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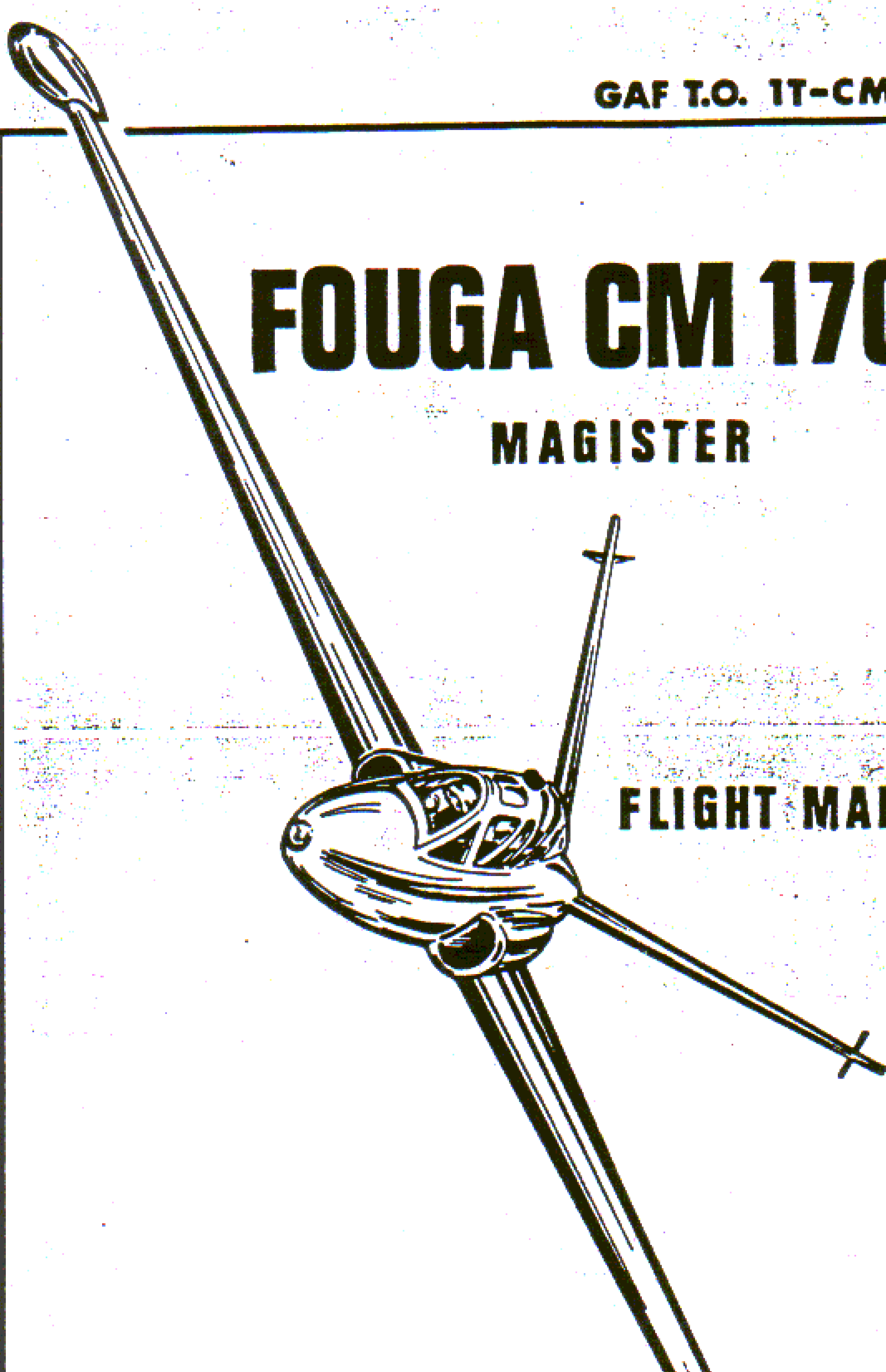

FOUGA CM 170 R

MAGISTER

FLIGHT MANUAL

1 January 1966

27. 6. 1968

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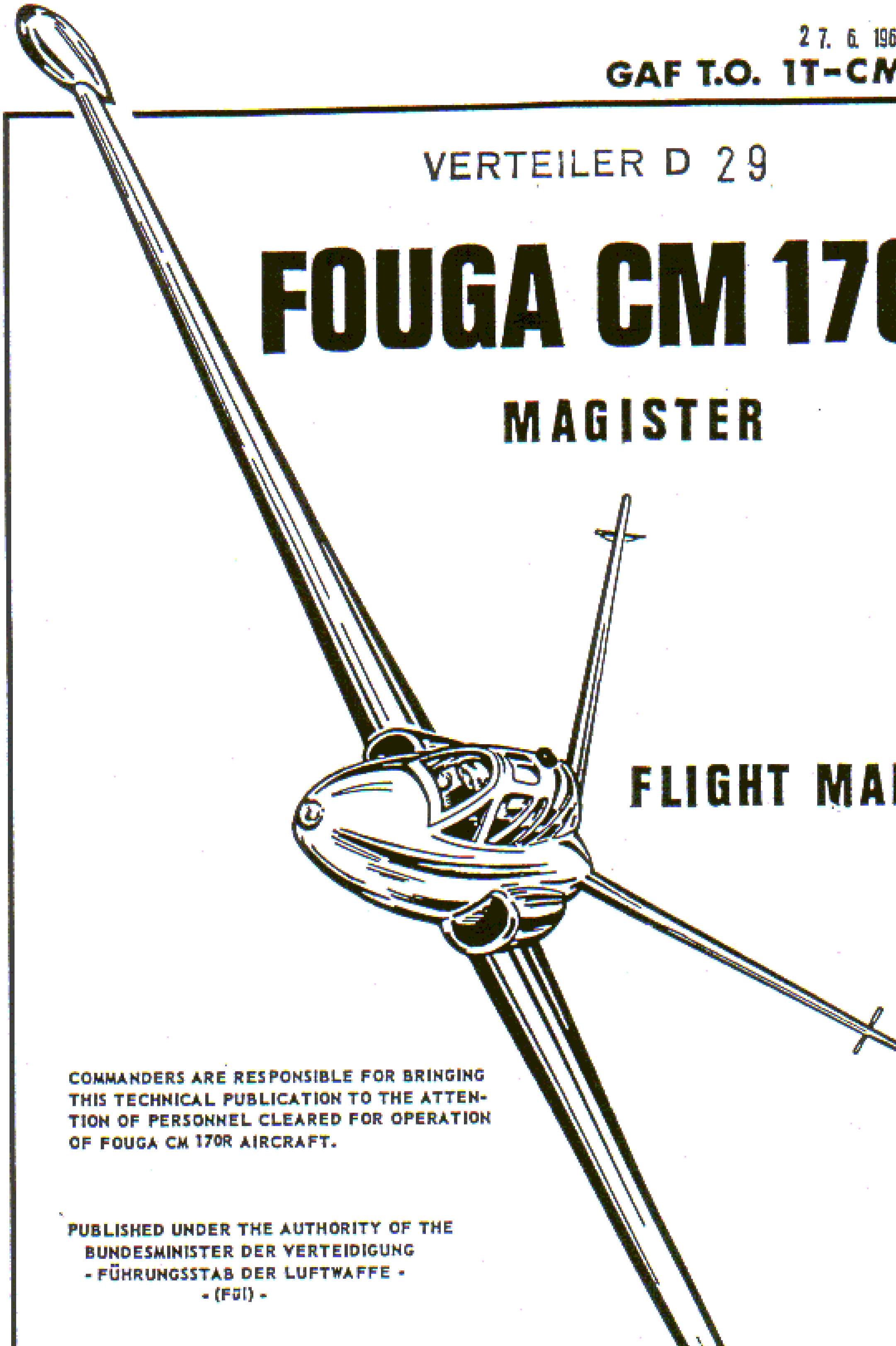


FLIGHT MANUAL

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS TECHNICAL PUBLICATION TO THE ATTENTION OF PERSONNEL CLEARED FOR OPERATION OF FOUGA CM 170R AIRCRAFT.

PUBLISHED UNDER THE AUTHORITY OF THE
BUNDESMINISTER DER VERTEIDIGUNG
- FÜHRUNGSSTAB DER LUFTWAFFE -
- (FüI) -

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

1 January 1966

Change 1 - 1 May 1967

FUS 6.68.100

TABLE OF CONTENTS

Foreword

SCOPE. This manual contains the necessary information for safe and efficient operation of the Fouga CM170R aircraft. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are not discussed.

SOUND JUDGMENT. Instructions in this manual are for a pilot inexperienced in the operation of the airplane. This manual provides the best possible operating instructions under most circumstances, but it is not a substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc. may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a positive approach, and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation, not specifically permitted in this manual is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA. Refer to GAF T.O. 0-1-1A which is devoted solely to the listing of all current Flight Manuals, Checklists, and Supplements.

STANDARDIZATION AND ARRANGEMENT. Standardization ensures that the scope and arrangement of all flight manuals are identical. The manual is divided into nine nearly independent sections to simplify using it as a reference manual.

SAFETY SUPPLEMENTS. Information involving safety will be forwarded to you by Safety Supplements. Supplements covering ground or air operational safety hazards will be issued by interim message form to the Air Staffs for dissemination to using organizations. Interim Safety Supplements will be formalized by printed Safety Supplements distributed from MatALw III A 1.

CHECKLISTS. The Flight Manual contains the amplified checklists. Abbreviated checklists will be issued by MatALw III A 1. Whenever a Safety Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement, will be issued. This will keep handwritten entries of Safety Supplement information in your checklist to a minimum.

WARNINGS, CAUTIONS, AND NOTES.

The following definitions apply to "Warnings", "Caution", and "Notes" found throughout the manual.

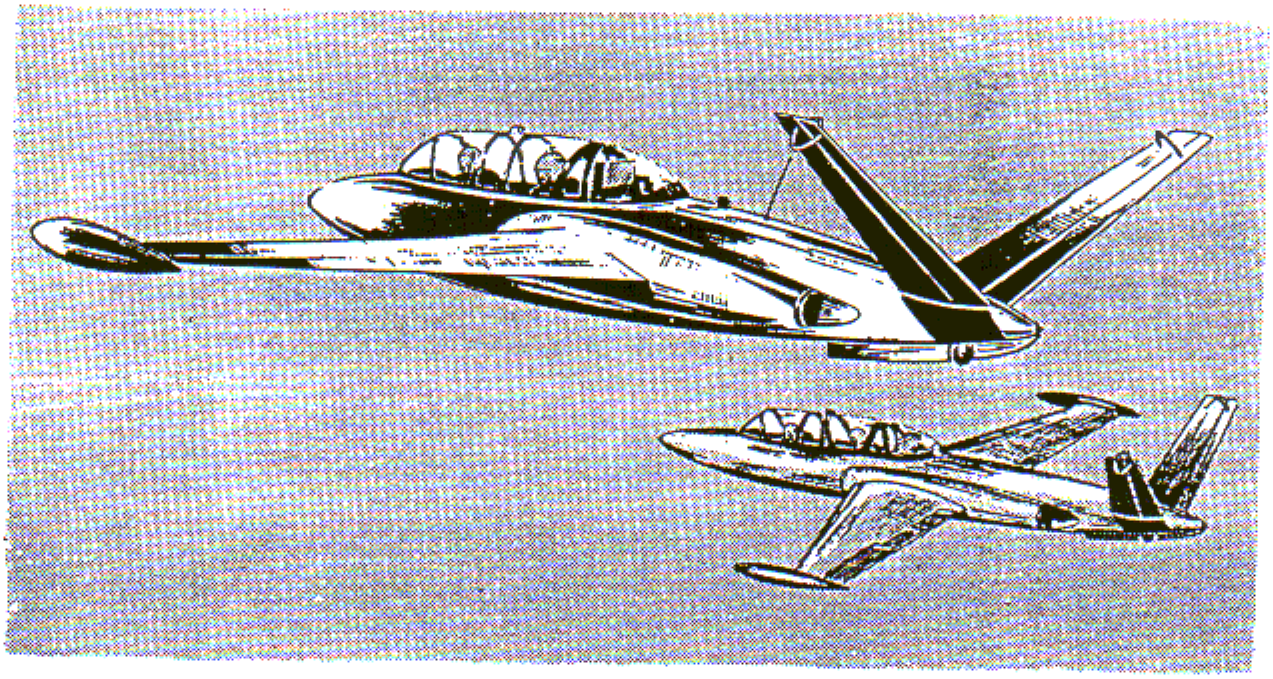
WARNING — Operating procedures, techniques, etc., which will result in personal injury or loss of life if not correctly followed.

CAUTION — Operating procedures, techniques, etc., which if not strictly observed will result in damage to or destruction of equipment.

Note — An operating procedure, technique, etc., which it is essential to highlight.

YOUR RESPONSIBILITY - TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports ensure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded to:

MatALw III A 1.



SECTION I DESCRIPTION

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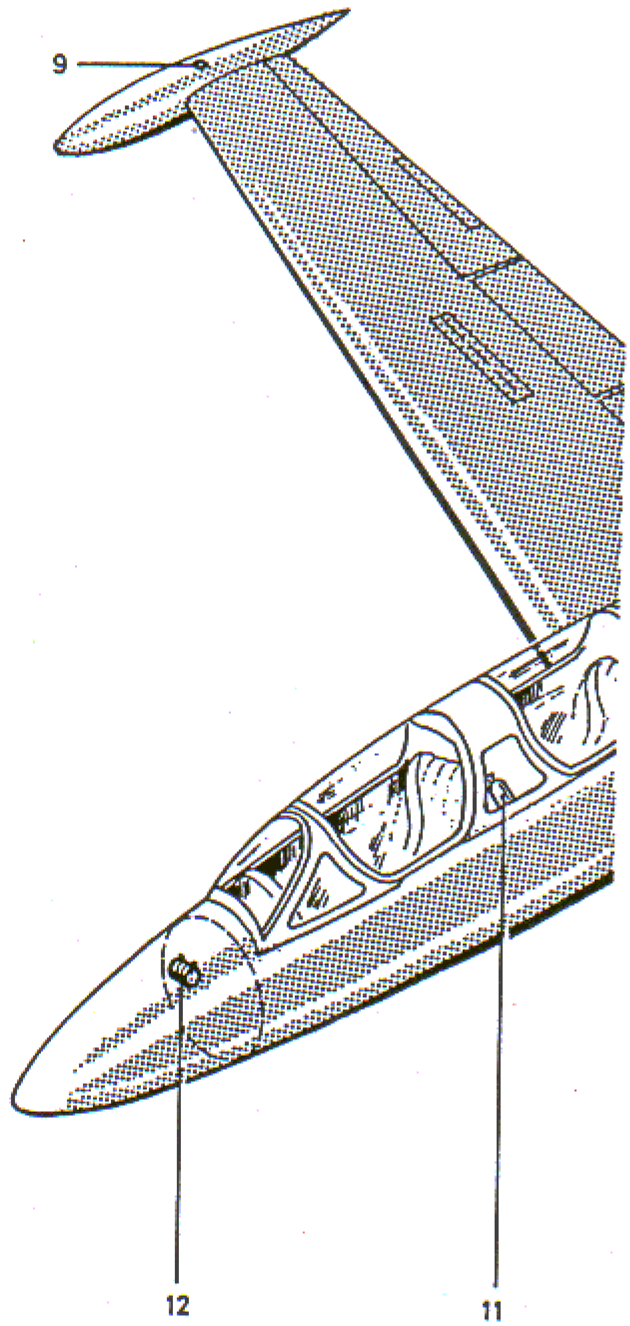
THE AIRPLANE.

The CM170R is a two-place, twin-engine jet aircraft. It is used as a pilot trainer and a fighter trainer. Special features of the airplane include a butterfly tail and a tricycle landing gear. Two machine guns can be installed in the nose. For special missions, the following additional loads can be installed: 4 rockets (90 mm-caliber) or 2 rockets (120 mm-caliber) or two 50kg-boms, or SS11, or SS12 equipment respectively.

COCKPIT INSTRUMENT PANELS AND CONSOLES.

Illustrations of the cockpit instrument panels and consoles depict two configurations only. Locations, therefore, may be different among the various configurations compared with those shown on the illustrations.

GENERAL ARRANGEMENT DIAGRAM



1 Elevator Trim Tabs
2 Baggage Compartment
3 External Power Receptacle
4 Oil Reservoir Filler Cover
5 Battery Cover
6 Hydraulic Reservoir Cover
7 Main Fuel Tank Filler Cover
8 Flux Valve (C-2A Compass System)
9 Tip Fuel Tank Filler Cover
10 Marboré II-Engine
11 Oxygen Cylinders
12 Deicer Reservoir

Figure 1-1 (Sheet 1 of 2)

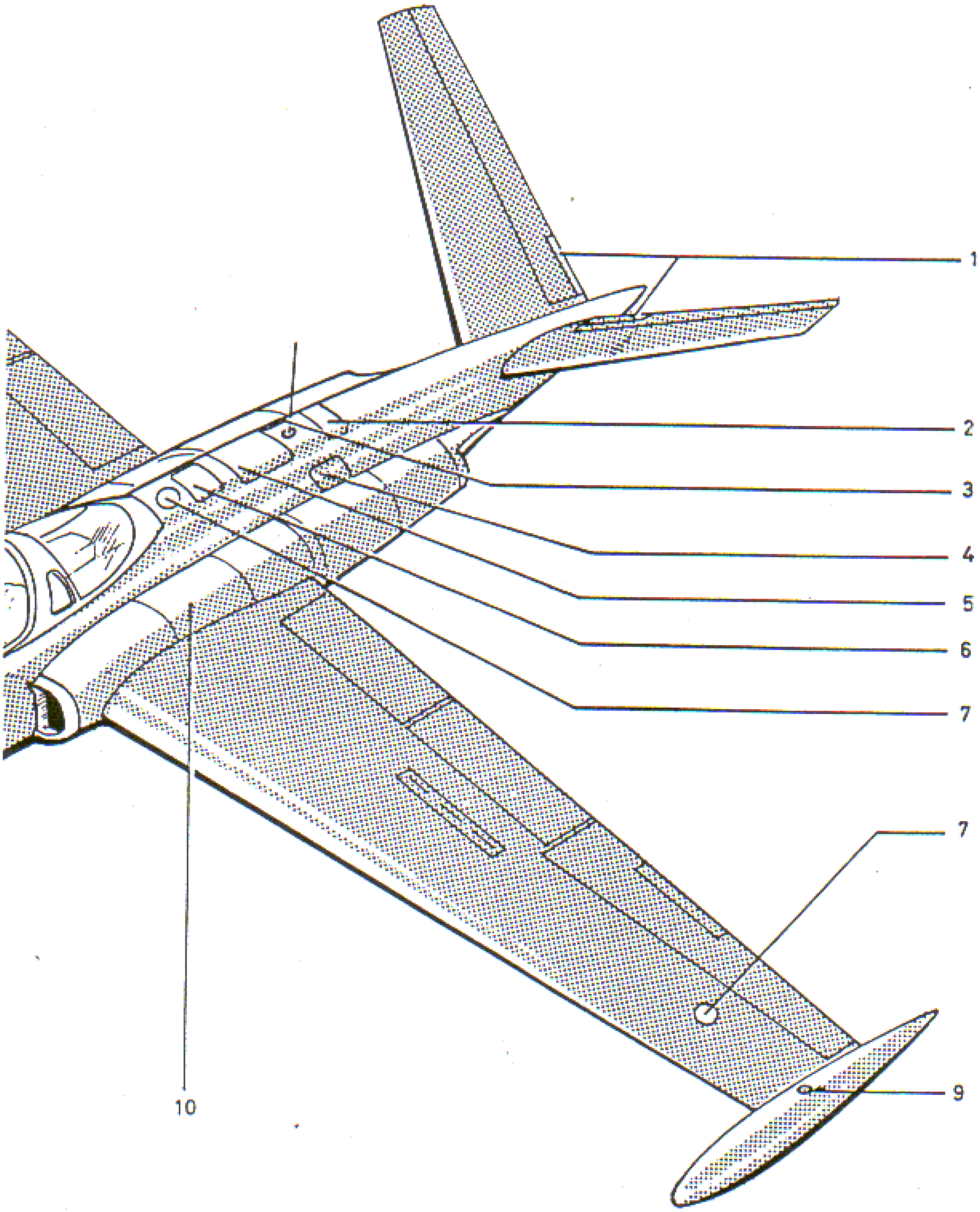


Figure 1-1 (Sheet 2 of 2)

DIMENSIONS.

