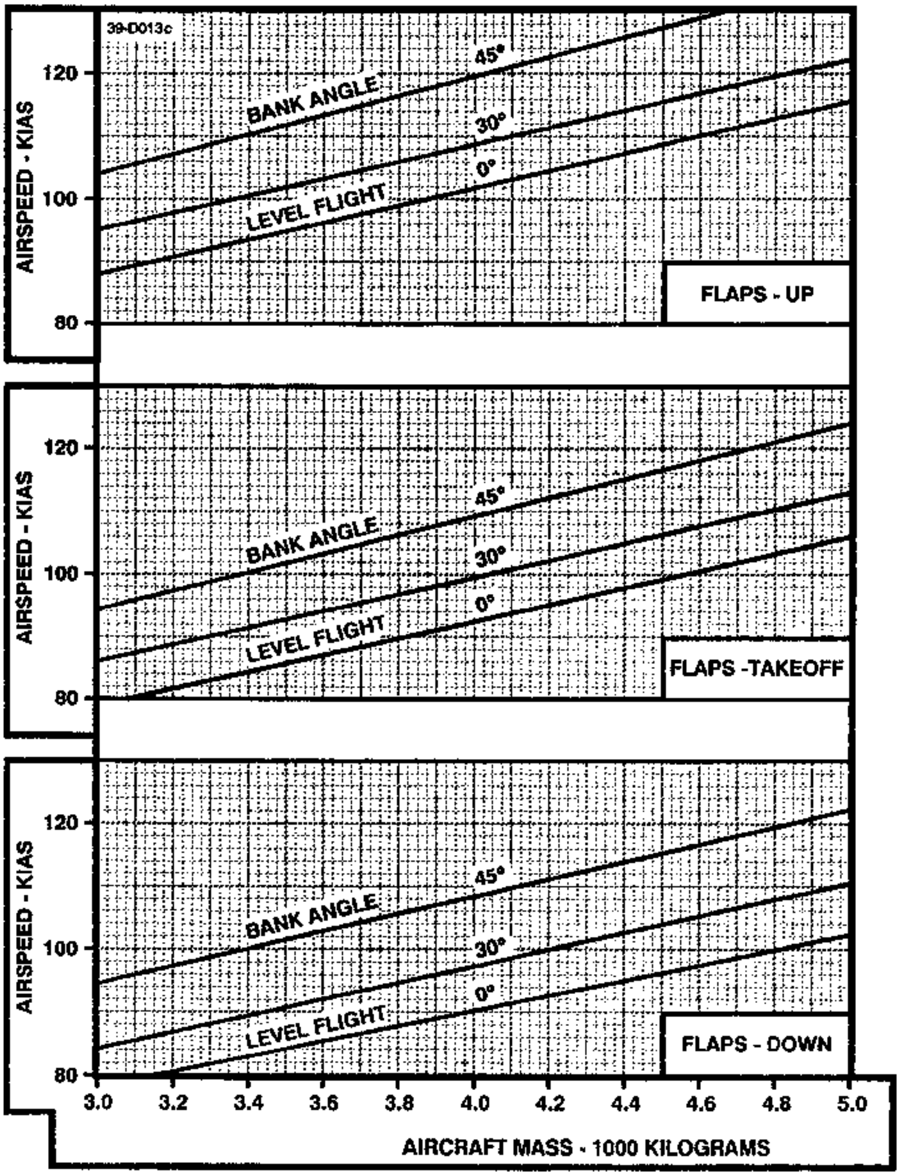
SPIN AND UNUSUAL ATTITUDES

The aircraft spin characteristics are satisfactory. The aircraft is reluctant to enter spin and accidental entry in an erect or inverted spin is extremely improbable.
An erect spin is entered by pulling the stick fully aft and applying full pro-spin rudder at a speed approx 10 knots above the stalling speed. During the first three turns, spin will be clearly oscillatory, with large amplitude oscillations and corresponding angular accelerations about the three axes. From the fourth turn the maneuver becomes almost stabilized and spin can be considered steady. The aircraft will have a nose- down attitude (approx 70 degrees below horizon). Altitude loss at 20 000 ft is approximately 700 ft per turn, whilst at 10 000 it decreases to 600 ft per turn. The airspeed indicator indicates increasing up to 170 knots, while the AOA indicator shows full scale deflection (high values). The following is a summary

STALLING SPEED

WITHOUT EXTERNAL STORES

- **ENGINE: IDLE**



NOTE

WITH ENGINE AT MAX RPM THE STALLING SPEED IN ALL CONFIGURATIONS SHALL BE DECREASED BY 5 KNOTS.