Wing span with wing tip tanks	12,15 m
Wing span without wing tip tanks	11,35 m
Length	10,055 m
Height to top of fin, approx.	2,80 m

GROSS WEIGHT.

The approximate gross weight of the fully loaded aircraft, including two pilots and full 244 l tip tanks is 3120 kg.

ENGINES.

The airplane is powered by two TURBOMECA Marboré II F 3 jet engines (figure 1-2). Sea level static thrust rating of each engine is approximately 400 kp at 22,600 RPM. A single-stage centrifugal-type compressor is driven by a single-stage turbine assembly. The engines are installed in the fuselage off the fuselage centerline. The rear portion of each tail pipe is offset at an angle of 10° to the horizontal axis in order to minimize yaw tendency in case of single engine operation. A generator for electrical supply is provided on the left engine only. No afterburner is installed.

ENGINE FUEL SYSTEM.

The engine fuel system incorporates fuel control units supplied by engine-driven fuel pumps at boost pump pressure. The electrical boost pump is installed in the aft fuselage fuel tank.

ENGINE FUEL PUMPS.

Each engine is fitted with a fuel pump to provide the high fuel pressure required by the engine fuel system. The engine fuel pumps supplement the boost pump pressure of the electrical boost pump.

ENGINE FUEL CONTROL UNITS.

Fuel flow to the engines is controlled by the throttles and is delivered and regulated by the engine fuel control units. Fuel from the engine fuel pumps enters the fuel control unit through an inlet strainer. Major basic control elements consist of a centrifugal governor, an acceleration control, an altitude control, a metering valve and a bypass valve. The bypass valve maintains a constant pressure head across the metering valve by bypassing excess fuel to the engine fuel inlet. A cut-off valve, located in the fuel outlet port of the engine fuel control unit, shuts off the fuel supply to the engine burners when the pilot retards the throttle to OFF.

THROTTLE LINKAGE.

The aircraft throttle mechanisms (one for each engine) rotate the input shaft of the respective engine fuel control unit. Thrust selection is provided through a 113-degree rotation of the main fuel control shaft.

THROTTLES.

The throttles in each cockpit consist of a drum-shaped grip installed on a lever. The throttle controlling engine RPM of the right engine incorporates the feature of gunsight distance control by rotating the grip. To prevent the levers from creeping, a friction control lever installed on the lower side of the left console in the forward cockpit only, may be actuated to lock the throttles in any position. The forward and aft throttles are mechanically interconnected and identical. A speed brake switch is located on the side of the throttle.

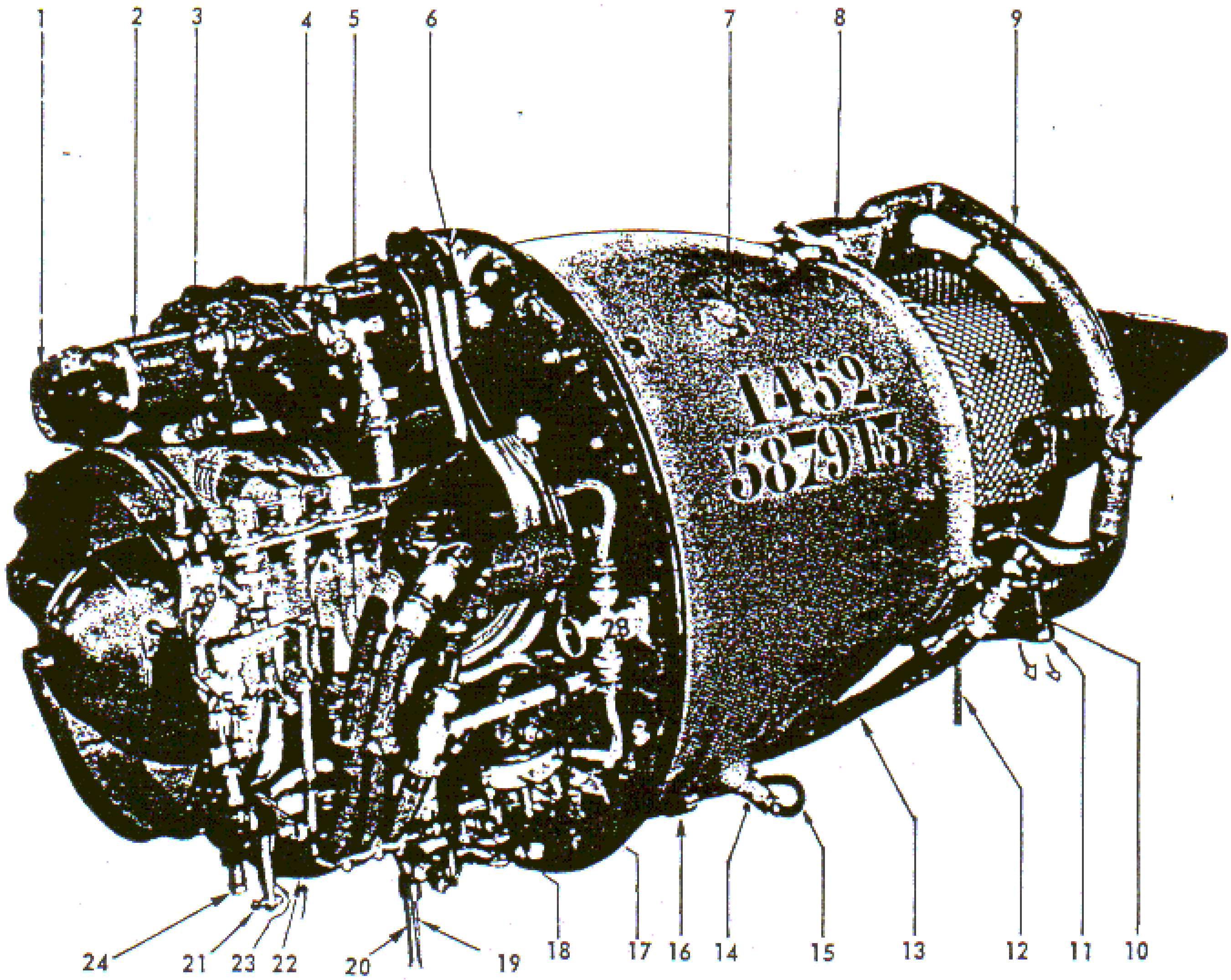
INJECTION AND IGNITION SYSTEM.

Two buttons are installed in the fuel handles in each cockpit. Depressing the button for the left engine first, initiates ignition. Pushing the respective fuel handle in the forward position, causes fuel to flow through the combined injection spark plugs into the combustion chamber.

STARTING SYSTEM.

An external power source, capable of turning the engine 1,200 RPM should be used for starting. The starting unit should be rated at 28,5 volts dc and set at 300 amperes. The airplane is equipped with one alkaline 35 ampere-hours battery. Battery starts are not recommended and should be attempted only under emergency conditions.

JET ENGINE MARBORE II F- LEFT VIEW



1 tach generator	15 ignition cable
2 accessory gear box	16 injection line
3 accessory gear box oil outlet	17 altitude control
4 engine oil inlet	18 injection pump
5 starter	19 injection pump vent
6 ignition coil	20 baffle vent
7 compressed air outlet	21 throttle lever
8 cooling air inlet	22 fuel supply line
9 cooling air manifold	23 breather return
10 rear bearing lubrication	24 engine oil outlet
11 cooling air outlet	25 idle stop
12 rear bearing oil drain	26 full throttle stop (full lower)
13 rear bearing oil outlet	27 fuel filter
14 ignition plug	28 fire detector

Figure 1-2

FORWARD INSTRUMENT PANEL (WITH UHF EQUIPMENT)

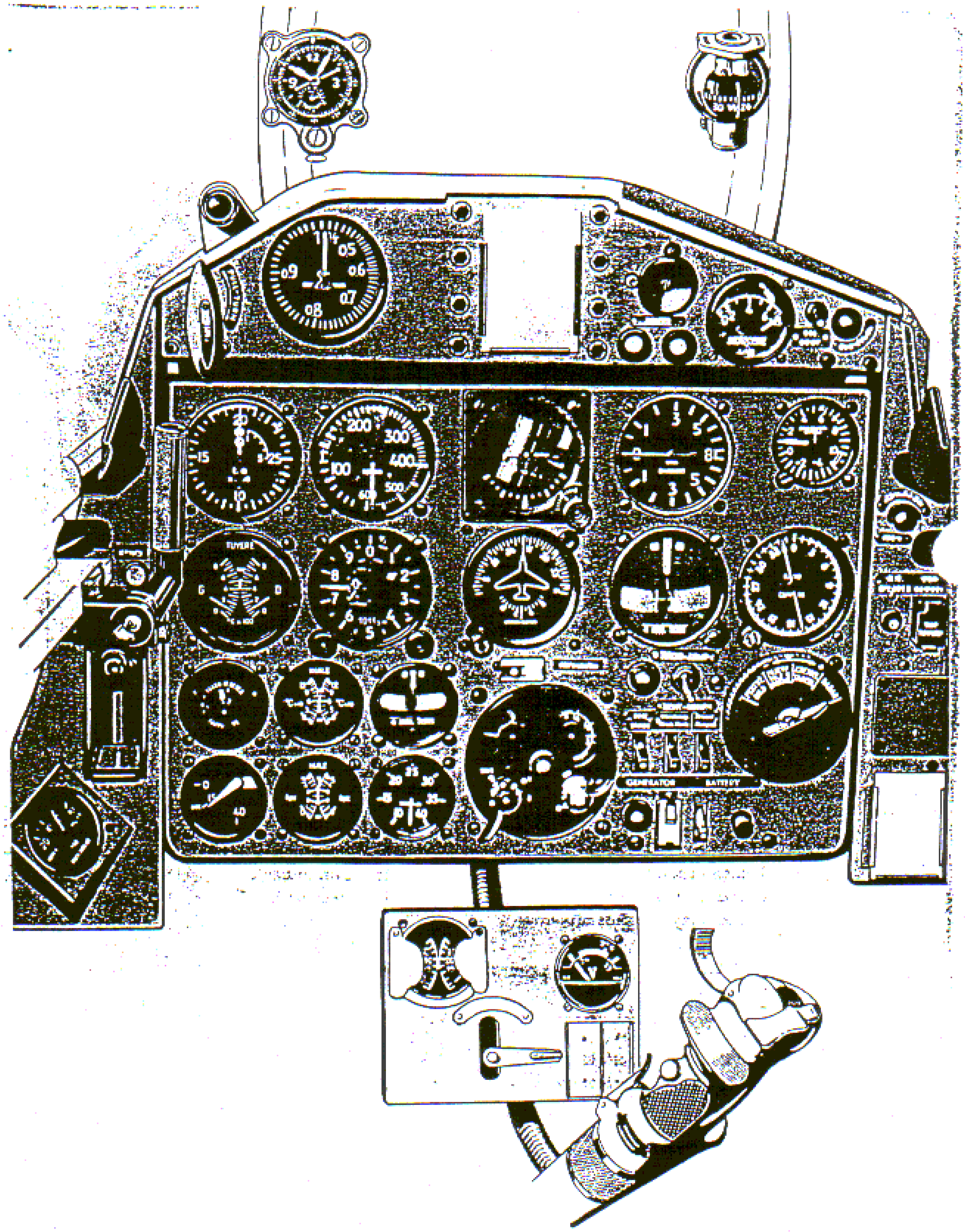
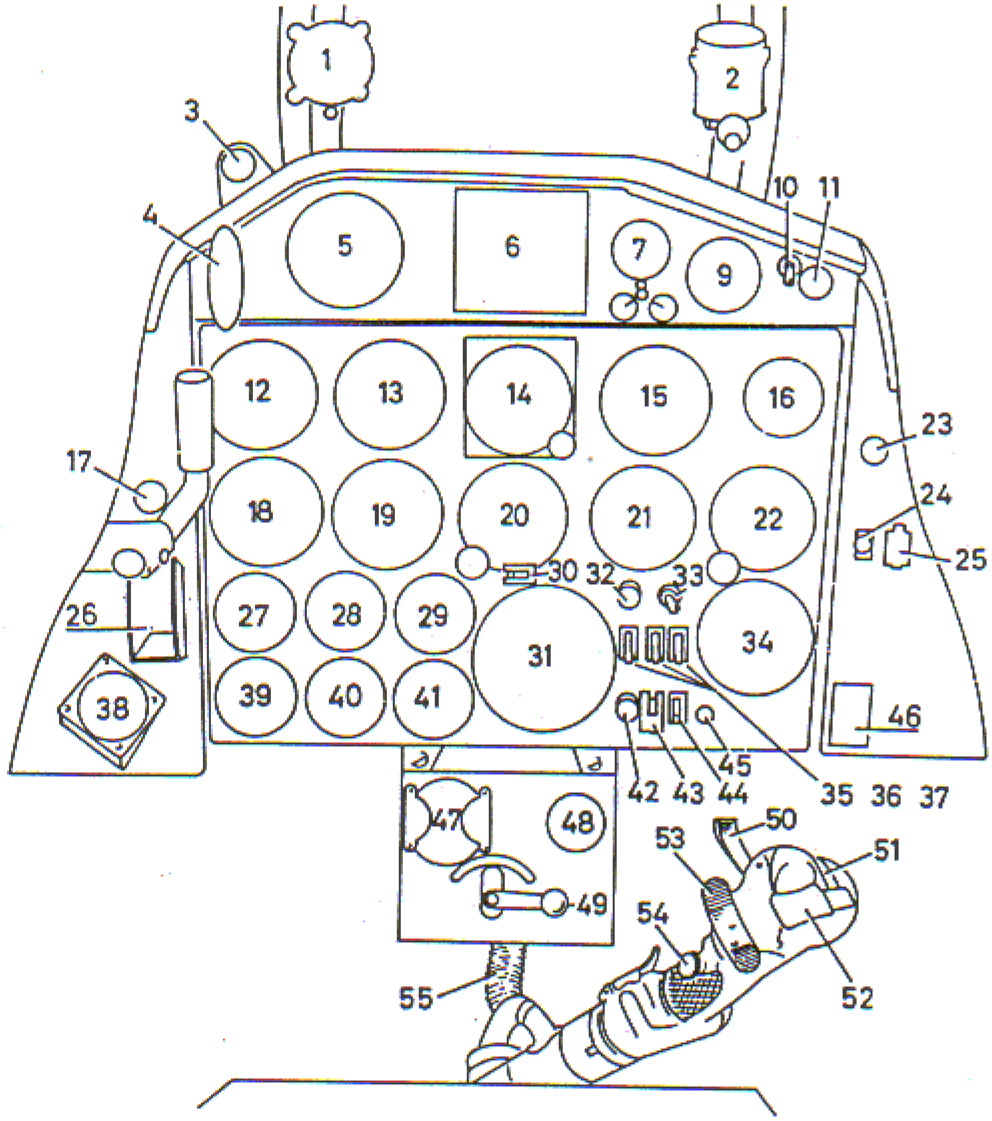


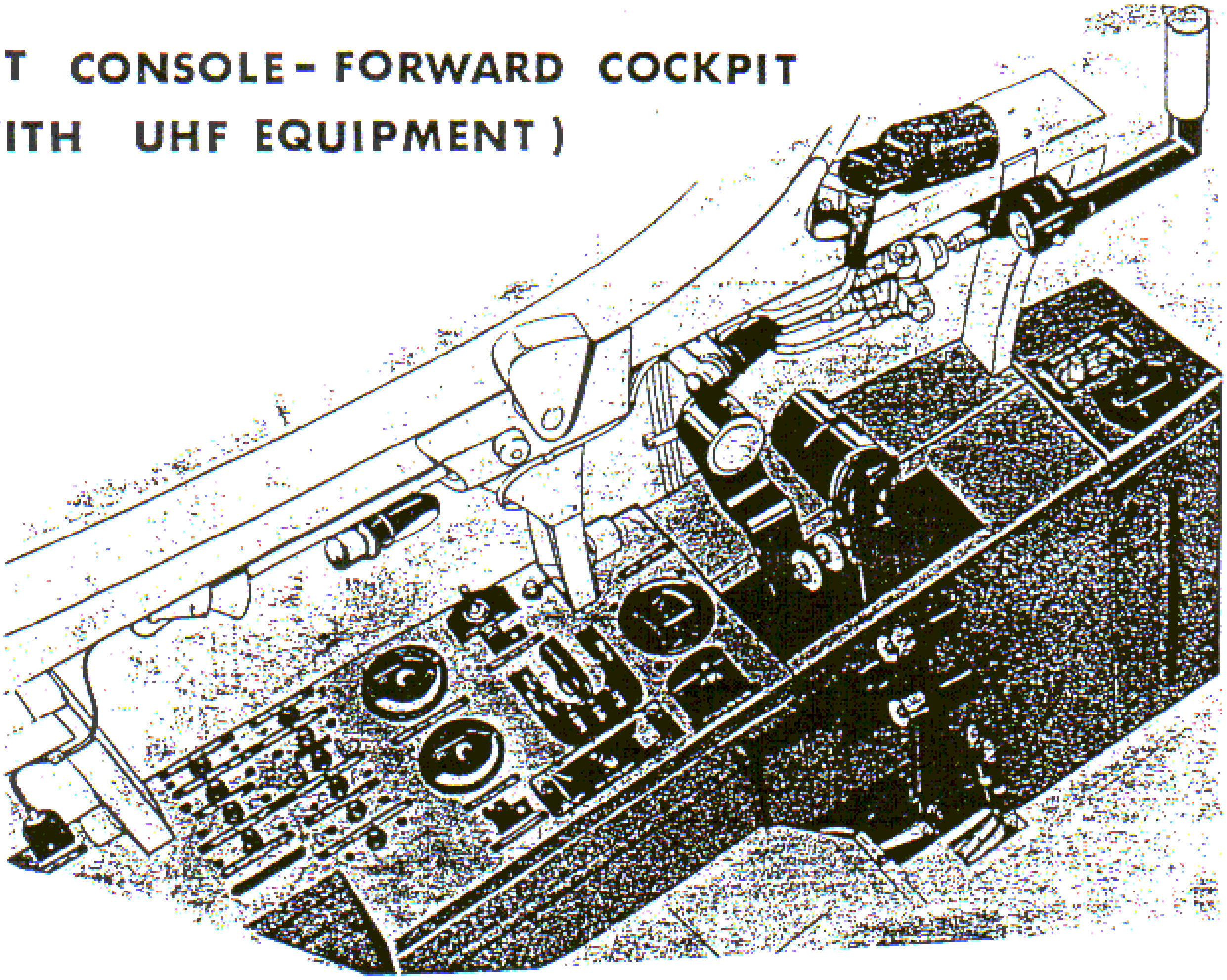
Figure 1-3 (Sheet 1 of 2)

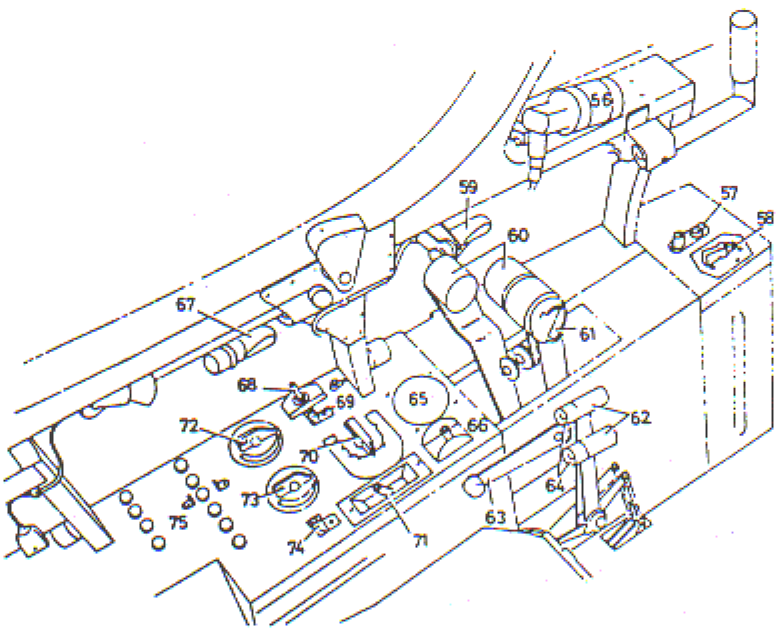


1. clock
2. standby compass
3. landing gear warning light
4. parking brake handle
5. machmeter
6. gyro compass correction card
7. de-icing pump
8. fire warning lights
9. fuel quantity indicator
10. standby compass light switch
11. canopy unsafe warning light
12. dual tachometer
13. airspeed indicator
14. attitude gyro indicator
15. vertical velocity indicator
16. G-meter
17. fuel low press. warning light
18. dual EGT indicator
19. altimeter
20. gyro compass indicator
21. turn and slip indicator
22. radio compass indicator
23. fuel low level warning light
24. gun re-cycling button
25. bomb salvo
26. landing gear lever
27. landing gear position indicator
28. dual oil temperature gauge
29. emergency turn and slip indicator
30. emergency turn and slip switch
31. oxygen demand regulator
32. pitot heat light
33. compass slaving cut-out switch
34. gunsight selector rheostat
35. pitot heat switch
36. turn and slip and attitude gyro switch
37. gyro compass switch
38. elevator trim tab position indicator
39. wing flap position indicator
40. dual oil pressure gauge
41. cabin pressure altitude ind.
42. generator-out warning light
43. generator switch
44. battery switch
45. battery circuit breaker
46. standby compass correction card
47. hydraulic pressure indicator
48. voltmeter
49. pedal adjustment crank
50. gun trigger
51. gunsight lock
52. bomb and rocket release
53. elevator trim tab control
54. microphone button
55. oxygen hose

Figure 1-3 (Sheet 2 of 2)

LEFT CONSOLE - FORWARD COCKPIT (WITH UHF EQUIPMENT)

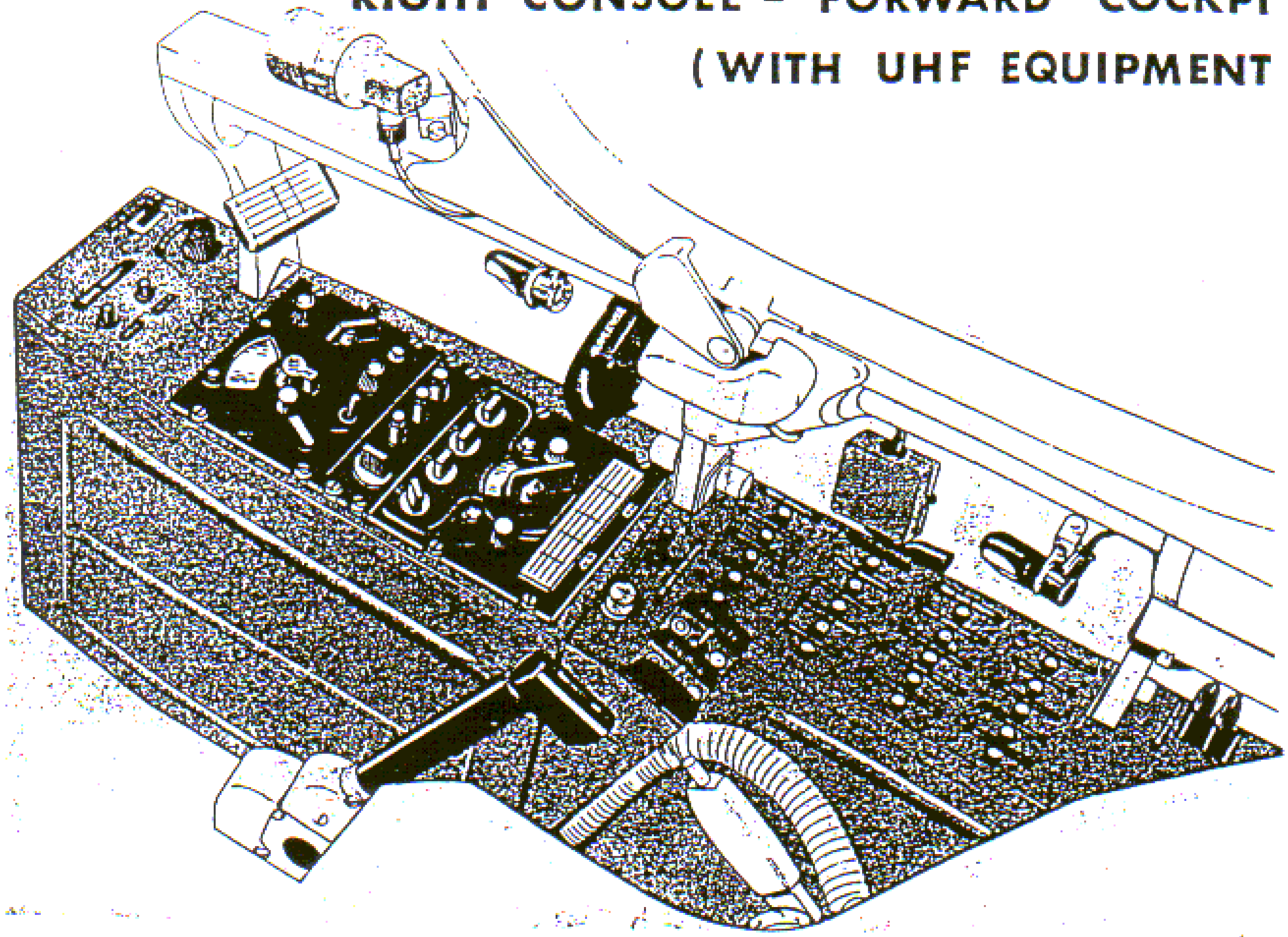




56. LH UV light
57. landing gear system selector
58. speed brake emergency control
59. LH instrument panel emergency light
60. throttles
61. speed brake control
62. fuel handles
63. throttle friction lever
64. injection and ignition buttons
65. air conditioning indicator
66. wing flap lever
67. LH console light
68. navigation light switch
69. UV light switch
70. air conditioning and pressurization switch
71. taxi and landing light switch
72. instrument panel emergency light rheostat
73. UV light rheostat
74. console light switch
75. circuit breakers

Figure 1-4

RIGHT CONSOLE - FORWARD COCKPI (WITH UHF EQUIPMENT



76. interphone switch
77. ADF-100 radio compass control shift switch
78. ARC-34 command radio control shift switch
79. interphone and radio compass light rheostat
80. ARC-34 frequency card
81. RH UV light
82. ADF-100 control unit
83. TEAM IV-T-3 interphone control unit
84. ARC-34 control unit
85. RH instrument panel emergency light
86. fresh air inlet
87. emergency hydr. pump (manual)
88. starter light
89. starter switch
90. tip tank dump switches
91. head set junction box
92. circuit breakers
93. RH console light

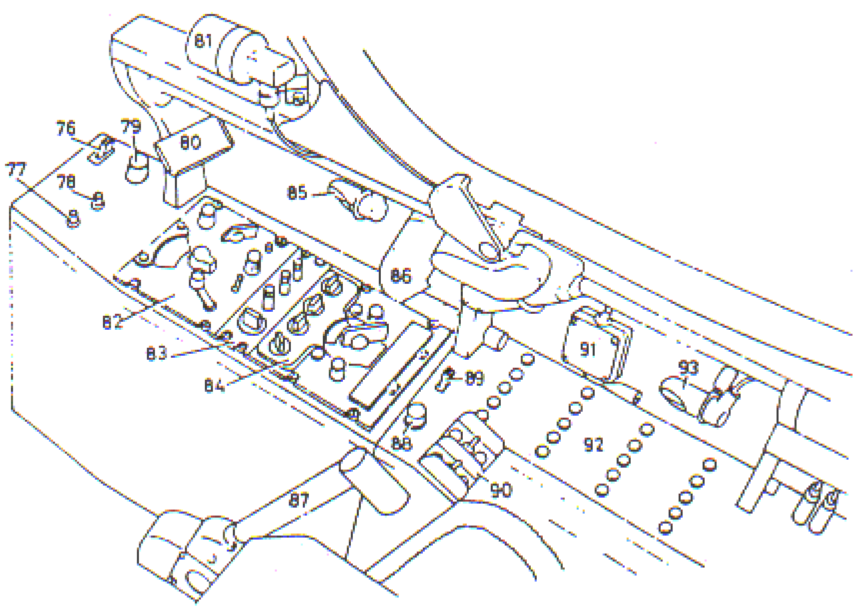
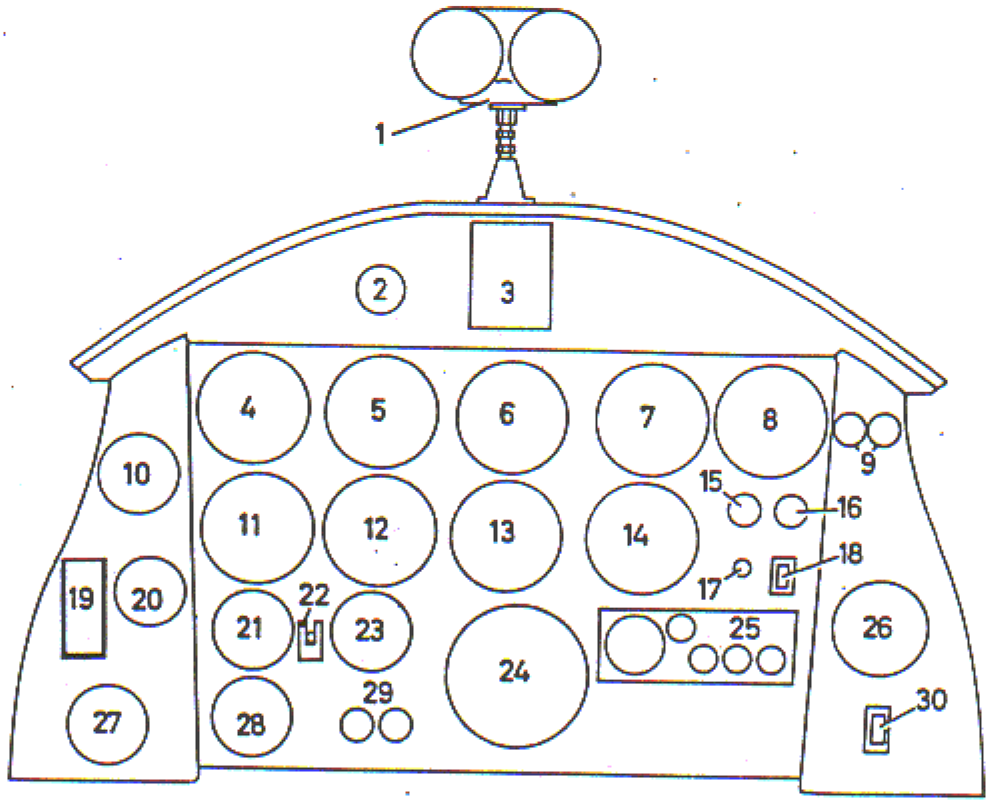


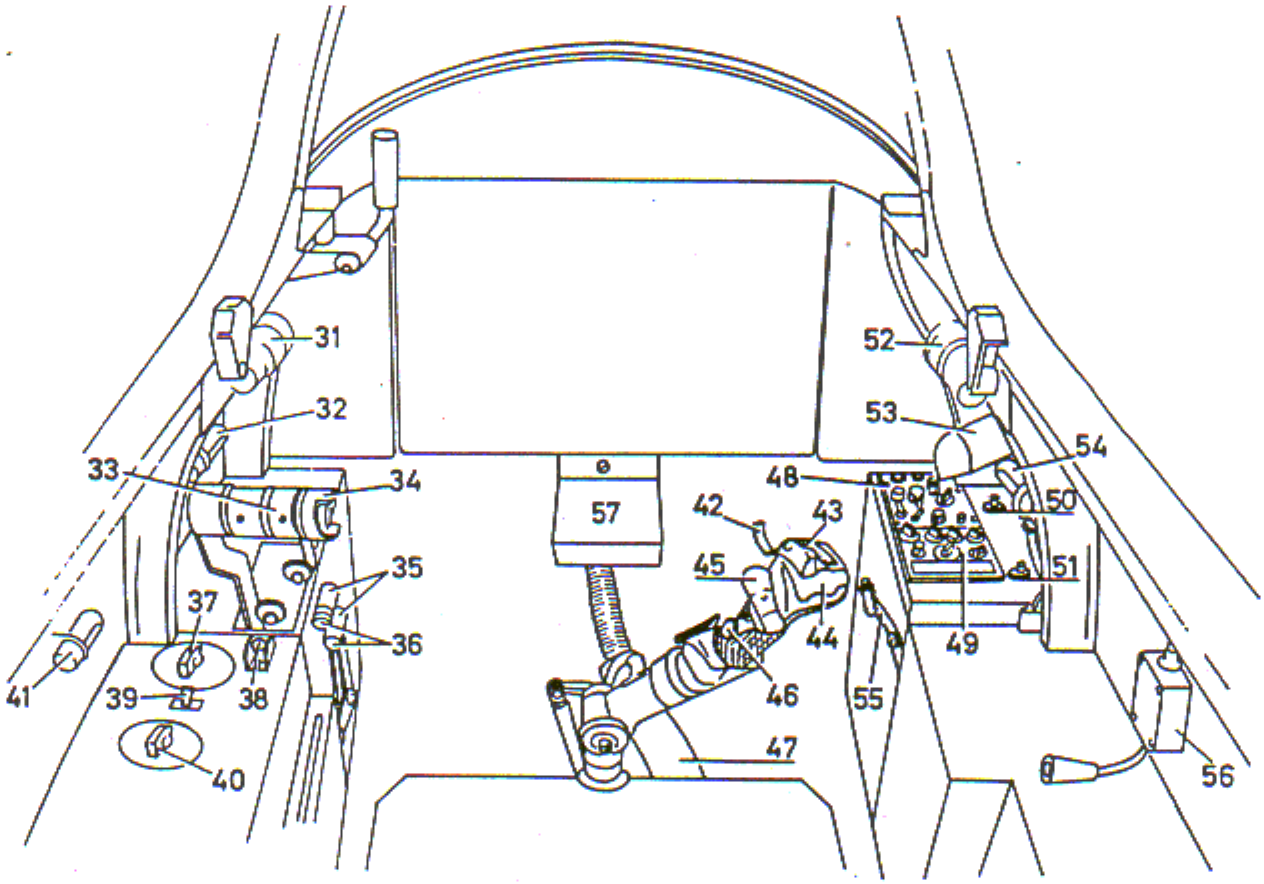
Figure 1-5



1. binocular periscope
2. side panel defrosting cock
3. gyro compass correction card
4. dual tachometer
5. airspeed indicator
6. attitude gyro indicator
7. vertical velocity indicator
8. radio compass indicator
9. fire warning lights
10. clock
11. dual EGT indicator
12. altimeter
13. gyro compass indicator
14. turn and slip indicator
15. generator-out warning light
16. pitot heat light
17. interphone override button
18. pitot heat switch
19. landing gear lever
20. landing gear position indicator
21. dual oil temperature gauge
22. emergency turn and slip switch
23. emergency turn and slip indicator
24. oxygen demand regulator
25. TEAM IV-T-3 interphone control unit
26. gunsight selector rheostat
27. elevator trim tab position indicator
28. wing flap position indicator
29. oil low pressure warning lights
30. gun lock

Figure 1-6 (Sheet 2 of 2)

LEFT AND RIGHT CONSOLES - REAR COCKPIT (WITH UHF EQUIPMENT)



31. LH UV light
32. LH instrument panel emergency light
33. throttles
34. speed brake control
35. fuel handles
36. injection and ignition buttons
37. instrument panel emergency light rheostat
38. wing flap lever
39. console light switch
40. UV light rheostat
41. LH console light
42. gun trigger
43. gunsight lock
44. bomb and rocket release
45. elevator trim tab control
46. microphone button
47. oxygen hose
48. ADF-100 radio compass control unit
49. ARC-34 command radio control unit
50. ADF-100 control shift switch
51. ARC-34 control shift switch
52. RH UV light
53. fresh air inlet
54. RH instrument panel emergency light
55. pedal adjustment crank
56. headset junction box
57. emergency turn and slip battery

Figure 1-7

STARTER SWITCH.

The electrical starts of the engines are actuated by switching the starter switch on the right console in the forward cockpit only to the corresponding position. The warning light beside the switch indicates operation of the starters.

ENGINE INSTRUMENTS.

FRONT COCKPIT.

(Item numbers of the instrument locations are taken from the UHF Instrument Panel Configuration.)

The engine instruments in the front cockpit consist of the following: A dual tachometer (12, figure 1-3) with 2 needles labeled D-right and G-left for the corresponding engine, indicating RPM. A dual EGT indicator (18, figure 1-3) indicates temperature in degrees Centigrade. A dual oil temperature gauge (28, figure 1-3). A dual oil pressure gauge (40, figure 1-3). A fuel quantity indicator (9, figure 1-3) and a fuel low pressure warning light (17, figure 1-3). Illumination of the light indicates boost pump failure or that the inverted flight reservoir is empty. A fuel low level warning light (23, figure 1-3). Illumination of the light indicates that the fuel quantity in the fuselage tanks has dropped to 150 l (33 Imp. gal.). Fire warning lights (8, figure 1-3) are also mounted in the front cockpit.