NOTE

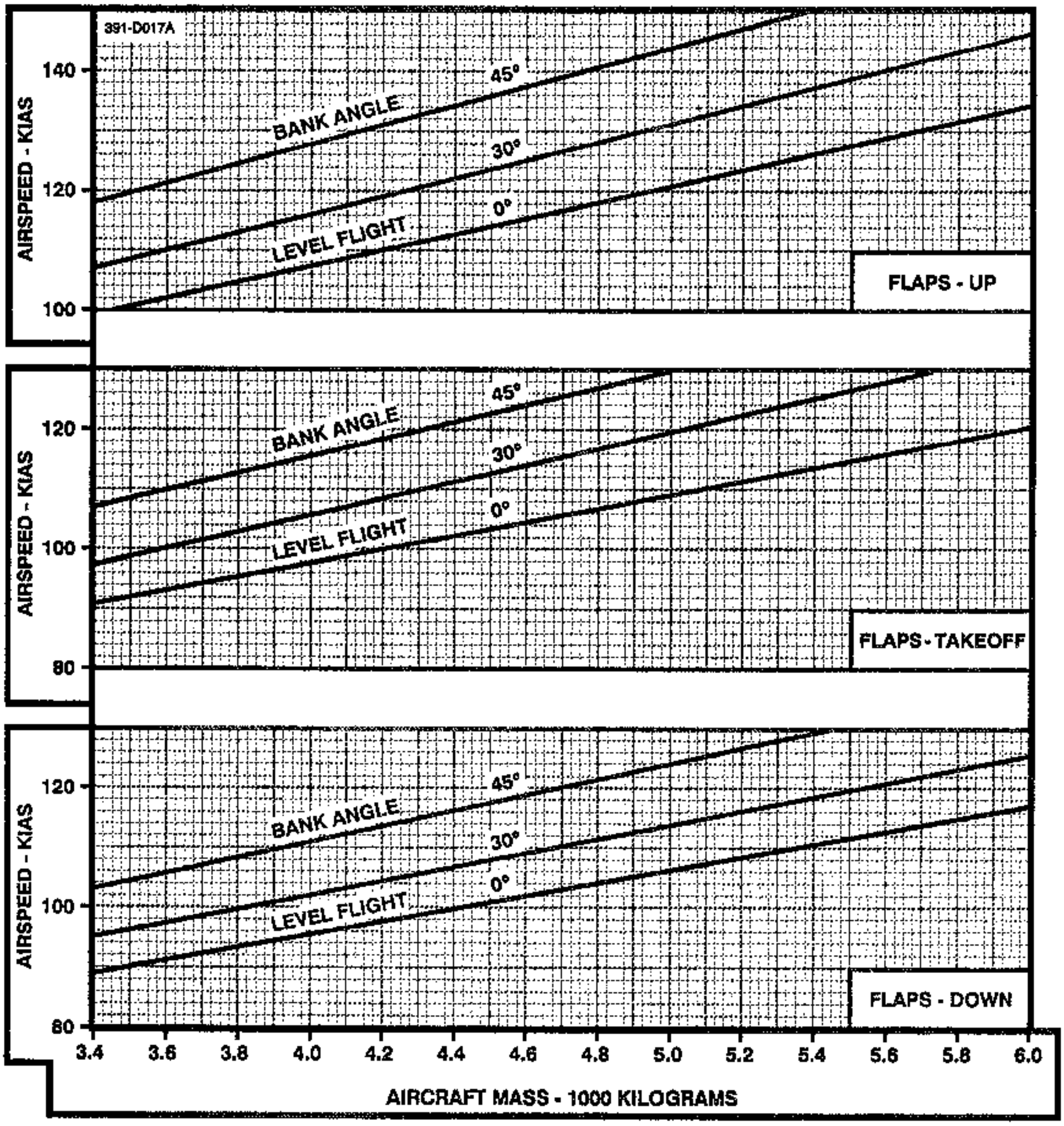
LANDING GEAR AND SPEEDBRAKE POSITIONS HAVE A NEGLIGIBLE EFFECT ON THE STALLING SPEED.

Figure 6-1 (Sheet 1 of 2)

STALLING SPEED

WITH EXTERNAL STORES

- ENGINE: IDLE



NOTE

WITH ENGINE AT MAX RPM THE STALLING SPEED IN ALL CONFIGURATIONS SHALL BE DECREASES BY 5 KNOTS.

NOTE

LANDING GEAR AND SPEEDBRAKE POSITION HAVE A NEGLIGIBLE EFFECT ON THE STALLING SPEED.

Figure 6-1 (Sheet 2)

of the recommended techniques for recovery from spins and unusual attitudes, as proven during spin trials. These techniques generally apply to any condition of aircraft mass, CG, fuel quantity in the tip tanks (unless otherwise specified) and refer to the aircraft in cruise configuration without external stores, with speedbrake retracted and throttle at IDLE.

ERECT SPIN

Recovery from Erect Spin with Symmetrical Tip Tank Fuel Load

The standard technique to recover from a normal erect spin with any quantity of fuel (symmetrically distributed) in the tip tanks, is as follows:

- Progressively apply rudder opposite the direction of rotation and smoothly advance the stick to the center position (elevator and ailerons at neutral).Neutralize the rudder as soon as rotation stops.

Spin recovery with tip tanks empty is very fast, and normally takes place in 1/2 to 2/3 of a turn. The greater the quantity of fuel in the tanks, the longer the time required for recovery. With tip tanks full, recovery takes place in 1 turn. Altitude loss for recovery and subsequent pullout is in any case less than 3000 ft.

Recovery from Erect Spin with Asymmetrical Fuel Load in the Tip Tanks

With one tip tank empty and an appreciable amount of fuel in the other tank, there are unusual and at times disturbing characteristics depending upon the direction of the spin and the positions of the controls in the spin. The standard action is however effective to recover from a spin with asymmetrical fuel load. When the "TIP TK UNBAL" caution light comes on a spin should not be entered intentionally (fuel asymmetry exceeds 50 kg).

SPIRAL MANEUVERS

If the pilot allows appreciable amounts of rudder and elevator to be eased off during a normal erect spin:

a. The aircraft can enter a nearly vertical spiral under load factor, in a nose-down stall condition with or without associated roll, or:

b. The aircraft behavior can appear substantially unchanged but the IAS may rise rapidly with "g" increase.

A normal recovery action is effective in these conditions.

INVERTED SPIN

Normal Behaviour

The aircraft behaviour during inverted spins can vary from steady, scarcely oscillatory spins to oscillatory spins of different intensity, from mild to wild. The airspeed indicator shows very low values (about 0) and the AOA indicator moves to low values. Nose-down attitude is not very pronounced and altitude loss is about 700 ft per turn.

WARNING

> Because of the varying behavior of the aircraft and of the disorientating effects that can result, intentional entry into an inverted spin is not recommended if pilots are not sufficiently familiar with the erect spin maneuver.

An inverted spin is entered from inverted flight at a speed approx 20 knots above stalling speed by applying full forward stick, pro-spin rudder and a small displacement of the ailerons in the direction opposite to the rudder; ailerons displacement is required only in the entry phase of the spin, after which aileron control should be returned to neutral.