REAR COCKPIT.

(Item numbers of the instrument locations are taken from the UHF Instrument Panel Configuration.)

The engine instruments in the rear cockpit consist of the following: A dual tachometer (4, figure 1-6), same as in front cockpit. A dual EGT indicator (11, figure 1-6). A dual oil temperature gauge (21, figure 1-6) and oil low pressure warning lights (29, figure 1-6) as well as fire warning lights (9, figure 1-6).

OIL SYSTEM.

The engines are supplied by two metal-type oil reservoirs which are interconnected by a balance line. Each reservoir has a capacity of 12,2 l. The overflow limits the filling capacity of each reservoir to appr. 6 l. The remaining reservoir capacity is used to smoothen the oil which flows back from the engine to the reservoir. Each reservoir consists of two chambers, one above the other. The oil flows from the lower chamber to the engine and back into the upper chamber. A pipe connects both chambers to guarantee a full lower chamber during normal flight. During inverted flight, oil cannot flow back through this pipe. Thus the oil quantity of the lower chamber is reduced only by the amount sucked by the engine.

Oil specification see Servicing Diagram Section I.

OIL PRESSURE GAUGE.

A dual oil pressure gauge (40, figure 1-3) is installed on the left side of the fwd instrument panel only. The gauge registers oil pressure in terms of hpz. (Hpz equals approximately atü.) The gauges receive power from dc system.

OIL LOW PRESSURE WARNING LIGHTS.

One oil low pressure warning light for each engine is installed on the lower left side of the instrument panel in the aft cockpit only. These lights illuminate when the lubricating oil pressure of the corresponding engine drops below 0,8 hpz. The lights receive power from dc system.

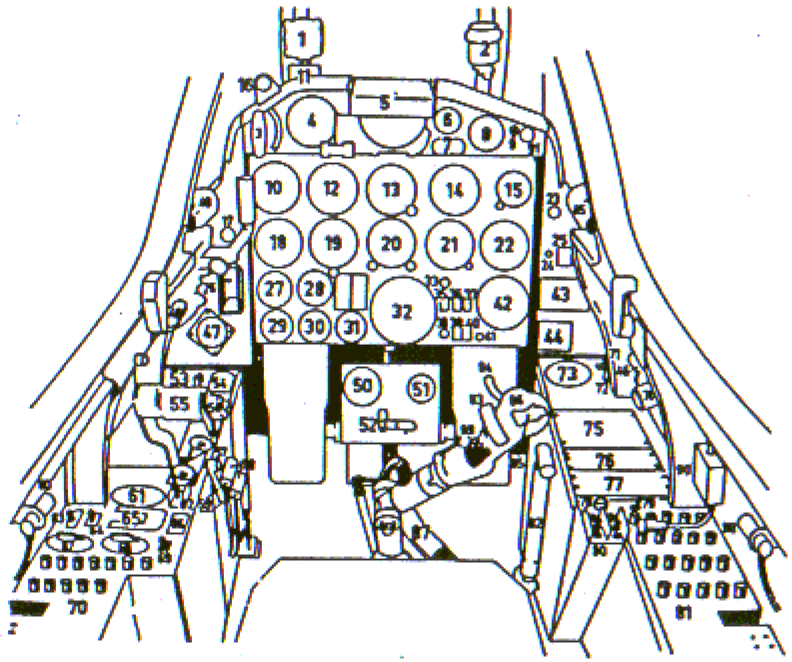
OIL TEMPERATURE GAUGES.

A dual oil temperature gauge in each cockpit displays oil temperature of the respective engine. The gauges are installed in the lower part of the instrument panels, the associated transmitters are placed in the oil reservoirs. The gauges receive power from dc system.

OIL RESERVOIR COOLING SYSTEM.

A flap is installed which is ground-adjustable only and is provided on the underside of the fuselage below the reservoirs to adjust the amount of reservoir cooling air flow.

FORWARD INSTRUMENT PANEL AND L/R CONSOLES (WITH VHF EQUIPMENT)

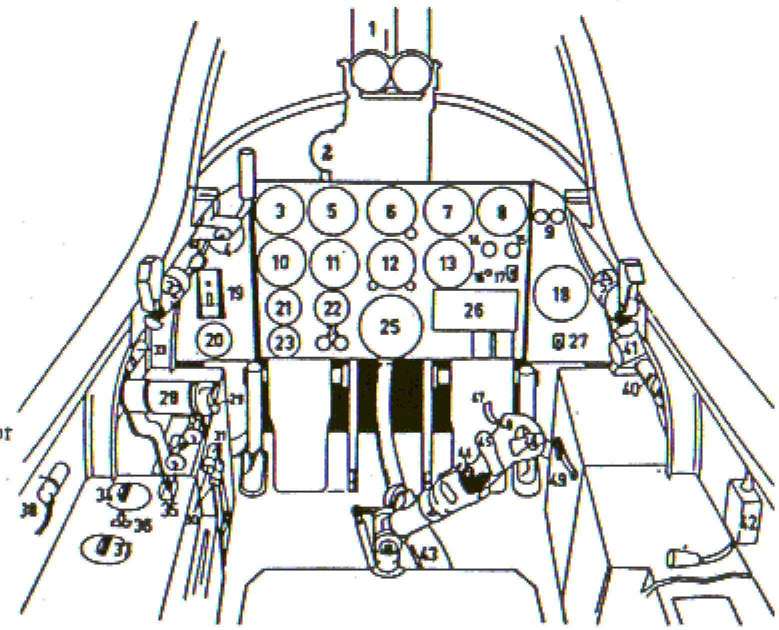


1. clock
2. standby compass
3. parking brake handle
4. machmeter
5. removed
6. windshield de-icing pump
7. fire warning lights
8. fuel quantity indicator
9. standby compass light switch
10. dual tachometer
11. removed
12. airspeed indicator
13. attitude gyro indicator
14. vertical velocity indicator
15. G-meter
16. landing gear warning light
17. fuel low pressure warning light
18. dual EGT indicator
19. altimeter
20. gyro compass indicator
21. turn and slip indicator
22. radio compass indicator
23. fuel low level warning light
24. gun re-cycling button
25. bomb salvo
26. landing gear lever
27. landing gear position indicator
28. dual oil temperature indicator
29. wing flap position indicator
30. dual oil pressure gauge
31. cabin pressure altitude indicator
32. oxygen demand regulator
33. pitot heat light
34. removed
35. pitot heat switch
36. attitude gyro indicator switch
37. gyro compass switch
38. generator-out warning light
39. generator switch
40. battery switch
41. battery circuit breaker
42. gunsight selector rheostat
43. armament selector panel
44. rocket firing selector
45. RH UV light
46. RH instrument panel emergency light
47. elevator trim tab position indicator
48. LH UV light
49. LH instrument panel emergency light
50. hydraulic pressure indicator
51. voltmeter
52. pedal adjustment crank
53. landing gear system selector
54. speed brake emergency control
55. throttles
56. speed brake control
57. throttle friction lever
58. fuel handles
59. injection and ignition buttons
60. LH console light
61. air conditioning indicator
62. wing flap control
63. navigation light switch
64. UV light switch
65. air conditioning and pressurization switch
66. taxi and landing light switch
67. instrument panel emergency light rheostat
68. UV light rheostat
69. console light switch
70. circuit breakers
71. interphone switch
72. interphone and radio compass light rheostat
73. VHF 2 (emergency) control unit L. M. T.
74. fresh air inlet
75. radio compass control unit
76. interphone control unit
77. VHF 1 (normal) control unit SARAM 5/52
78. starter light
79. starter
80. tip tank dump switches
81. circuit breakers
82. emergency hydr. pump (manual)
83. elevator trim tab control
84. gun trigger
85. bomb and rocket release button
86. gunsight lock
87. oxygen hose
88. RH console light
89. microphone button
90. headset junction box
91. canopy unsafe warning light

Figure 1-8

REAR INSTRUMENT PANEL AND L/R CONSOLES (WITH VHF EQUIPMENT)

1. binocular periscope
2. side panel defrosting cock
3. dual tachometer
4. clock
5. airspeed indicator
6. attitude gyro indicator
7. vertical velocity indicator
8. radio compass indicator
9. fire warning lights
10. dual EGT indicator
11. altimeter
12. gyro compass indicator
13. turn and slip indicator
14. generator-out warning light
15. pitot heat light
16. interphone override button
17. pitot heat switch
18. gunsight selector theostat
19. landing gear lever
20. elevator trim tab position indicator
21. landing gear position indicator
22. dual oil temperature gauge
23. wing flap position indicator
24. oil low pressure warning lights
25. oxygen demand regulator



26. interphone control unit
27. gun lock
28. throttles
29. speed brake control
30. injection and ignition buttons
31. fuel handles
32. LH UV light
33. LH instrument panel emergency light
34. instrument panel emergency light rheostat
35. wing flap lever
36. console light switch
37. UV light rheostat
38. LH console light
39. RH UV light
40. RH instrument panel emergency light
41. fresh air inlet
42. headset junction box
43. oxygen hose
44. microphone button
45. elevator trim tab control
46. bomb and rocket release button
47. gun trigger
48. gunsight lock
49. pedal adjustment crank

Figure 1-9

FUEL SUPPLY SYSTEM.

The aircraft fuel supply system (figure 1-10) consists of two interconnected bladder-type non-self sealing internal fuel tanks, two non-jettisonable wing tip tanks and a special inverted flight fuel tank to supply fuel to the engine during inverted flight. The internal fuel tanks are gravity refueled through a filler well located in the aft fuselage tank. The tip tanks are gravity refueled through individual filler wells. Air pressure tapped from the compressor of the engine is utilized to transfer fuel from the tip tanks into the forward fuselage tank and to fill the inverted flight tank. The fuel supply is turned on or off by 2 fuel handles. An electrically operated booster pump is installed in the aft fuselage tank and supplies fuel under pressure through a strainer and a check valve to the engines. The booster pump operates during engine failure and assures sufficient fuel boost pump pressure for high altitude airstarts. The boost pump is operating any time the airplane electrical system is energized and the circuit braker is ON. A fuel boost pump warning light illuminates when boost pump pressure drops below 4,40 PSI (310 g/cm^2) indicating that the boost pump has failed or that the inverted flight fuel tank is empty. The warning light is supplied from the dc system.

FUEL TRANSFER SYSTEM.

Engine compressor air is used to transfer the fuel contained in the tip tanks into the forward fuselage tank. Transfer operation starts when the contents in the fuselage tanks has dropped by appr. 100 l from fuel full capacity. At this time, the float valve in the forward tank opens. Pressurized air from the engine is routed through a check valve to an air pressure regulator and distributes the air flow to the tip tanks, keeping fuel level in the forward tank constant until the tip tanks are empty. The regulator assures constant adequate pressure in both tip tanks necessary for uniform transfer of fuel from the tips to the forward fuselage tank. Air entering the fuselage tanks during the transfer action is vented to the atmosphere through the fuselage tank vent line.

Forward Fuselage Fuel Tank.

This fuel tank is interconnected with the aft fuselage fuel tank. A float valve in the tank opens to admit fuel from the tip tanks after appr. 110 l of total capacity of the fuselage fuel tanks have been consumed. Fuel from each tip tank enters the forward fuel tank through a strainer, a check valve and the forward tank float valve.

Aft Fuselage Fuel Tank.

All fuel supplied to the engines is fed from the aft fuel tank. Fuel in the forward fuselage fuel tank is at equal level with the fuel in the aft fuel tank at all times. The aft fuel tank contains the booster pump, a filler well, and the transmitter for the fuel indicator in the cockpit.

Wing Tip Tanks.

One metal-type tip tank is installed at each wing tip. Each tip tank is fitted with a filler well, an electrically operated fuel dump valve, air pressure lines and a position light.

Inverted Flight Fuel Tank.

A special fuel reservoir is provided which is separated by a diaphragm into two chambers, the fuel chamber and the air chamber. During normal flight attitude, the fuel boost pump in the aft fuselage fuel tank forces fuel into the reservoir against the air pressure acting on the opposite side of the diaphragm separating the reservoirs. Pressurized air from the engines is used and routed to the reservoir through a pressure reducer. This reducer valve reduces pressure to 4,50 PSI (355 g/cm^2) which is below fuel boost pump pressure of appr. 10,17 PSI (715 g/cm^2). Due to this arrangement boost pump pressure overcomes counter acting air pressure so that the reservoir is filled with fuel at all times during normal flight attitude. During inverted flight, when the fuel boost pump is no longer submerged in the aft fuel tank, air pressure leads the fuel in the inverted flight tank directly to the engine. As soon as normal flight attitude is again established, the boost pump can refill the reservoir.

WARNING

The fuel contained in the inverted flight reservoir limits inverted flight to a period of 30 seconds at max. thrust at sea level.

Fuel Cocks.

The fuel cocks (one cock for each engine) plumbed into the fuel lines below the fuel tank are operated by the fuel handles below the throttles in each cockpit. Placing the right or left fuel handle in the forward position causes the right or left fuel cock to open

FUEL SYSTEM

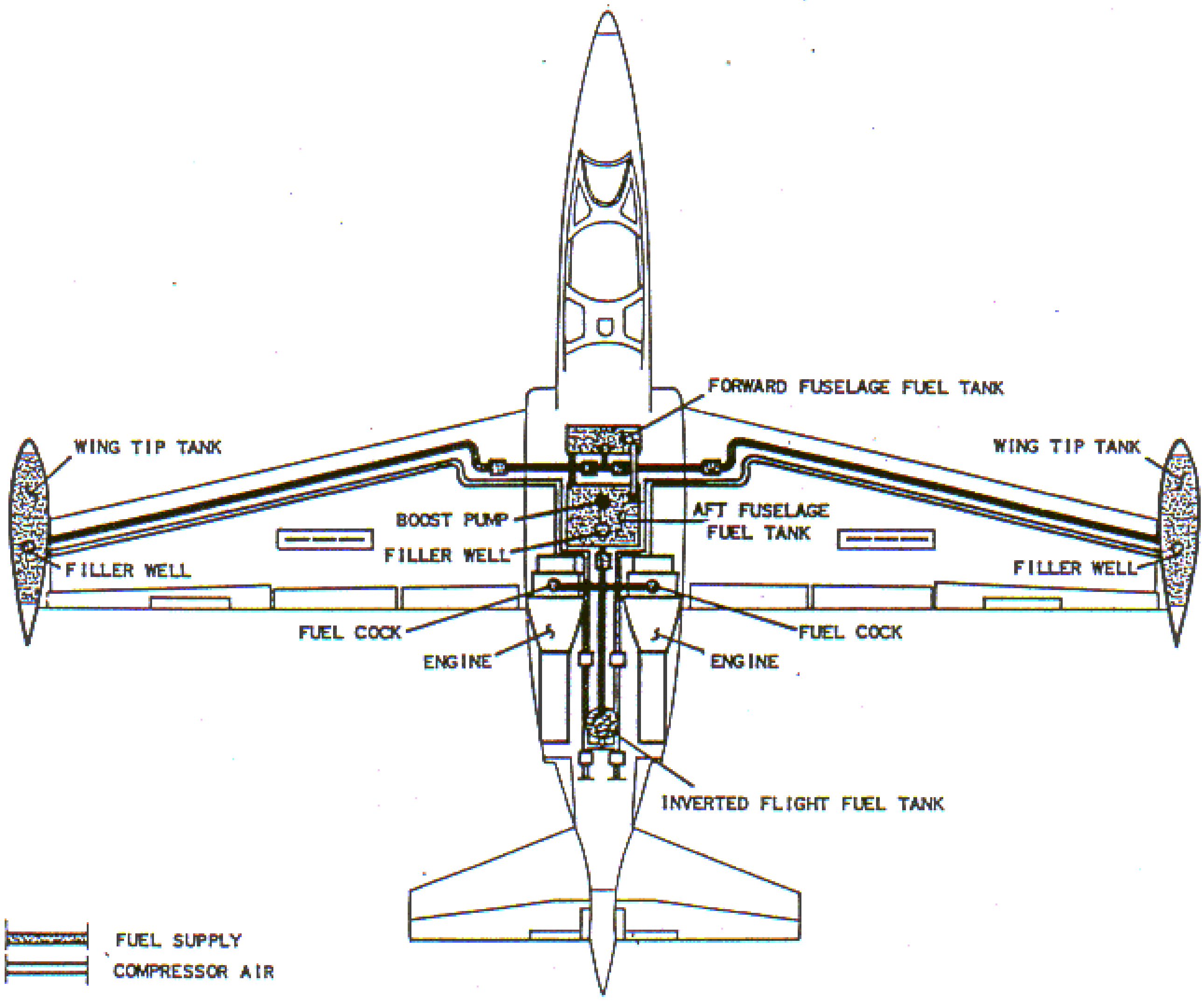


Figure 1-10

respectively. Placing the fuel handles in the aft position causes the cocks to shut off fuel to the corresponding engine.

Fuel Quantity Indicator.

A fuel indicator is installed in the forward cockpit only. It is a ratiometer type, electrically operated and graded in liters. The indication is limited to internal fuel only.

Fuel Low Level Warning Light.

A fuel low level warning light is installed in the forward cockpit only. The light illuminates blinking when the fuel amount has dropped to 150 - 180 l in level flight attitude and is steady when the amount of fuel is down to 150 l.

Tip Tank Fuel Dump Switch.

Two dump valves are located on the tip tanks for dumping fuel out of the tip tanks. The corresponding fuel dump switches are located on the right side of the forward console. Two control lights will illuminate when the dump valves are operated.

FUEL SPECIFICATIONS AND GRADES.

See Servicing Diagram, figure 1-19, for fuel specifications and grades.

FUEL QUANTITY DATA	Liters
Internal Fuel	730
Tip Tanks	244
TOTAL USABLE FUEL	974
Unusable Fuel - appr. 10 l internal tanks	

ELECTRICAL POWER SUPPLY SYSTEM.

The electrical system of the CM170R (figure 1-11) is a single-wire dc system, 27,5 V. Ground return is through the airplane structure. Since most of the instruments are not directly connected to ground, the ground wires are routed to the nearest junction box and connected to a common ground wire.

POWER SOURCE.

The airplane is powered by a dc generator rated 2,5 KW which is driven by the left engine accessory drive.

WARNING

The generator is operative only as long as the left engine is operative.

Battery.

An alkaline battery 35 ampere-hours is provided and receives a floating change from the generator. In case of generator failure the battery supplies power for a limited period of time to operate the electrical equipment necessary to continue the flight.

Auxiliary Power Unit.

Ground power may be furnished to the airplane through an external power plug above the cooling flap of the right engine. It permits a rating of 150 A or 3 second-load of 300 A for starting purposes.

Inverter.

An instrument inverter delivers three-phase current at 115 V, 400 Hz, to supply power to the gyrosyn compass system, the attitude gyro indicator, and the turn and slip indicator. The inverter is installed in the aft fuselage. All radio units have their own power packs.

Electrical System Controls.