Recovery from Inverted Spin

The best technique to recover from a steady inverted spin is essentially the same as used in erect spin recovery, namely:

1. Progressively apply full rudder opposite the direction of rotation.

CAUTION

> It can be difficult to determine the direction of rotation in an inverted spin. This is because the aircraft is yawing in one direction but rolling in the opposite direction. The direction of rotation will always be correctly indicated by the turn indicator on the ADI. In case of disorientation, it is recommended that all controls be neutralized. This action will result in spin recovery within two turns.

2. Immediately return elevator and ailerons to neutral.
3. Neutralize the rudder as soon as rotation stops.

Behaviour during Recovery

For inverted spins, the standard recovery procedure normally leads to recovery within approximately one turn. Control forces to operate the rudder, though higher than those required to recover from an erect spin, remain reasonable and the stick is neutralized with moderate force. The altitude lost for recovery and subsequent pullout is approximately 4000 ft.

UNUSUAL ATTITUDES

The recovery from unusual attitudes, connected with extremely low airspeed and high nose-up attitudes, does not involve any difficulty. Returning all controls to the neutral position will normally result in the aircraft pitching down with consequent increase in speed.
If autorotation should commence through mishandling of controls at low speed, returning of all controls to neutral will normally effect a recovery.

EFFECT OF RUDDER DURING SPIN

The rudder is the most effective control to recover from any type of spin, and full antispin rudder deflection produces the quickest recovery. Neutralization of all controls can still permit recovery but time to recover and altitude loss will obviously be greater.

EFFECT OF AILERON DURING SPIN

In general the use of inspin aileron during erect spin has a destabilizing effect which makes the spin rough and oscillatory. Outspin aileron has a stabilizing effect and produces a smoother spin. During inverted spins outspin aileron may produce a very oscillatory aircraft behavior, whereas inspin aileron has a noticeable stabilizing effect. The use of the standard recovery procedure is, however, still recommended.

EFFECT OF SPEEDBRAKE DURING SPIN

The aircraft behavior does not change appreciably if the maneuver is accomplished with the speedbrake out. It is however recommended that the speedbrake be held closed to reduce to a minimum altitude loss during recovery.

EFFECT OF EXTERNAL STORES DURING SPIN

The presence of external stores does not remarkably affect the aircraft spin behavior which is generally less oscillatory than without external stores.
Effectiveness of controls remains correct and recovery is always promptly obtained by applying opposite rudder.

EFFECTIVENESS OF FLIGHT CONTROLS

ELEVATOR

The elevator is effective throughout the flight envelope and permits maneuvering the aircraft to the limit load factors.

AILERONS

The lateral control, fitted with servo unit, is effective throughout the speed range and has no deflection limitation.
Rolling maneuvers with full stick deflection, especially at high altitudes (above 25 000 ft), are characterized by a mild nose-up tendency. As the CG position moves aft, there is an increased possibility of unintentional stick longitudinal inputs: these are to be avoided since they are likely to result in disproportionate load factor variations.
While there is usually no reason for switching the "AIL SERVO" off in flight, it must be kept in mind that changing from aileron servo control to manual and vice versa, if the aircraft is not trimmed or the stick is off center at time of changeover, can result in an abrupt maneuver since the aircraft reacts very quickly.
To obtain first-hand information on the effect of servo control turning off and the stick forces required for manual control, it is recommended that tests be initially carried out during low speed flight.

RUDDER

The rudder starts being effective on takeoff at approximately 45 KIAS and remains effective throughout the flight envelope. Control forces increase with airspeed and normally prevent high deflections from being obtained at high speeds. There are no deflection limitations up to 180 KIAS. For higher airspeeds, rudder deflection has to be progressively limited up to one third of the maximum value at the max aircraft speed.

WING FLAPS

Selecting the flaps to the takeoff position will be accompanied by a slight nose-up tendency of the aircraft; selecting the flaps to the landing position will involve a further slight nose-up moment and a slight buffeting. All these effects are very easily controlled by use of the longitudinal control and can be trimmed with the longitudinal trim.

SPEEDBRAKE

The speedbrake is very effective and can be used at any speed within the speed range of the aircraft. Selecting the speedbrake out at high Mach numbers and even more at high IAS will produce a nose-up moment which can be easily opposed by the pilot.

POOR VISIBILITY FLYING

When flying in conditions of poor visibility, maintain a speed of approx 200 KIAS. This speed, except in case of contrasting operational requirements, is an acceptable compromise between the aircraft maneuvering capability and the time needed by the pilot to detect ground features or obstacles.

MANEUVERING FLIGHT

The control stick forces during aerobatics are moderate. The optimum indicated airspeeds to accomplish some aerobatic maneuvers at medium altitudes are:

- 270 KIAS for looping
- 230 to 350 for aileron roll
- 310 KIAS for roll off the top.

DIVING

EFFECTS OF COMPRESSIBILITY

During dives and maneuvers up to Mach 0.76, aircraft stability and control remain satisfactory. Beyond Mach 0.76 a slight nose-down moment occurs which increases gradually with the increase in Mach number it can be counteracted with moderate force on the elevator. Above Mach 0.78 a buffeting of the aircraft is noted. The aircraft is however fully controllable up to the limit of 0.82 Mach number.

DIVE RECOVERY

For minimum loss of altitude during dive recovery it is recommended that the throttle be retarded to IDLE and the speedbrake extended. Control stick forces are reasonable and well within the pilot capabilities. It should be noted that, due to the load factor applied during recovery, compressibility phenomena are somewhat stronger. The chart at figure 6-2 shows the values of altitude lost during recovery from a dive.

EFFECTS OF GUSTS

The gust loads imposed on the aircraft increase with speed; if speed is doubled the gust load will double. At high speed, in extremely turbulent air, gust loads may be as high as 4 g. If the gusts occur during high-speed maneuvered flight, they can cause the limit load factor of the aircraft to be inadvertently exceeded. Therefore, if it is necessary to fly in severe turbulence, reduce speed to 230 KIAS, and refrain from intentionally pulling more than 2 g.

FLIGHT WITH EXTERNAL STORES

Flight with external stores does not require any special technique in this aircraft. The influence of the external stores, apart from drag, is negligible. Flight with external stores slightly reduces the climb and cruise performance (see "Performance Data" manual), whereas the flying qualities remain satisfactory.

FLIGHT WITH ASYMMETRICAL LOAD

Within the permitted asymmetrical load limits (see Section V) and under special operating conditions, planning missions in asymmetrical external store configurations is permitted. Asymmetrical loading involves a deterioration of both lateral and directional controls. The rolling moment due to the mass of the asymmetrical load must be counteracted by aileron trim to prevent rolling in the direction of the heavy wing. This aileron deflection increases with decreasing speed and increasing load factor. Moreover, in case of asymmetrical external stores, an unbalanced drag effect results in a yaw moment which can be easily counteracted by application of the rudder. Directional trimming is easily obtained for any

DIVE RECOVERY CHART

EXAMPLE:

IF 4.0 g PULLOUR FROM A 45% DIVE AT 350 KIAS IS STARTED AT 22000 ft. THE ALTITUDE LOST DURING DIVE RECOVERY WILL BE 3000 ft.

① **ENTER CHART WIYH KIAS AT START OF PULL-OUT - 350 KIAS**

② **PROCEED RIGHT TO ALTITUDE AT WHICH PULLOUT IS STARTED - 22000 ft**

③ **THEN DOWN TO DIVE ANGLE - 45 DEG**

④ **PROJECT RIGHT AND INTERSECT**

⑤ **DIVE RECOVERY LOAD FACTOR - 4 g**

⑥ **READ ALTITUDE LOST DURING PULLOUT 3000 ft**

NOTE

If KTAS is known, enter chart with KTAS at start of pullout, proceed up to the dive angle and repeat steps ④⑤ and ⑥

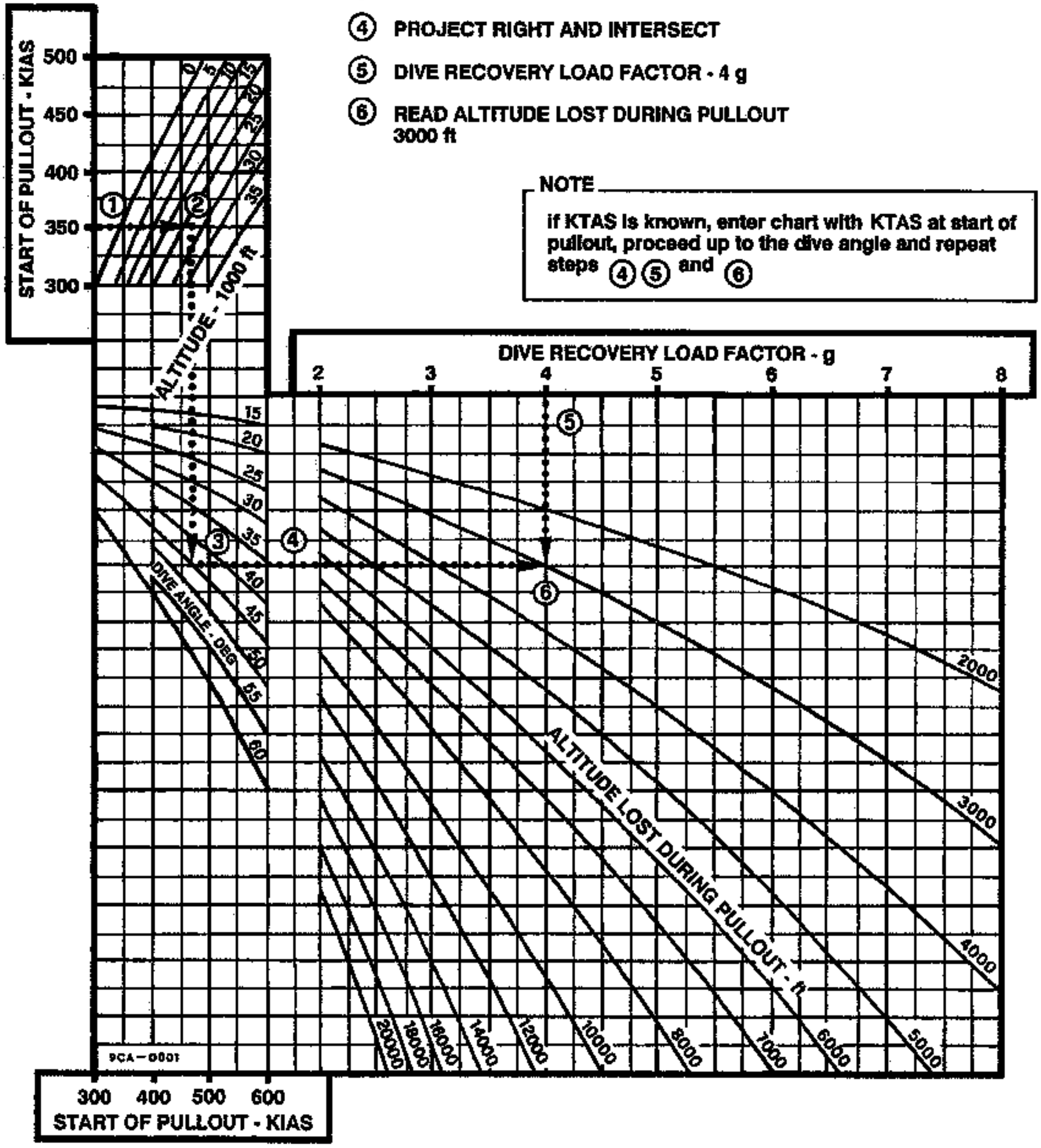


Figure 6-2

asymmetrical load configuration. With lateral asymmetries exceeding 850 kgm, a slight residual pressure on the rudder pedals may be required at low speed to maintain the slip indicator centered.