A generator switch is provided on the instrument panel in the forward cockpit only. The battery switch is located at the same place. A battery circuit breaker located on the forward instrument panel only disconnects the battery from the bus if a predetermined value is exceeded. A voltmeter located on the lower forward instrument panel only connected to the dc bus bar reads generator, APU or battery voltage. During flight, battery power is measured when the generator is disconnected from the bus. On the ground, when no APU is connected and the engine is not operating, the voltage indication may be used to check that the battery is installed and properly connected. A generator-out warning light on the instrument panel in the front and rear cockpit illuminates when the generator has tripped from the circuit or in case of generator failure.

ELECTRICAL POWER DISTRIBUTION

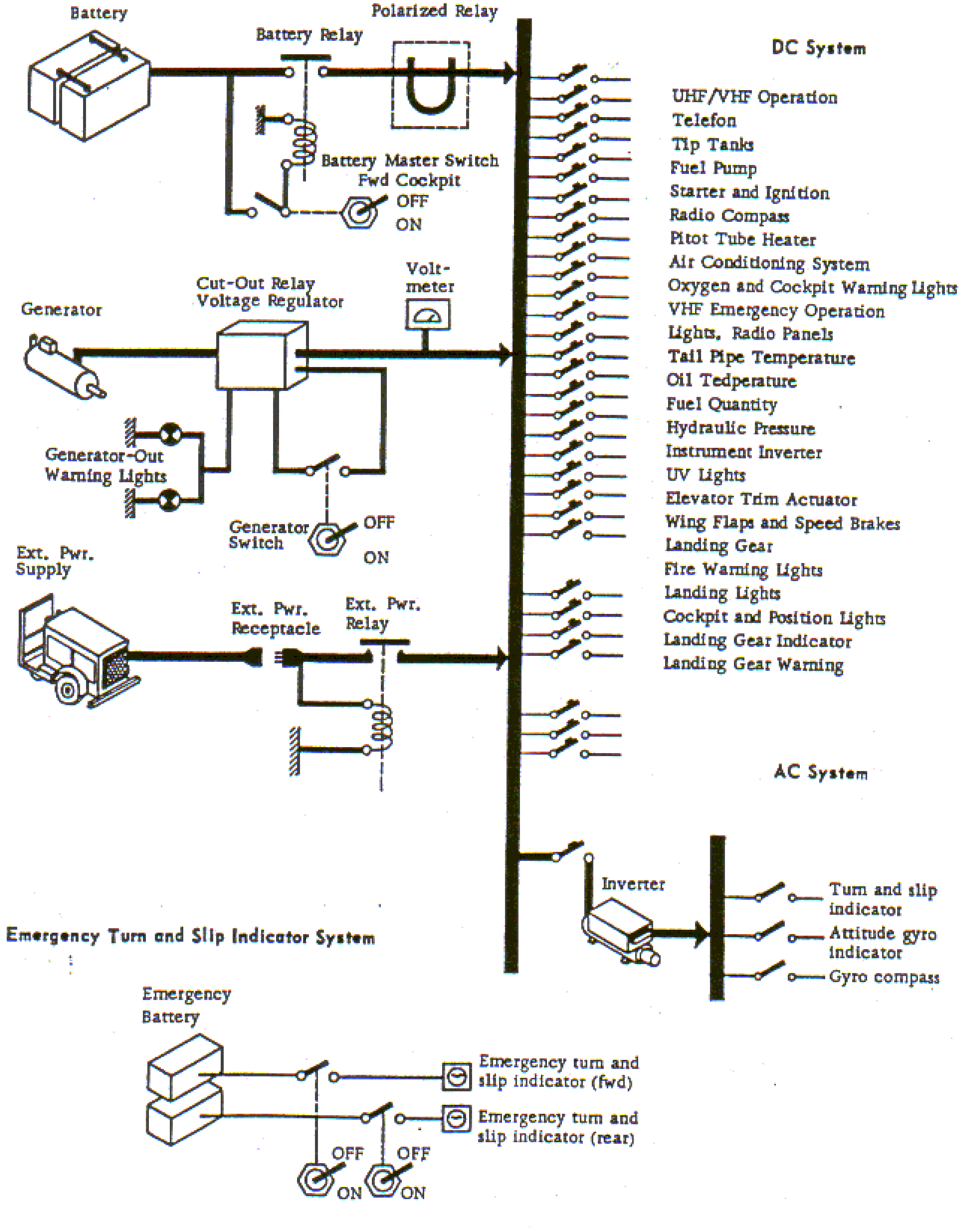


Figure 1-11

HYDRAULIC SYSTEM

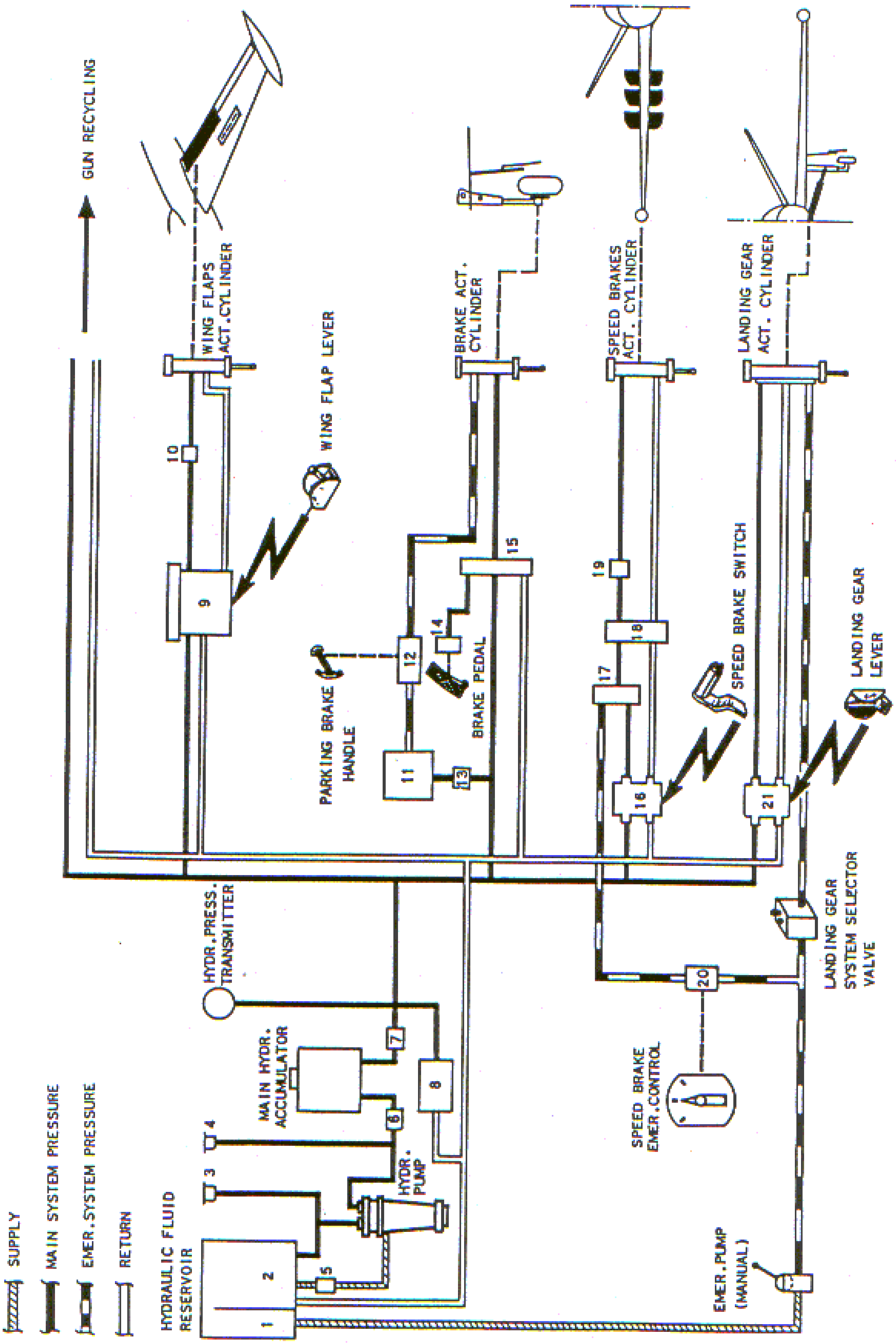


Figure 1-12

KEY TO FIGURE 1-12

1 Emergency system reservoir
2 Main system reservoir
3 Ground connection
4 Ground connection
5 Check valve
6 Check valve
7 Filter
8 Relief valve
9 Wing flap distributor
10 Sychronization box
11 Parking brake accumulator
12 Parking brake distributor
13 Check valve
14 Brake accumulator
15 Distributor valve
16 Speed brake selector valve
17 Shuttle valve
18 Locking valve
19 Synchronization box
20 Speed brake emergency selector valve
21 Landing gear system selector valve

HYDRAULIC SYSTEM.

The hydraulic system in this airplane (figure 1-12) provides power to operate the landing gear, the wing flaps, the wheel brakes, the speed brakes, and the machine gun cycling system (if installed). The necessary system pressure is provided by a self-regulating pump driven by the left engine. The pump flanged to the accessory drive is in operation at all times and supplies pressure as long as the left engine is operative. The system includes one reservoir, two accumulators (normal and emergency), synchronization boxes, dual pressure gauges, check valves, filter, a pressure switch, a safety valve, and ground service connections. A clutch is provided for preventing engine damage in case of pump malfunction. For emergency operation a manually operated emergency hydraulic pump is available.

CAUTION

The left engine has an accessory drive only. Therefore, normal hydraulic pressure is lost when the left engine is inoperative.

The engine-driven pump supplies 210-250 HPZ into the hydraulic system. Pressure in excess of 250 HPZ is routed to the hydraulic reservoir.

HYDRAULIC SYSTEM RESERVOIR.

The reservoir is divided into two sections (normal and emergency). It has a capacity of 6,5 l. 1,4 l are provided for the emergency system. The reservoir is accessible and serviced through the access panel on top of the fuselage. One section line extends to the engine-driven pump, the other to the emergency hand pump.

HYDRAULIC PRESSURE GAUGE.

A dual pressure gauge on the forward instrument panel only is provided with two scales in HPZ. One scale indicates normal system pressure, the second scale indicates emergency pressure.

ACCUMULATORS.

One accumulator (normal operation), plumbed into the system pressure line downstream from the engine driven pump is charged with nitrogen at 100 atü. The accumulator stores a supply of high-pressure fluid and also acts to dampen shocks in the system. The second accumulator (emergency operation) is provided to store pressure for operating the parking brake which at the same time serves as an emergency braking system if the normal power brake should fail.

EMERGENCY HYDRAULIC PUMP.

The emergency hydraulic pump is provided in the forward cockpit only. The pump which is manually operated provides hydraulic pressure to operate the landing gear and the speed brakes in case normal hydraulic system pressure is lost. The pump draws fluid from the hydraulic system reservoir which supplies both, the normal and the emergency system. Only the extension of the landing gear is possible. If the landing gear is to be extended in an emergency situation, the circuit breaker LANDING GEAR on the left console in the forward cockpit must be pulled, the landing gear lever has to be placed in the DOWN-position, the landing gear system selector switch on the left console in the forward cockpit must be placed in EMERGENCY and the manually operated pump must be actuated.

CAUTION

Failure to pull the circuit breaker causes the hydraulic pressure to build up and the gear retracts if the landing gear system selector is depressed while the lever for the normal operation of the gear is in UP position.

For further information on the landing gear system refer to LANDING GEAR, this section.

To operate the speed brakes in case of emergency, the speed brake emergency control (3-position valve) on the left console in the forward cockpit must be in either RETRACT or EXTEND (RENTRE or SORTIS) position and the manual hydraulic pump must be operated.

For further information on the speed brake system refer to SPEED BRAKES, this section.

CONTROL STICK GRIP

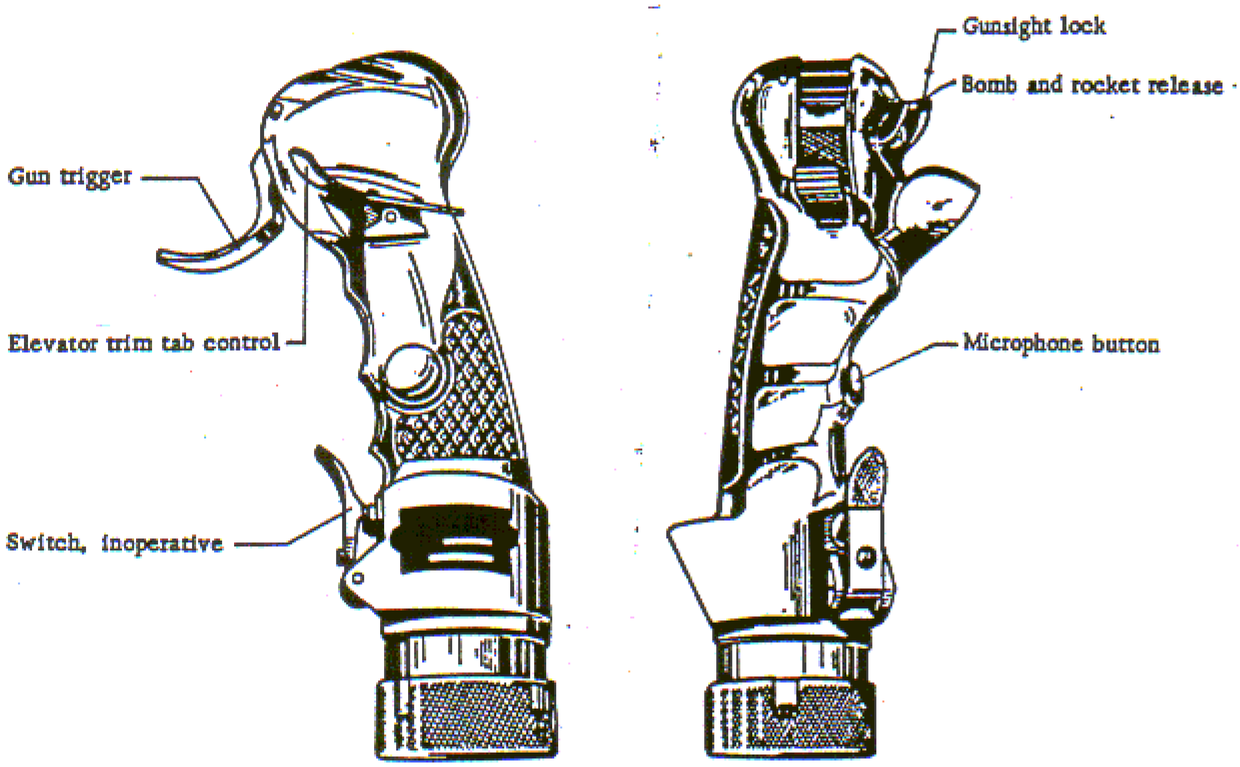


Figure 1-13

FLIGHT CONTROL SYSTEM.

The flight controls (figure 1-14) consist of cable and pushrod systems. The controls are entirely mechanical. No hydraulic servo system is available. The primary flight control surfaces include ailerons, the elevator and rudder. The functions of the elevator and the rudder are realized in the form of a ruddevator in the butterfly tail.

CONTROL STICKS.

The control sticks in the front and rear cockpit are interconnected. The sticks are movable to either side about a hinge halfway between the grip and the cockpit floor. Movement of the stick sideways transmits motion through connecting rods and cables to the ailerons. Movement of the sticks fore or aft transmits motion through a system of control rods hinged at the base of the sticks to the ruddevator coordinator in the aft section of the fuselage for elevator function. The control stick grip in each cockpit (figure 1-13) incorporates the elevator function trim switch, the camera/armament trigger, and the mike button.

RUDDER PEDALS.

Control of the rudder function of the ruddevator is exercised by actuation of rudder pedals in either cockpit. Motion is transmitted through pushrods to the ruddevator coordinator in the aft section of the fuselage. The rudder pedals are arranged on pedal blocks. A handcrank located on the lower portion of the instrument panel in the front cockpit and on the right console in the rear cockpit permits forward or aft adjustment of the pedals. The pedals also serve to conventionally apply the wheel brakes by toe action.

Two artificial feel springs are incorporated in the linkage operating in the rudder function of the ruddevator since aerodynamic forces are not too pronounced.

Ruddevator Coordinator.

A coordinating unit installed in the aft section of the fuselage is required to convert stick and rudder pedal movements into properly coordinated control surface deflections of the butterfly tail producing reactions of the airplane about the lateral and vertical axis similar to conventional elevator and rudder control.

Butterfly Tail.

The control surfaces on the butterfly tail combine the elevator and rudder functions of the conventional controls. In the elevator function the movements of the control stick in the forward or aft direction result in up or down motions of the left and right ruddevator control surfaces. The aerodynamic forces acting on the control surfaces to lift or lower the tail of the aircraft are actually the result of the combined forces of each surface of the butterfly tail.

In the rudder function, pedal movements produce control surface deflections on the butterfly tail which are opposite in direction between the left and right control surfaces, i.e., in entering a right hand turn, the control surface or the right section of the tail unit moves down while the control surface on the left section moves up. This creates both, a force which pulls the airplane's tail to the left and at the same time a torque effect contrary to the direction of bank required for a right hand turn. However, in banking the airplane using the aileron this counteracting rolling tendency is overcome so that only the force acting in direction of the lateral axis of the plane is effected.

TRIM SYSTEM.

Trim control is provided in the pitch axis only. An electric motor located in the aft section of the fuselage is the motivating force that operates the trim control surfaces on the ruddevator control surfaces through flexible drives and pushrods. The trim surfaces deflect the same amount and in the same direction.

Elevator Trim Control.

A two selector switch spring-loaded to the center off-position is provided on the control stick grip in each cockpit. When actuated in either position, power is furnished to the trim motor. The trim control surfaces deflect in the required direction and movement stops, when the control switch is released. A trim position indicator on the left side of the instrument panel in each cockpit reflects position of the trim control surfaces.

The pilot in the rear cockpit has priority in trim control. Actuation of the rear cockpit trim control shorts out the switch in the front cockpit.

WING FLAPS.

The wing flaps are electrically controlled and hydraulically operated. A solenoid valve is energized when the wing flap lever in either cockpit (66, figure 1-4 and 38, figure 1-7) is placed in the UP or DOWN position to direct hydraulic fluid into the actuating cylinders. A flap synchronizer assures uniform travel of both flaps. Maximum deflection (full down) is 40°. The flaps are operative as long as normal hydraulic system pressure is available.

The flaps stop at any intermediate position when the wing flap lever is released during extension or retraction of the flaps. The wing flaps are automatically locked in any position selected. Electrical power is provided by the dc system.

Note

When the wing flap levers in both cockpits are actuated simultaneously, the lever in the rear cockpit has priority over the lever in the front cockpit.

WING FLAP LEVERS.

The wing flaps are controlled by electrically interconnected wing flap levers (toggle switches) (66, figure 1-4 and 38, figure 1-7) located on the left console in each cockpit. The positions are UP, OFF (center) and DOWN.

Wing Flap Position Indicator.

Wing flap position is electrically relayed to the flap position indicators on the instrument panels in each cockpit. (39, figure 1-3 and 28, figure 1-6). Power is provided from the dc system.

SPEED BRAKES.