LATERAL TRIMMING AND MINIMUM CONTROL SPEED WITH ASYMMETRICAL LOAD

Flight with asymmetrical load requires aileron and rudder trimming or application of continuous control forces by the pilot to keep the aircraft straight and level. As airspeed changes the effectiveness of the control surfaces also changes and so changes the deflection of the aileron control and rudder pedals in order to balance the load asymmetry.

When the aileron control reaches the full trimming deflection, minimum speed for lateral trim is also attained (figure 5-11). A further speed reduction requests the pilot to hold a continuous lateral control force on the stick and to increase aileron deflection to maintain wings-level flight. The speed at which full aileron deflection is required, is the minimum obtainable aileron control speed (figure 5-11). A further reduction of speed below this value will result in an uncontrollable roll in the direction of the heavy wing and prompt action will be required by the pilot to return speed above the minimum value.

FLIGHT CHARACTERISTICS WITH ASYMMETRICAL LOAD

Takeoff

When takeoff with asymmetrical load is performed, rotation and takeoff speeds must not be less than the minimum lateral control speed (see figure 5-11). Takeoffs with asymmetrical load may require large rudder application during the takeoff run. It is recommended that 50% of the available aileron trim be set before takeoff for imbalance conditions up to 400 kgm and further increments of 10% of trim be used for every 100 kgm of additional imbalance. The pilot should promptly act on the stick in the lift-off phase to maintain the wings level and subsequently use lateral trim as needed for straight flight.

Flight

Small aileron and rudder trim applications are sufficient to maintain wings- level flight within the maximum permissible asymmetry limit at all speeds. Whenever stores are individually dropped, aileron inputs may be required, whose amplitude is a function of airspeed. This requirement is to be borne in mind in all flights with external stores during which a condition of asymmetrical load (inadvertent release of a store) could accidentally result. In asymmetrical flight conditions all turns should be made, if possible, on the side away from the heavy wing, especially when flying at low speed. Besides, it must be borne in mind that, under asymmetrical load conditions, a lateral center-of-gravity displacement toward the heavier wing will result. As a consequence, the longitudinal accelerations along the aircraft axis, such as those caused by the engine thrust variations or by the use of the speedbrake, will introduce a yawing moment; to every thrust variation or extension of the speedbrake there will correspond a yaw (on the load side when the engine throttle is advanced, on the opposite side when the engine throttle is retarded or the speedbrake is extended) which at low speeds, when the aircraft aerodynamic reactions are weaker, may involve large directional attitude changes.

Landing

A straight-in approach to the runway is recommended; this procedure allows a continuous control of the sideslip angle to be maintained and, since large throttle movements are not required, it does not enhance the yawing effect of thrust variations. On the contrary, the overhead pattern which requires large turns at low speed, may prevent the pilot from noticing the build-up of large sideslip angles, thus resulting in a possible loss of control.

Thrust variations and speedbrake extension, producing accelerations along the aircraft axis, can result, under asymmetrical load conditions, in large yaw moments which, at low speed, can drive the aircraft into excessive sideslip angles: great care should therefore be taken to avoid strong and abrupt thrust variations during approach to landing or go-around. Besides, with asymmetrical load, accelerations along the vertical axis create a rolling moment on the load side; this must be borne in mind since a rolling moment difficult to counteract by use of the ailerons could be experienced on landing, from load factor application. Landing should be made with flaps at takeoff, on the runway side away from the load, preferably with crosswind, if any, from the load side.

After ground contact, the aircraft remains directionally fully controllable down to very low speeds. A lateral deflection of the stick is however necessary to maintain the wings level. When braking, bear in mind that the center-of-gravity lateral displacement always results in a yawing moment on the side opposite the load. The aircraft lateral bank at speeds lower than the aileron effectiveness speed is moderate and permits normal taxiing. Bank may increase to values slightly above 5 in presence of large asymmetries, only at very low speeds. It is recommended that turns in the taxi roll be made on the side of the heavy wing to relieve the weight on the corresponding wheel.

SECTION VII

ALL WEATHER OPERATION

TABLE OF CONTENTS

INTRODUCTION

This section contains explanations, operational peculiarities and procedures which affect the operation of the aircraft in extreme weather and climatic conditions. Normal instrument flight procedures are covered in Section II.

FLIGHT IN POOR VISIBILITY CONDITIONS

In conditions of poor visibility, an airspeed of approx 200 KIAS shall be maintained during low level flight. This speed, except in case of other operational requirements, is an acceptable compromise between the aircraft maneuvering capability to avoid unexpected obstacles and the speed at which such obstacles are approached.

ICE AND RAIN

ICING CONDITIONS

On the Ground Icing conditions can occur at ambient temperatures of less than 6°C and relative humidity greater than 50%. The most severe icing conditions will occur when operating in fog with visibility less than 500 metres. During ground run in the above conditions, the "ANTI-ICE/ENGINE" switch must be selected ON to have the engine face heated by compressor hot air.

NOTE

> Even if the "ANTI-ICE/ENGINE" switch is turned on, heating of the air intake lips and ducts is inoperative since conditioned by the microswitch, located on the landing gear.

In flight

Icing conditions which may be encountered are light, moderate, and severe. Moderate and severe icing particularly can cause rapid buildup of ice on aircraft surfaces, greatly affecting performance. Short duration climbs and descents may be made thru light icing conditions.

WARNING

The aircraft should not be flown in moderate or severe icing conditions. If any icing is encountered, leave the area of icing conditions as soon as possible.

Ice accumulation on the engine air intakes may cause engine damage. The ingestion of ice by the engine may cause a jar, vibrations or noise in the engine and damage the first stage compressor blades. Instrument indications may remain normal even though damage has occurred.

CAUTION

- If flight in icing conditions results in ice accumulation on the aircraft, logbook entry is required; the engine must be inspected for ice ingestion damage when this occurs.
- When conditions of snow or ice exist, the approach ends of runway are usually more slippery than any other areas due to melting and refreezing of ice and snow at this location.

When considered necessary or at any rate when the "ICE" caution light illuminates, proceed as follows:

1 "ANTI-ICE/PITOT" switch - Check - ON.
2. "ANTI-ICE/ENGINE switch - ON.
3. "WINDSHIELD/RAIN RMVL" switch - ON.

RAIN

When flying in rain, forward visibility may be reduced by the drops of water on the windshield, especially in low altitude, low speed flight. The situation can be improved by operating the windshield anti-ice system ("RAIN RMLV" switch to ON), which in this case functions as a wiper.

LANDING ON WET OR SLIPPERY RUNWAY

Normal landing procedures should be used. Landing ground roll distances are significantly increased on a wet or slippery runway. If crosswind is a factor, lower the nosewheel to the runway immediately after touchdown maintaining directional control with the rudder and nosewheel steering as necessary. Avoid using brakes for directional control. If crosswind is not a factor, hold the nose as high as possible after touchdown to obtain maximum aerodynamic braking, and hold this attitude until speed is reduced to 70 KIAS. After nosewheel is lowered, retract flaps, engage nosewheel steering and apply brakes gradually. Hydroplaning and/or tire skidding on a wet or icy runway will increase stopping distance and easily result in loss of directional control. Make every effort to remain in the center of the runway if barrier engagement should become necessary. Taxi carefully, as nosewheel steering can be relatively ineffective on a wet or slippery runway.

NOTE

Hydroplaning occurs above a characteristic speed which is a function of the tire inflation pressure only. The type of tire is a factor for the phenomenon to occur with a minimum film of water, whilst the pressure applied to the brakes may produce a locking effect on the wheel with possible tire blowout when a dry surface or a surface covered by an insufficient film of water is reached, however the anti-skid system should prevent such occurence.

CAUTION

Painted areas on runways, taxiways, and ramps are significantly more slippery than unpainted areas. When painted areas are wet, the coefficient of friction may be negligible. Also painted areas may serve as condensation surfaces and it is possible that their areas are wet, frosty, or icy when the overall weather conditions are dry.

TURBULENCE AND THUNDERSTORMS

ENGINE SURGE AND FLAME-OUT

Flight in severe turbulence, hailstorms, and thunderstorms should be avoided because of the increased danger of engine flame-out and high probability of damage to airframe and components from impact with ice, hail, and lightning. Monitor JPT and engine tachometer indicators continuously to allow for timely corrective action. The following may cause engine flame-outs:

a. Penetration of cumulus build-ups with associated high moisture content.

b. Icing of either engine air intakes.

c. Turbulence associated with penetration can result in violent change of angle-of-attack.

TURBULENT AIR PENETRATION PROCEDURES

CAUTION

> Flight through thunderstorms or severe turbulence must be avoided whenever possible. Maximum use of weather forecast to help avoid thunderstorms and turbulence is essential.

If flight through these areas cannot be avoided, ensure that the "ANTI-ICE/PITOT" "WINDSHIELD/RAIN RMVL" and "ANTI-ICE/ENGINE" switches are at ON (observe the associated indicators) and proceed as follows:

1. Airspeed - Establish 230 KIAS and trim for level flight. Severe turbulence will cause large and rapid variations in airspeed. Do not change thrust except for extreme airspeed variations.
2. Attitude - Attitude is the primary reference in extreme turbulence. Pitch and bank should be controlled by reference to the attitude indicator. Do not change trim. Maintain control as near to neutral as possible to avoid overcontrolling. Do not use sudden or extreme control inputs. Extreme gusts will cause large attitude changes but smooth and moderate use of elevator will re-establish the desired attitude.
3. Altitude - Severe vertical gusts may cause appreciable altitude variations. Allow altitude to vary. Do not chase altitude and vertical velocity indications.

PENETRATION SPEED

If flight through severe turbulence is unavoidable, the recommended "best penetration speed" is 200 KIAS.

WARNING

> If inadvertent flight in severe turbulence and thunderstorms is experienced, do not exceed 230 KIAS.

CAUTION

> Flying in severe turbulence or hail may result in engine intake duct airflow distortion which can result in engine surge and possible flame-out. However, normal engine relighting may be accomplished.

NIGHT FLYING

The aircraft is fitted with an effective and widely adjustable night illumination system. To prevent eye disturbance created by reflection in the canopy and favor eye adaptation to the night vision, it is recommended that lighting be maintained to the minimum level still comfortable for the pilot. When flying in thunderstorms where lightning strokes are expected, the lights should be maintained full bright to minimize the blinding effect created by lightning in proximity of the aircraft.
To prevent spatial disorientation, it may help if the anti-collision lights are turned off in the vicinity of clouds or before entering a cloud formation. In formation flight, the leader will turn the anti-collision lights off to prevent blinding the other pilots. During night flight even in good weather conditions, the reduced number and quality of the external references will require frequent reference to flight instruments to check aircraft attitude and flight parameters.

COLD WEATHER OPERATION

Most cold weather operation difficulties are encountered on the ground. The following instructions are to be used with the normal procedures in Section II when cold weather aircraft operation is necessary.

Before Entering Aircraft

Remove protective covers and plugs; check to see that surfaces, ducts, exposed structures, drains and vents are free from snow, ice, and frost. Brush off light snow and frost. Remove ice and encrusted snow, either by a direct flow of air from a portable ground heater or by using deicing fluid. Remove light frost from the windshield and canopy with a clean soft rag.

WARNING

- Takeoff distance and climb performance can be degraded by snow and ice accumulation. The roughness and distribution of the ice and snow can vary stall speeds and characteristics dangerously.
- Ensure that water does not accumulate in control hinge areas or other critical areas where refreezing may cause damage.