The speed brakes are installed in the wings (3 on top and 3 below each wing) and are designed to extend above and below the wing surfaces. The speed brakes may be used at any airspeed. The system is electrically controlled and hydraulically operated. The speed brake control a three-position switch spring-loaded to the center off-position is installed in each cockpit on the right engine throttle lever. When this switch is placed in IN or OUT position, the extend

FLIGHT CONTROL SYSTEM

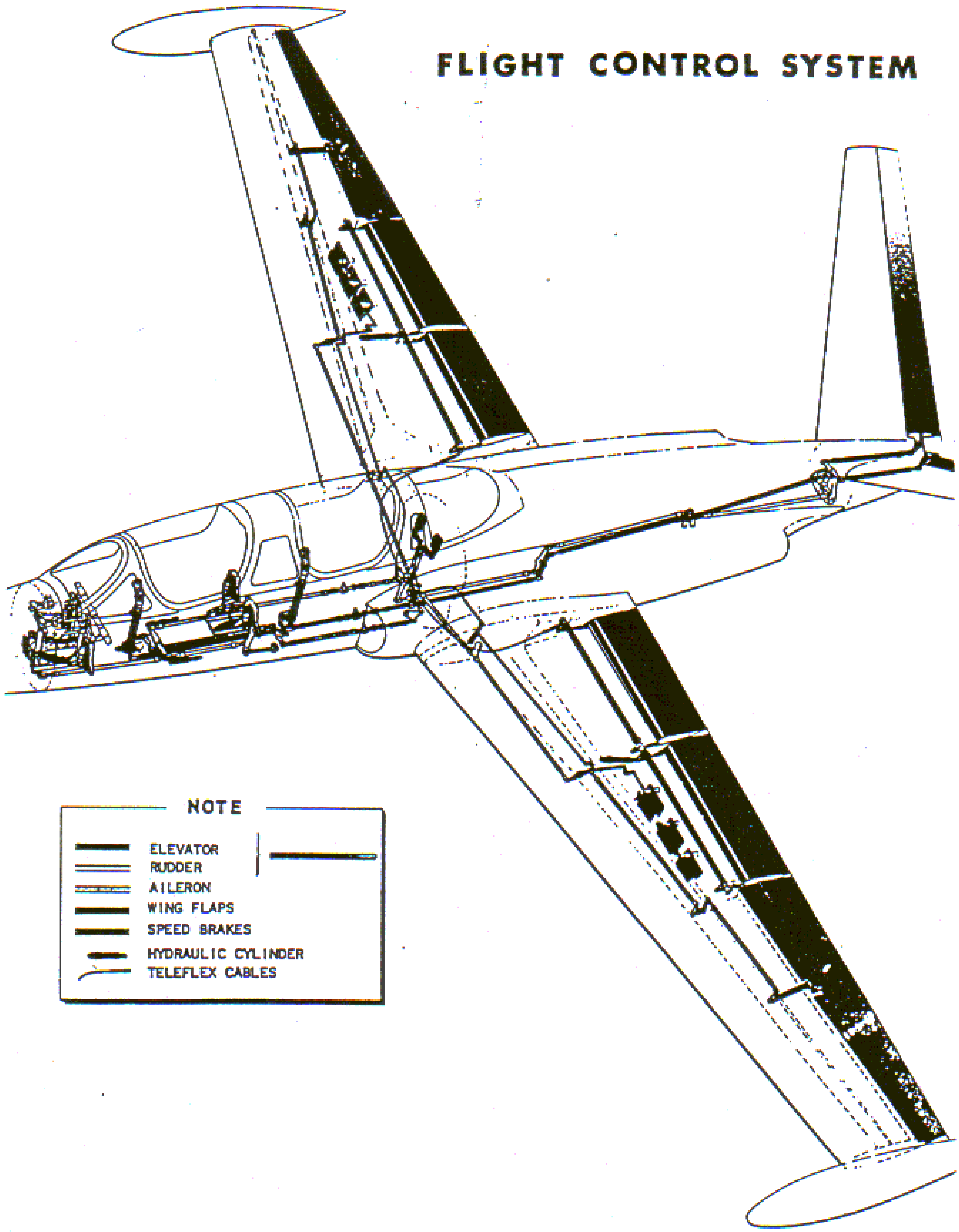


Figure 1-14

or retract solenoid of the hydraulic control valve admits pressure to the actuating cylinders. The speed brakes may be stopped at any intermediate position by releasing the switch. A synchronizer is provided to assure uniform travel of the left and right wing speed brakes. Power is derived from the dc system. There is no speed brake indication in cockpits because visual observation by the pilots is possible.

SPEED BRAKE SYSTEM EMERGENCY OPERATION.

To operate the speed brakes in case of emergency, the speed brake emergency control on the left console in the front cockpit must be placed in EXTEND or RETRACT position. Working the hydraulic hand pump generates hydraulic pressure to operate the brakes. There is no speed brake indication in cockpits because visual observation by the pilots is possible.

LANDING GEAR.

The landing gear consists of a tricycle landing gear. The two main gears are hinged on the wing spars and retract spanwise into the landing gear wing recesses. The non-steerable nose gear retracts aft into the fuselage. A tail wheel, which is not part of the landing gear is provided to prevent the tail of the aircraft from hitting the ground during excessive nose high landings. The landing gear system is electrically controlled and hydraulically operated. The landing gear lever when placed in UP or DOWN position energizes the retract or extend solenoid in the landing gear control valve. The control valve is wired through the landing gear system selector valve and the circuit breaker marked LANDING GEAR in the forward cockpit. When the landing gear lever is placed in UP position, the landing gear control valve admits hydraulic pressure to the three landing gear operating cylinders and to the main gear uplocks. Pressure reducers are provided to reduce the hydraulic system pressure in the gear actuating lines.

LANDING GEAR LEVERS.

The landing gear levers (26, figure 1-3 and 19, figure 1-6) located on the left side of the forward and rear instrument panel, control hydraulic actuation of the landing gear. The levers are mechanically interconnected so that both will be in the same position at all times. They are locked in the DOWN position as long as the weight of the aircraft rests on the landing gear. A microswitch on the left main gear closes the electrical circuit to the landing gear down-unlocked solenoid when the airplane is off the ground so that the landing gear lever can be moved to the UP position. If it becomes necessary to retract the gear during ground roll in case of emergency, an override push-button (safetywired) is provided above the landing gear lever. When depressed the override push-button unlocks the downlock mechanism and the landing gear lever may be placed in the UP position.

CAUTION

Electrical and hydraulic systems must be operating.

MAIN GEAR LOCKING MECHANISM.

The main gears are locked in the UP position by a lug on each main gear by which engages a hook in the main gear uplock. Extend position locking is accomplished by locking claws in the drag strut cylinder.

NOSE GEAR LOCKING MECHANISM.

Extended and retracted position locking is acommplished by claws in the drag strut cylinder.

LANDING GEAR EMERGENCY EXTENSION.

To extend the gear in case of failure of the normal hydraulic system during flight, an emergency extension system is provided. The gear may be extended manually by working the hand pump when the landing gear system selector switch is placed in EMERGENCY and the circuit breaker LANDING GEAR is pulled.

CAUTION

Failure to pull the LANDING GEAR circuit breaker on the left console in the forward cockpit causes the gear to retract again when the normal operating lever is in UP position.

Landing Gear Indicating and Warning System.

A landing gear indicator panel is installed in each cockpit (27, figure 1-3 and 20, figure 1-6). Three red lights are located in the upper portion of the panel.

one for each unit of the landing gear system. The lights are illuminated any time the associated gear is moving (gear unsafe warning) and/or unlocked.

The green lights illuminating when the gear is properly locked in the DOWN position are duplicated for each gear. One set of lights (3) can be energized by turning the 2-position switch in the center of the panel to verify a lamp filament failure of one or more of the first set of lamps, of the first set does not indicate the gear in the DOWN position. A push-to-test button on top of this switch is used to check the filaments of all lamps of the panel. Also in the center is a 3-position switch which controls brightness of all lights. When the gear is properly locked in the UP position, all lights are deenergized. An additional red warning light installed in the left corner of the forward instrument panel only, illuminates if one of the engines operates at a speed below approximately 17.000 RPM and all gears are not properly locked in the DOWN position.

BRAKES.

The brakes are actuated by the hydraulic system and are operated by toe pressure on the upper part of the rudder pedals.

PARKING BRAKE.

The parking brake is set by a T-handle located on the instrument panel in the front cockpit. It provides a means of setting the brakes for extended periods. A dual hydraulic pressure indicator indicates on its right hand scale the pressure in the parking brake accumulator.

CAUTION

- Simultaneous application of the rudder pedals and the parking brake handle will result in no brake effect because the valves are kept in a position where no pressure will reach the brakes.
- In case of hydraulic system failure and a hydraulic pressure gauge indication of 110-120 hpz only, the accumulator will be discharged when the brakes are being applied once more. No steering of the aircraft will be possible. The same applies for the parking brake with the pressure gauge indicating only 90 hpz, while a pressure indication of appr. 250 hpz will permit appr. 20 times for emergency braking.

FLIGHT INSTRUMENTS.

PITOT-STATIC SYSTEM INSTRUMENTS.

The pitot-static-operated instruments include th airspeed indicator, machmeter, altimeter, and vertical velocity indicator as follows.

Airspeed Indicator.

The airspeed indicator (13, figure 1-3 and 5, figure 1-6), located on the instrument panel in each cockpit, is calibrated in increments of 10, from 60 through 600 knots.

Machmeter.

A machmeter (5, figure 1-3) is installed in the front cockpit only. The instrument is calibrated from Mach 0.4 - 1.0 direct reading. It can be used to a height up to approximately 45.000 feet.

Altimeter.

One altimeter (19, figure 1-3 and 12, figure 1-6) is installed on the instrument panel in each cockpit. The instrument incorporates one pointer for 100 and one scale for 1000 feet. The 1000 feet indication appears in a window. A knob is installed below the scale of the altimeter to set barometric pressure.

Vertical Velocity Indicator.

The vertical velocity indicator located on each instrument panel (15, figure 1-3 and 7, figure 1-6) indicates vertical component of airplane speed, based on the rate of change of atmospheric pressure. The instrument is a direct reading instrument calibrated in feet/min. (The range of the instrument is from 0 - 8.000 feet/min max.)

CABIN PRESSURE ALTITUDE INDICATOR.

A cabin pressure altitude indicator is installed on the instrument panel in the front cockpit only (41, figure 1-3). It is calibrated in feet and indicates cabin pressure altitude.

TURN AND SLIP INDICATOR.

The 3° per second-turn and slip indicator (21, figure 1-3 and 14, figure 1-6) is installed on the instrument panel in each cockpit. The instruments are supplied with 115-volt 3-phase ac power through the instrument inverter.

EMERGENCY TURN AND SLIP INDICATOR.

The aircraft is also provided with a 3° per second-emergency turn and slip indicator in each cockpit (29, figure 1-3 and 23, figure 1-6). The instruments are supplied by a 4-volt dry battery installed below the rear instrument panel.

STANDBY COMPASS.

The standby compass located above the instrument panel on the right side of the windshield in the front cockpit only (2, figure 1-3) is a standard type magnetic compass to be used as a check on the operation of the gyro compass system or in the event of an emergency. Reading should be taken only during straight and level flight since errors may be introduced by turning or accelerating. A compass correction card indicating deviation is located on the right side of the forward instrument panel (46, figure 1-3).

GYRO COMPASS SYSTEM.

Refer to Section IV for description and operation of the SPERRY C2A compass system.

ATTITUDE GYRO INDICATOR.

The SFENA 703BD indicator (14, figure 1-3 and 6, figure 1-6), located on the instrument panel in each cockpit, provides a constant visual indication of pitch and bank attitudes. The instrument has complete freedom through 360 degrees of rotation about the roll axis and effective freedom of ±80 degrees up or down about the pitch axis. The vertical-seeking gyro of this instrument is powered by 115-volt 3-phase ac power supplied by the instrument inverter. The airplane symbol may be adjusted in relation to the horizon bar by a knob located on the lower right side of the instrument. Pulling this knob permits quick erection of the gyro to the vertical position. An attitude warning flag with a cross will appear in the upper right portion on the dial face when the instrument is not receiving adequate power.

G-METER.

The G-meter (16, figure 1-3) located in the front cockpit only has three pointers and a common scale. The outer or main pointer indicates instantaneous acceleration, the middle pointer records maximum positive acceleration, and the inner pointer records maximum negative acceleration. The recording pointers may be reset by means of the knob on the instrument.

EMERGENCY EQUIPMENT.

OVERHEAT AND FIRE WARNING LIGHTS.

The engine compartments of the aircraft are equipped with an overheat and fire warning system. 6 bi-metal fire detectors are installed in each engine. Two warning lights (8, figure 1-3 and 9, figure 1-6), in cockpit will indicate a fire or overheat condition. Refer to Section III for procedure to be followed if these lights illuminate.

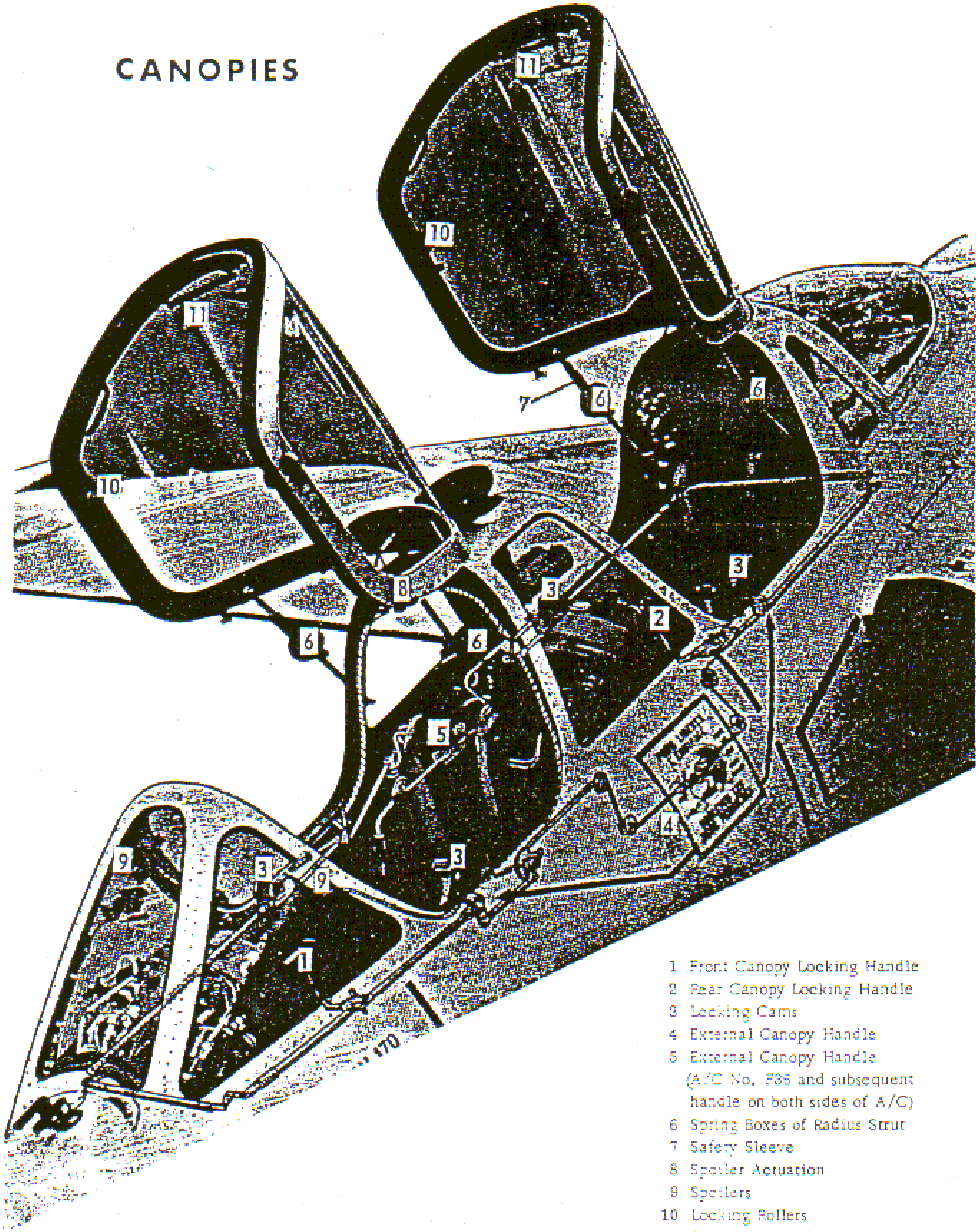
ESCAPE SYSTEM.

Escaping of this aircraft in an emergency condition consists of unlocking and pushing the canopies upwards into the airstream, and bailing out by means of seat-type parachutes. No ejection seats are provided.

CANOPIES.

The canopies are locked and unlocked by means of the canopy locking handle (figure 1-16) located on the left side in each cockpit. In case of emergency the canopies are unlocked by the same handle. The air flow will then bring the canopy to the open position. It may become necessary to push the canopy upwards by hand after unlocking it. In jettisoning front canopy, spring-loaded spoilers are actuated and protect the pilot in rear cockpit from the airflow. When closed, the canopy seal is inflated by engine air pressure to seal the canopy frame against cockpit sill and windshield.

CANOPIES



1 Front Canopy Locking Handle
2 Rear Canopy Locking Handle
3 Locking Cams
4 External Canopy Handle
5 External Canopy Handle (A/C No. F36 and subsequent handle on both sides of A/C)
6 Spring Boxes of Radius Strut
7 Safety Sleeve
8 Spoiler Actuation
9 Spoilers
10 Locking Rollers
11 Part-Open Handle

Figure 1-15

CANOPY LOCKING HANDLE

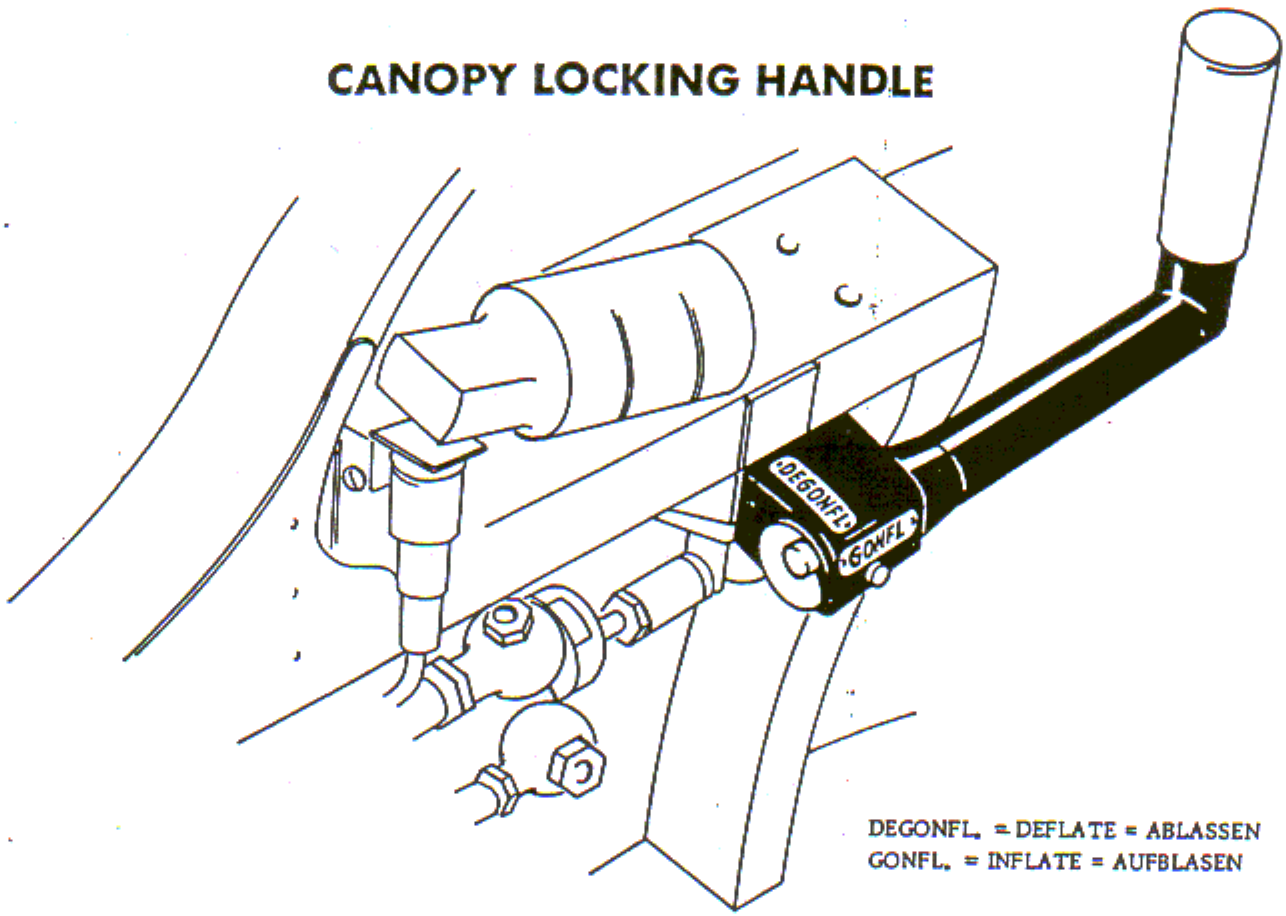


Figure 1-16

CANOPY CONTROLS.

The canopy controls in each cockpit consist of a canopy locking handle, a knurled slider for the canopy open-position, a manually operated part-open handle, a canopy unsafe warning light, an external canopy handle for ground operation, and a square key used for opening or closing the canopy from outside for parking purposes. A key holder is provided on the access door to the APU receptacle.

Canopy Locking Handle.

This handle on the left side in each cockpit (figure 1-16) is used for locking and unlocking the canopy during flight and on the ground. The handle is provided with two buttons. One button (DEGONFL. - DEFLATE) serves to release pressure from the canopy seals. Pushing the other button (GONFL. - INFLATE) returns button (DEGONFL.) in its normal position and causes reinflation of the canopy seals.

Knurled Slider.

A knurled slider serves as a safety device for the canopy open position. To close the canopy, the slider must be pushed upwards by hand to bend the strut.

Part-Open Handle.

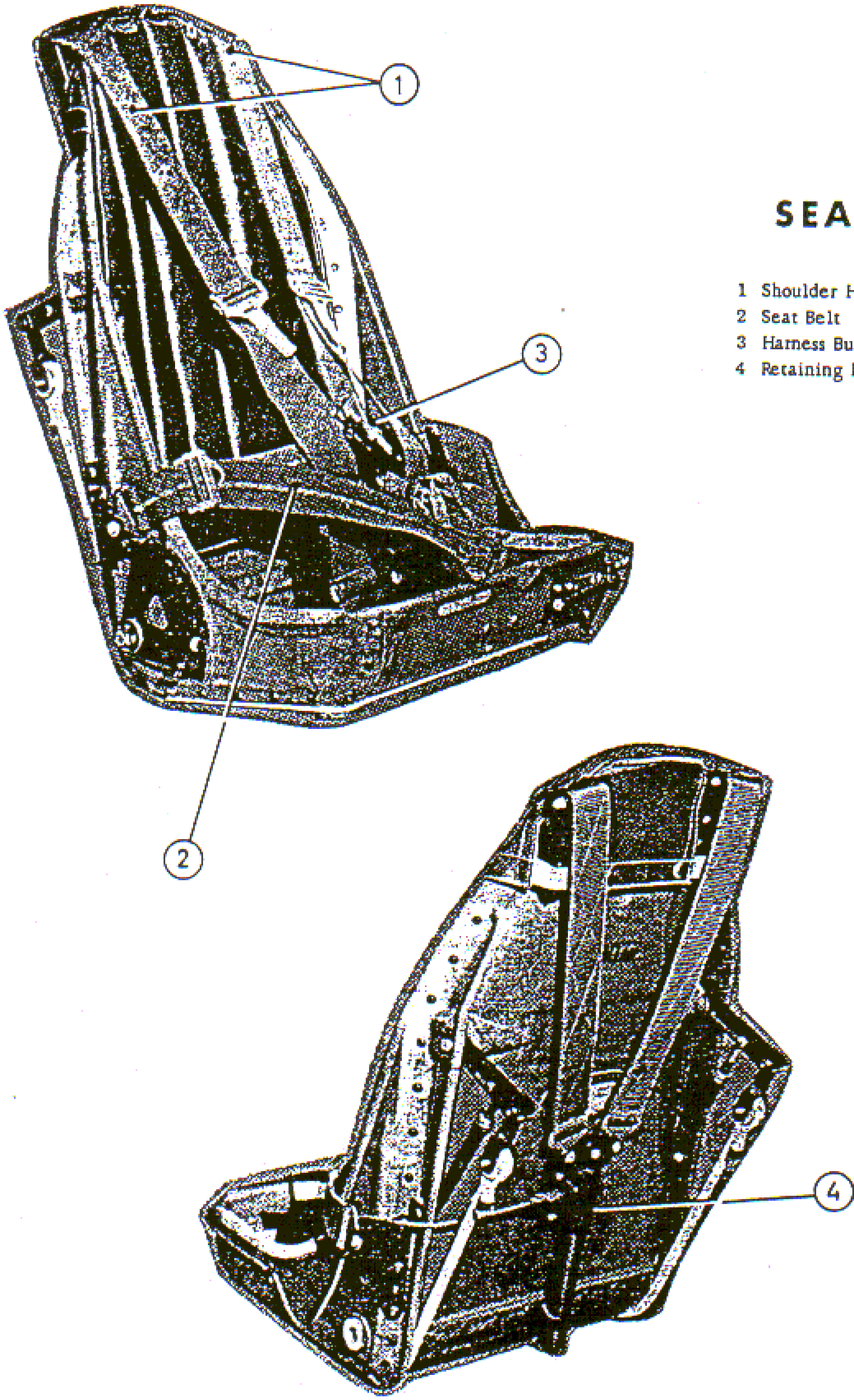
A small handle is installed on the forward canopy frame in each cockpit to keep the canopy in the part-open position.

Canopy Unsafe Warning Light.

The red light (11, figure 1-3) in the forward cockpit only will illuminate when the canopy of either cockpit is not locked.

External Canopy Handles.

The external canopy handles (two on each side for each cockpit) located on both sides outside of the fuselage, are folded back into the fuselage and protected by a plexiglass window. The handles are accessible when the windows are broken. After having actuated the handles, the canopy has to be lifted to gain access to the cockpit. A streamlined edge on the lower canopy part provides a hold for lifting the frame.

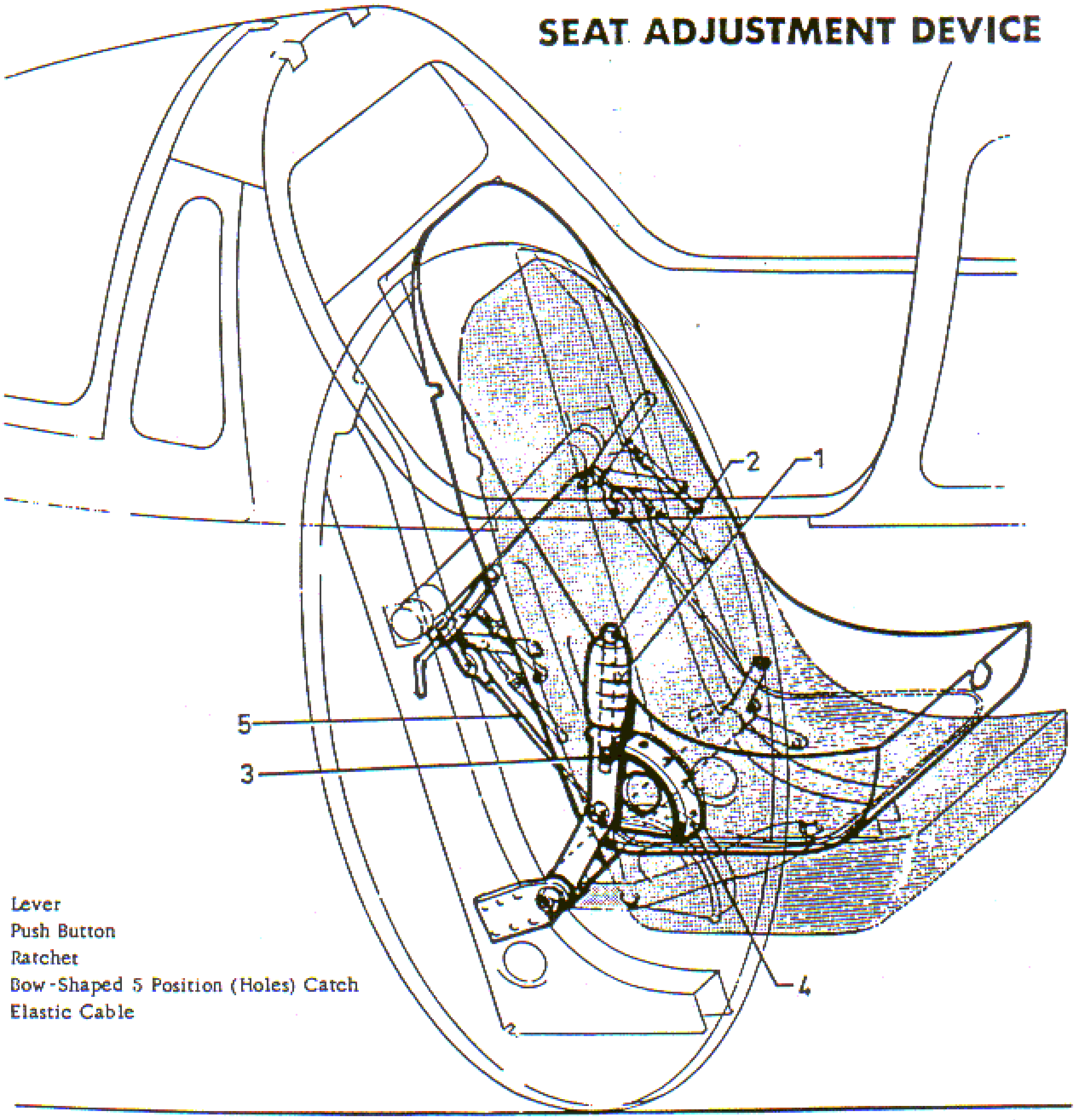


SEAT

1 Shoulder Harness
2 Seat Belt
3 Harness Buckle
4 Retaining Device

Figure 1-17

SEAT ADJUSTMENT DEVICE



1 Lever
2 Push Button
3 Ratchet
4 Bow-Shaped 5 Position (Holes) Catch
5 Elastic Cable

Figure 1-18

SEATS.

The seat is arranged for use of a seat-type parachute. Height of seat can be adjusted by a lever located on the right side of the seat. A button installed on the lever has to be pressed before the lever can be moved up or down. When the button is released the seat will remain in the selected position.

Four harness straps are fastened on the seat bucket and routed to a quick disconnect fitting. A retaining device on the aft side of the seat bucket keeps the pilots in their seats when the retaining device is locked. Unlocking the retaining device by means of a handle at the left corner of the seat bucket front side enables the pilots to move forward again.

AUXILIARY EQUIPMENT.

Auxiliary equipment, including cockpit air conditioning and pressurization system, oxygen system, lighting etc. is decribed in Section IV.

EXTERNAL SAFETY PINS, CLAMPS, LOCKS, AND COVERS

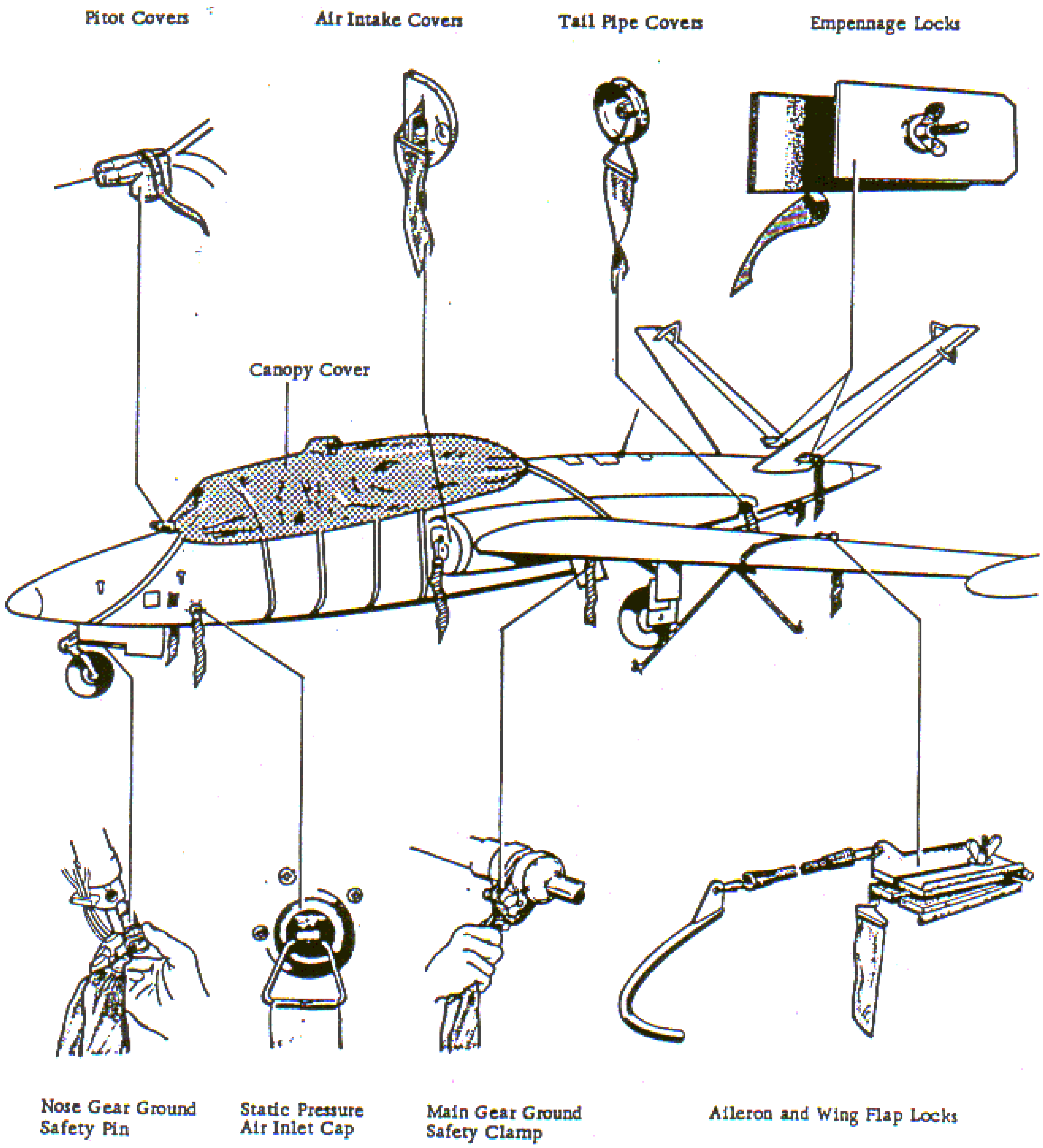
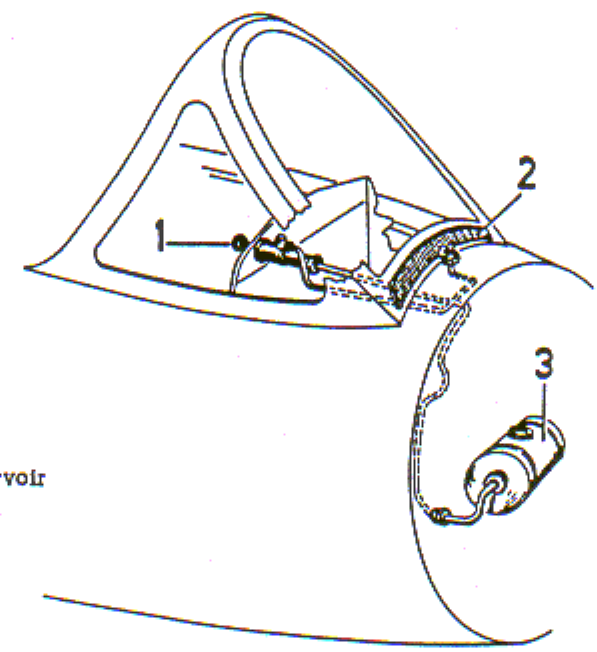


Figure 1-19

SERVICING DIAGRAM

Fluid	Specifications			
	French	NATO	USA	Engl.
Fuel	Air 3407	F-40(JP-4)	MIL-J-5624	DERD 2486 (AVTAG)
For alternate use		F-33(JP-1)		
Engine Oil	Air 3512	0-138		DED 2479/0 (OM-71)
Hydraulic Oil	Air 3520	H-515	MIL-H-5606	DTD 585 (OM-15)
De-Icer Fluid (Isopropyl Alcohol)	Air 3660	S-737	MIL-F-5566	
Oxygen Spec. BB-0-925				
APU - 28 Volt				

EXTERNAL WINDSHIELD DEFROSTING



1 Pump
2 Defrosting Tube
3 Isopropyl Alcohol Reservoir

Figure 1-20 (Sheet 1 of 2)

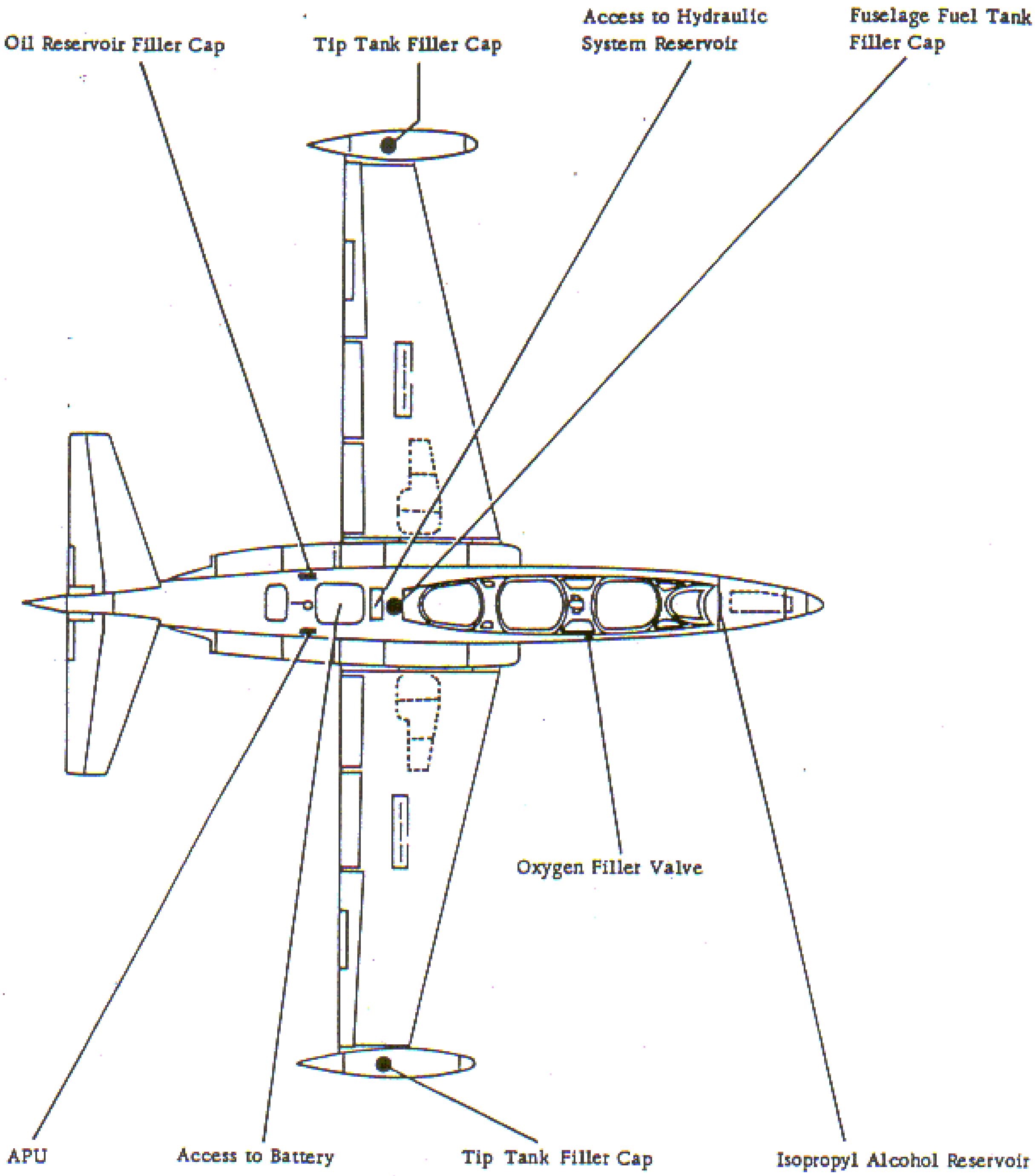


Figure 1-20 (Sheet 2 of 2)

EXTERNAL SAFETY PINS, CLAMPS, LOCKS, AND COVERS.