CAUTION

To avoid damage to aircraft surfaces, do not permit ice to be chipped or scraped away.

Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packings. Inspect area behind aircraft to ensure that water or snow will not be blown onto personnel and equipment during engine start.

Engine Start

Use external power for starting to conserve the battery. No preheat or special starting procedures are required. Turn on cockpit heat and canopy demist system as required, immediately after engine start.

Taxiing

Nosewheel steering effectiveness is reduced when taxiing on ice or hard packed snow. The nosewheel will skid sideways easily, increasing the possibility of tire damage. However, reduced speeds will generally be necessary when taxiing over the uneven snow and ice covered surfaces common in low temperature environments. Increase the normal interval between aircraft, both to ensure a safe stopping distance and to prevent icing of aircraft surfaces from melted snow and ice caused by the jet blast of the preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice fog generated by the engine. If bare spots exist through the snow, skidding onto them should be avoided.

WARNING

Make sure that all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments while taxiing.

Takeoff

Use normal throttle procedures during takeoff. Takeoff should not be attempted with ice and snow on the wings and empennage or on any other surface where it might affect performance.

Landing

Use minimum run landing techniques. After touchdown prepare for tendency of the aircraft to veer toward either side of runway. In cold environment, main landing gear legs may not compress equal amounts, causing aircraft to veer to the side of the lower leg. Nosewheel steering will have a reduced effectiveness during high-speed portion of landing roll on icy runway.

CAUTION

Residual thrust with minimum engine power can easily cause excessive taxi speeds.

Engine Shutdown

Use normal engine shutdown procedure.

Before Leaving Aircraft

The canopy should be closed and locked on aircraft parked outdoors to prevent the entry of blowing snow caused by operation of other aircraft or from natural conditions.

HOT WEATHER AND DESERT OPERATION

Operation in hot weather and desert requires that precautions be taken to protect the aircraft from damage caused by high temperatures, dust, and sand. Care must be taken to prevent the entrance of sand into aircraft parts and systems such as the engine, fuel system, Pitot-static system, etc. All filters should be checked more frequently than under normal operations. Plastic and rubber segments of the aircraft should be protected both from high temperatures and from blowing sand.

Canopy covers should be left off to prevent sand from accumulating between the cover and the canopy and acting as an abrasive on the plastic canopy. With a canopy closed, cockpit damage may result when ambient temperature is above 45°C. Canopy should be opened in advance of flight to reduce cockpit temperature for comfort. Desert and hot weather operation requires that, in addition to normal procedures, the following precautions be observed.

Entering Aircraft

During preflight inspection it is recommended that gloves be worn since aircraft surfaces are extremely hot in high ambient temperatures.

Takeoff

Use normal takeoff technique. High ambient temperatures cause ground speed to be higher than normal, therefore, in case of takeoff at high gross mass make sure you do not to exceed tire speed limit. Be alert for gusts and wind shear near the ground.

Approach and Landing

Monitor airspeed closely to ensure that recommended approach and touchdown airspeeds are maintained; high ambient temperatures cause true speed to the ground to be higher than normal. Anticipate a long landing roll due to higher ground speed at touchdown.

GLOSSARY

UNIT SYMBOLS

A	Ampère
Ah	Ampère per hour
°C	Celsius Degrees
dB	Decibel
dm	Decimeter
ft	Feet
g	Gravity
h	Hour
kg	Kilogram
kgm	Kilogram per meter
kHz	Kilo Hertz
km/h	Kilometers per hour
kN	Kilo Newton
kt	Knots
kW	Kilowatt
lb	Pounds
lb/hr	Pounds per hour
M	Mach
m	Meter
mbar	Millibar
MHz	Mega Hertz
min	Minutes
NM	Nautical Miles
psi	Pounds Square Inches
RPM, rpm	Rounds per minute
V	Volt

ABBREVIATIONS

A

A/A	Air-to-Air
A/C	Aircraft
A/G	Air-to-Ground
A/SKID	Anti Skeed
AAM	Air-to-Air Missile
AC	Alternate Current
ACCLRM	Accelerometer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADJ	Adjustment
AFRC	Air/Fuel Ratio Control
AFT	Afterward
AGL	Above Ground Level
AIL	Aileron
ALT	Altitude
ALTM	Altimeter
AM	Amplitude Modulation
ANT	Antenna
AOA	Angle of Attack
ARMT	Armament
ASC	Airborne Strain Counter
ASL	Azimuth Steering Line
ASM	Anti-Ship Missile
ATC	Air Traffic Control
ATT, ATTD	Attitude
ATT IND	Attitude Indicator
AUTO	Automatic
AUX	Auxiliary
AVTR	Airborne Video Tape Recorder

B

BATT	Battery
BCN	Beacon
BFCU	Barometric Fuel Control Unit
BFL	Bomb Fall Line
BK	Brake

BIT	Built in Test
BOT	Bottom
BOV	Blow-Off Valve
BRD	Bomb Rocket Dispenser
BRG	Bearing
BRT	Bright
BSTR	Booster (motor)

C

C	Colorerd
cal	Caliber
CCIL	Continuously Computed Impact Line
CCIP	Continuously Computed Impact Point
CCRP	Continuously Computed Release Point
CHAN	Channel
CKT BKR	Circuit Breaker
CID	Communication/Identification Display
CL	Checklist
CLR	Clear
CMPS, COMP	Compass
CMPTR	Computer
CNTR	Counter
COMD	Command
COMM	Communication
COND	Conditioning
CONT, CONTR	Control
CRS	Course
CRT	Cathoderay Tubes
CSG	Computer Symbol Generator

D

D/N, DN	Down
DC	Direct Current
DCL	Declutter
DEM, DEMIST	Demisting
DEP	Data Entry Panel
DETR	Detector
DF	Direction Finder
DG	Directional Gyro

DGFT	Dogfight
DIM	Dimmer
DIR	Director/Direction
DIRS	Doppler/Inertial Reference System
DIS	Disconnected
DISP	Dispenser
DIST	Distance
DIV	Diversity
DME	Distance - Measuring Equipment
DPLR	Doppler
DR	Dead Reckoning
DVS	Doppler Velocity Sensor

E

E	East
EAS	Equivalent Air Speed
ERECT	Erection
EL	Elevation
ELEV	Elevator
ELR	Engine Life Recorder
ELT	Emergency Locator Transmitter
EMER, EMERG, EMG	Emergency
ENG	Engine
ENT	Enter
EO	Electro Optical
EPC	Electro Pressure Control
EPROM	Eraseable - Programmable Read-Only Memory
ESS	Essential
EXH	Exhaust
EXT	External

F

F/D, FD	Flight Director
FCN	Function
FDC	Flight Director Computer
FDS	Flight Director System
FLT	Flight
FOV	Field of View
FREQ	Frequence

FPL	Flight Plane
FPM	Flight Path Marker
FRL	Fuselage Reference Line
FUS	Fuselage
FWD	Forward

G

G, GD	Guard (Channel)
GCJB	Ground Crew Jack Box
GEN	Generator
GEU	Gun Electronic Unit
GND	Ground
GS	Glide Slope
GS	Ground Speed

H

HAT	Heght Above Target
HDG	Heading
HI	High
HSI	Horizontal Situation Indicator
HTR	Heater
HUD	Head-Up Display
HUDWAC	Head-UP Display and Weapon Aiming Computer
HYD	Hydraulic

I

IA	Initialization Altitude
IAS	Indicated Air Speed
IDENT	Identification
IFF	Identification Friend/Foe
IFOV	Instantaneous Field of View
IGN	Ignition
ILS	Instrument Landing System
IMN	Indicated Mach Number
IND	Indicator
INST	Instrument
INTPH, INT	Interphone
INV	Inverter

IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere

J

JETT	Jettison
JPT	Jet Pipe Temperature

K

KIAS	Knots Indicated Airspeed
KTAS	Knots True Airspeed
KYBD	Keyboard

L

L	Left
LAT	Latitude
LCD	Liquid-Cristal Display
LCOS	Lead Computed Optical Sight
LDG LT	Landing Light
LG	Landing Gear
LH	Left Hand
LL	Latitude/Longitude
LMTR	Limiter
LO	Low
LOC	Omni-directional Localizer
LP	Low Pressure
LRF	Laser Range Finder
LT	Light

M

M	Mode
MAC	Mean Aerodinamic Chord
MAG VAR	Magnetic Variation
MAN	Manual
max	Maximum
MDA	Minimum Decision Altitude
MEM	Memory

MFD	Multifunction Display
MK	Mark
MKR, MKR BCN	Marker Beacon
MIC	Microphone
MON	Monitor
MSL	Missile
MSTR	Master
MTR	Metering

N

N	Normal
NAV	Navigation
NCU	Navigation Computer Unit
NDB	Nondirectional Beacon
NFDCP	Navigation Flight Director Control Panel
NO, No	Number
NOR, NORM	Normal
NW	Nosewheel
NWS	Nosewheel Steering

O

OAT	Outside Air Temperature
OHEAT	Overheat
ORIDE	Override
OXY	Oxygen

P

PARK	Parking
PB	Push-button
PDU	Pilot Display Unit
PIV	Pressure Increasing Valve
PNL	Panel
POS	Position
POS IND	Position Indicator
PP	Present Position
PRE	Preselection
PRESS	Pressure
PRI	Primary

PUS	Pylon Unit Standard
PWR	Power
PYL	Pylon (tanks)

Q

Q/A	Quantity per Attack
Q/S	Quantity per Signal
QRF	Quick-Release Fitting
QTY	Quantity

R

R	Right
RAD	Radiation
RCDR	Recorder
RDR	Radar
RDU	Remote Display Unit
RDY	Ready
REC	Receiver
REV	Reversionary
RH	Right hand
RKT	Rocket
RLY	Relay
RMVL	Removal
RNAV	Radio Navigation
RPL	Ripple
RPM, rpm	Round per Minute
RRV	Rate Reset Valve
RUD	Rudder
RWR	Radar Warning

S

SC	Scale
SEC	Secondary
SEL	Selector/Selected
SGL	Single
SIF	Selective Identification Feature
SJB	Salvo Jettison Box
SMC	Stores Management Computer

SMS	Stores Management System
SPD	Speed/Speed (brake)
SP/SPT	Steerpoint
SQ	Squelch
SS	Swapshoot
ST	Station
STBD	Starboard
STBY	Standby
STEER	Steering
STRF	Strafe
SVR	Sealed Video Recorder
SW	Switch
SYS	System

T

T/O	Takeoff
T/R, TR	Transmitter/Receiver
TAC, TCN	TACAN - Tactical Air Navigation
TEMP	Tempoerature
TFOV	Total Field of View
TK	Tank
TIP	Fuel Tip Tank
TOT	Total
TRANS	Transfer
TRNAV	Tactical Area Navigation
TST	Test
TTG	Time to Go
TTS	Total Temperature Sensor

U

UHF	Ultra High Frequency
UNBAL	Unbalance
UTIL	Utility
UTM	Universal Transversal Mercator

V

VERT	Vertical
VHF	Very High Frequency

VOL	Volume
VOR	Very High Frequency Omni-directional Radio Beacon

W

W	West, White
WAC	Weapon Aiming Computer
WARN	Warning
WCP	Weapon Control Panel
WD	Wind
WIP	Weapon Inventory Panel
WMP	Weapon Momitor Panel
WPT	Waypoint
WRB	Weapon Release Button
WSHLD	Windshield

Z

ZSL	Zero Sight Line

ALPHABETICAL INDEX