The external safety pins, clamps, locks and covers (figure 1-19) that should be removed before flight are listed below.

a. Pitot cover(s).

b. Engine air intake duct covers (two) - One each duct.

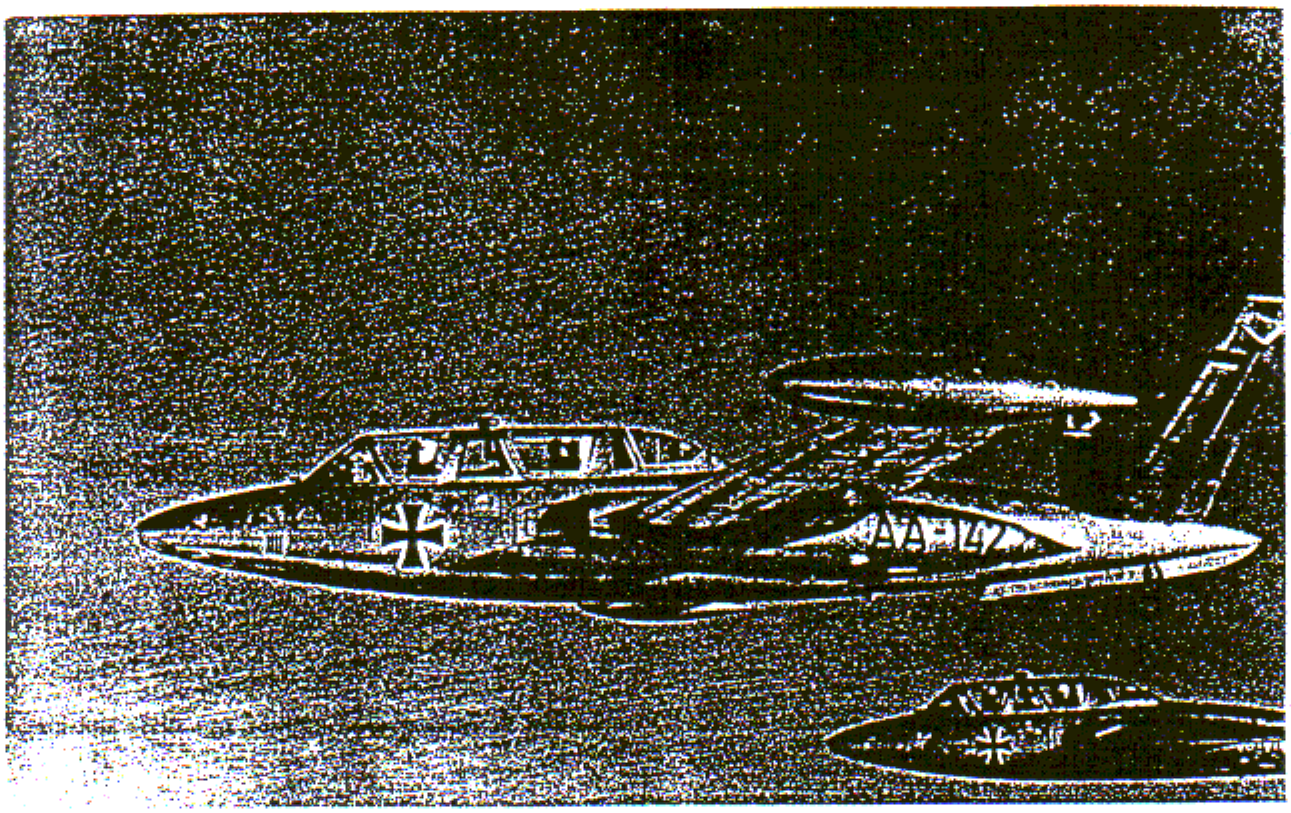
c. Tail pipe covers (two) - One on each side.

e. Nose gear ground safety pin.

f. Static pressure air inlet cap (two) - One on each side.

g. Main gear ground safety clamp (two) - One each main gear.

h. Aileron and wing flap locks (two) - One on each side.



SECTION II NORMAL PROCEDURES

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PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Refer to Section V for all operation limitations.

FLIGHT PLANNING.

Preflight planning data, such as takeoff performance, fuel required, cruise data, and other performance information to complete the proposed mission, will be determined using the performance data contained in Appendix I of this Flight Manual.

CHECKLIST.

This section contains the amplified checklist. The abbreviated checklist is published separately as GAF T.O. 1T-CM170-CL-1-1.

PREFLIGHT CHECK.

On bases where ground personnel is not completely familiar with your aircraft, make sure that post flight and preflight inspections are accomplished in accordance with the Technical Manual of Inspection Requirements.

BEFORE EXTERIOR INSPECTION.

1. Form 781 - Check A/C status, servicing, and fill in.
2. Pitot cover - Remove.
3. Personnel equipment - Check. Make sure that personnel equipment, parachute harness, mask and helmet are in a good condition.

Front Cockpit.

1. Ignition buttons - OUT.
2. Fuel handles - CLOSED.

CAUTION

If one or both fuel handles were not fully closed, drain engines.

3. Gear handle - DOWN.
4. Emergency gear-up button - Secured.
5. De-icer-check before IFR-flight - Quantity and function, then lock.
6. Oxygen - 3/4 Minimum.
7. Parking brake - Set.

ELECTRICAL SYSTEM.

8. Main circuit breaker - IN.
9. Battery - ON.
10. Voltmeter reading - 25, 5 V.
11. Fuel Indication - Check fuel indicator for proper reading.
12. Pitot heater - Warm up. Check function of pitot heater by operating pitot heat switch (light out) and check pitot tubes for warming up. Openings free.
13. Landing-, position- and cockpit-lights - Check (for Night and IFR).
14. Battery - OFF.

Rear Cockpit.

1. Ignition buttons - OUT.
2. Fuel handles - CLOSED.
3. Gear handle - DOWN.
4. Emergency gear-up button - Secured.
5. Oxygen - 3/4 Minimum.

ELECTRICAL SYSTEM.

6. Pitot heater - Warm up.
7. Cockpit lights - Check (for Night and IFR).

Rear Cockpit (Solo Flights).

1. Cockpit - Check. (Loose items, equipment, tools, etc.)
2. Harness, oxygen hose, and radio lead - Secured.
3. Oxygen - 100%. Check "SECOURS" position (Emergency) and switch full off.
4. Cabin seal-button - IN.
5. Fresh air vent - Closed.
6. Canopy - Closed and locked.

EXTERIOR INSPECTION.

Perform the exterior inspection as outlined in figure 2-1.

Note

Check all screw slots for alignment with respective red marks on aircraft.

Nose Section.

1. Static port left side - Free.
2. External canopy handle left side - Check. Check condition of plexi glass and the two release handles visually.

EXTERIOR INSPECTION

THE FLIGHT CREW EXTERIOR INSPECTION PROCEDURES ARE PREDICATED ON THE FACT THAT MAINTENANCE PERSONNEL HAVE COMPLETED ALL POST FLIGHT AND PREFLIGHT REQUIREMENTS OUTLINED IN T.O. 1T-CM170R-2-1. THEREFORE, DUPLICATE INSPECTIONS BY THE FLIGHT CREW HAVE BEEN ELIMINATED, EXCEPT FOR CERTAIN ITEMS REQUIRED IN THE INTEREST OF FLIGHT SAFETY. THE FLIGHT CREW EXTERIOR INSPECTION IS TO CHECK THE AIRPLANE FOR GENERAL CONDITION, AND SHOULD FOLLOW THE PATH AS SHOWN.

NOTE

WHILE MAKING EXTERIOR INSPECTION, CHECK ALL SURFACES FOR CRACKS, DISTORTION, LOOSE RIVETS, AND DAMAGE; CHECK FOR FUEL, OIL, AND HYDRAULIC LEAKS; ALL GROUND SAFETY LOCKS REMOVED.

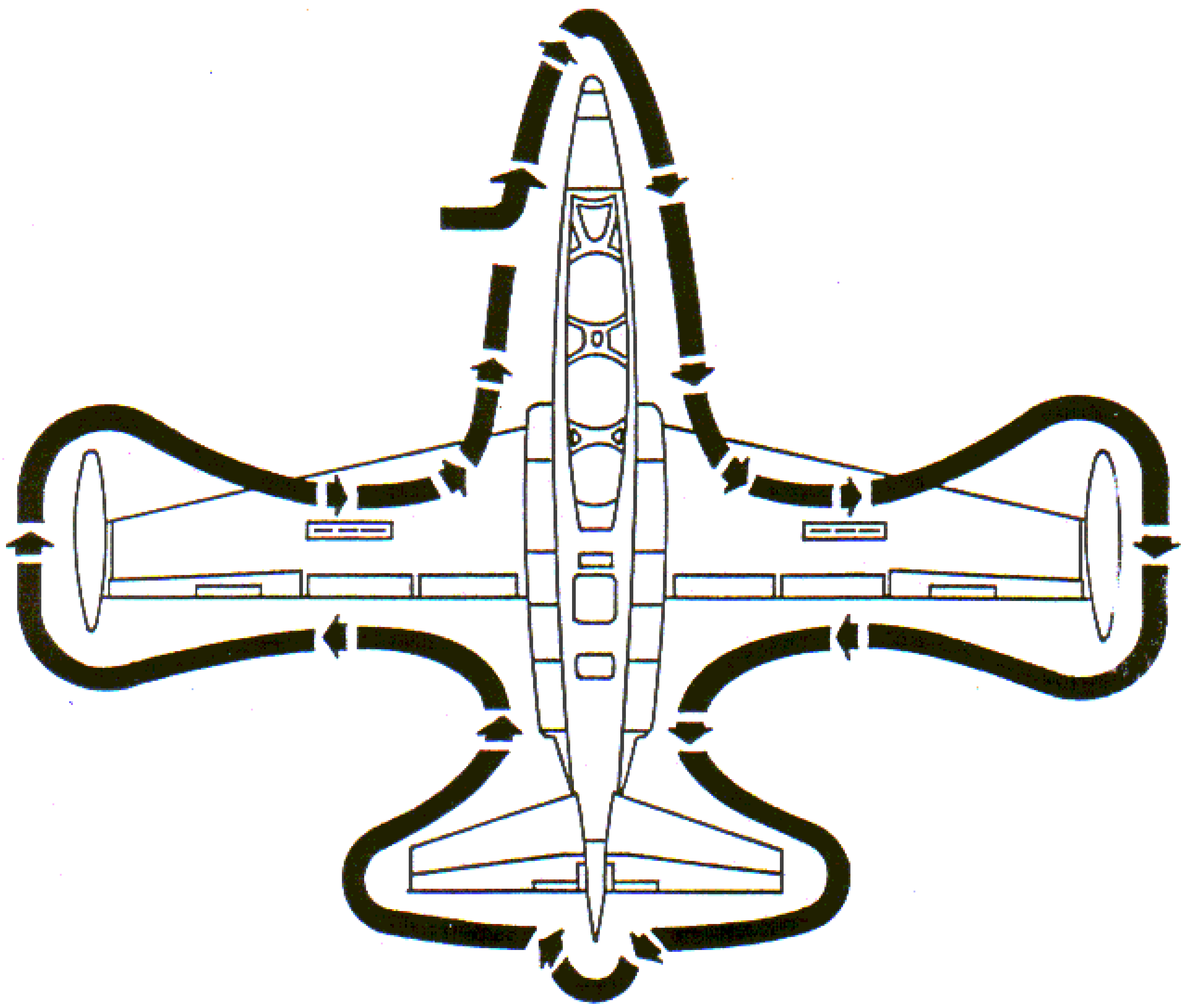


Figure 2-1

3. Landing light - Condition.

4. Nose wheel - General condition and slippage marks.

5. Strut - Extension. Check for proper extension.

6. Shimmy damper - Engaged.

7. Nose wheel door - Condition. Check for distortion.

8. Static wire - Ground contact.

9. Inspection plates and gun ports - Closed.

10. Oxygen shut-off valve - Secured. Valve is secured in the open-position and must not be adjusted.

11. Fresh air vents (2) - Closed.

12. Static port right side - Free.

13. External canopy handle right side - Same as left.

Right Wing and Landing Gear.

1. Air intake cover - Removed.

2. Air intake - Clear. (Check visually for foreign objects.)

3. Inspection plates - Closed.

4. Shockstrut extension - 5 cm min. for an air-craft full of fuel.

5. Fairing door and 3 rollers - Condition.

6. Tire - General condition and slippage marks.

7. Hydraulic lines - No leakages.

8. Wheel - Chocked.

9. Wing surface - Condition.

10. Speed brakes - Flush.

11. Position light - Condition.

12. Tip tank - Full.

a. Cap closed.

b. Protection cover open. Ground crew will close cover during tiptank pressure check.

c. Check fuel emergency dump hole to be free.

d. Check tip tank for condition.

13. Aileron control lock - Removed.

14. Wing flaps - Distortion. Clearance 2 mm. Check the wing flaps locked up and the 2 mm-clearance by moving the flaps laterally.

Aft Fuselage (Right Side).

1. Radio glass cover - Closed and locked.

2. Antennae - Condition.

3. Engine cowling and fuselage access doors - Closed.

4. Tail pipe - Clear. Remove tail pipe cover and check for cracks and wrinkles.

5. No oil or fuel puddles under A/C.

Note

In case of puddles fire department is to be notified.

6. Tail wheel and keel plates - Condition.

Empennage and Tail.

1. Tail plane control locks - Removed.

2. Controls - Operation and condition. Check ruddevator movement and the operation of the artificial feel springs.

3. Trim tabs - NEUTRAL.

WARNING

Hands off trim tabs.

4. Position light - Condition.

5. Inspection plates - Closed.

Aft Fuselage (Left Side).

1. Check same as right side.

2. Oil tank - Quantity and closed, cover secured.

Left Wing and Landing Gear.

1. Check same as right side.

2. Fuselage tank - Full and closed, cover secured.

INTERIOR INSPECTION.

Switches are ON, when they are either in the up, forward, or outward position.

Front Cockpit.

1. Seat and rudder pedals - Adjust.
2. Harness - Fasten and adjust. Check retaining device for operation.
3. Flight controls - Free and proper movement.
4. Circuit breakers left console - IN.
5. All light switches - OFF.
   a. Emergency cockpit light switch.
   b. UV-light rheostat.
   c. Console light switch.
   d. Position light switch.
   e. UV-light switch.
   f. Landing-and taxi-light switch.
   g. Standby compass light switch.
   h. Radio- and RC-light rheostat.
6. Cabin pressure switch - CLOSED.
7. Throttles - OFF.
8. Fuel handles - CLOSED.
9. Seal button - OFF.
10. Landing gear system selector - NORMAL.
11. Speed brakes - Extend by emergency system, then switch back to normal system.
12. Emergency turn needle switch - OFF.
13. G-Meter - Check + 1G.
14. Main circuit breaker - IN.
15. Radio master switch - ON.
16. Radio and radio compass - OFF.
    a. Channel - Preset.
    b. Volumes (Radio and BT) - ON.
    c. Radio operation selector - "N" (normal).
17. Tip tank dump switches - NEUTRAL.
18. Starter switch - NEUTRAL.
19. Circuit breakers right console - IN (weapon system as required).
20. Oxygen and radio - Connect and PMcCripe Check.
21. Battery - ON.
22. Check lights (night flying position if applicable):
    a. Landing gear (3 green).
    b. Canopy light.
    c. Pitot heat light.
    d. Generator warning light.
23. Push Test:
    a. Landing gear (second system and 3 red).
    b. Fuel low pressure warning light (booster pump).
    c. Landing gear warning light.
    d. Fire warning lights (2).
    e. Fuel low level warning light.
    f. Starter light.
    g. Fuel dump lights (2). By means of the test push buttons aft of the fuel dump switches.

Rear Cockpit (Dual Flights).

1. Seat and rudder pedals - Adjust.
2. Harness - Fasten and adjust.
3. Controls - Free and proper movement.
4. Light switches - OFF.
   a. Emergency cockpit light switch.
   b. UV-light rheostat.
   c. Console light switch.
5. Seal button - OFF.
6. Emergency turn needle switch - OFF.
7. Radio and radio compass - OFF.
   a. Channel - Preset.
   b. Volumes (Radio and BT) - ON.
   c. Radio operation selector - "N" (normal).
8. Oxygen and radio - Connect and PMcCripe Check.
9. Check Lights:
   a. Landing gear (3 green).
   b. Pitot heat light.

DANGER AREAS

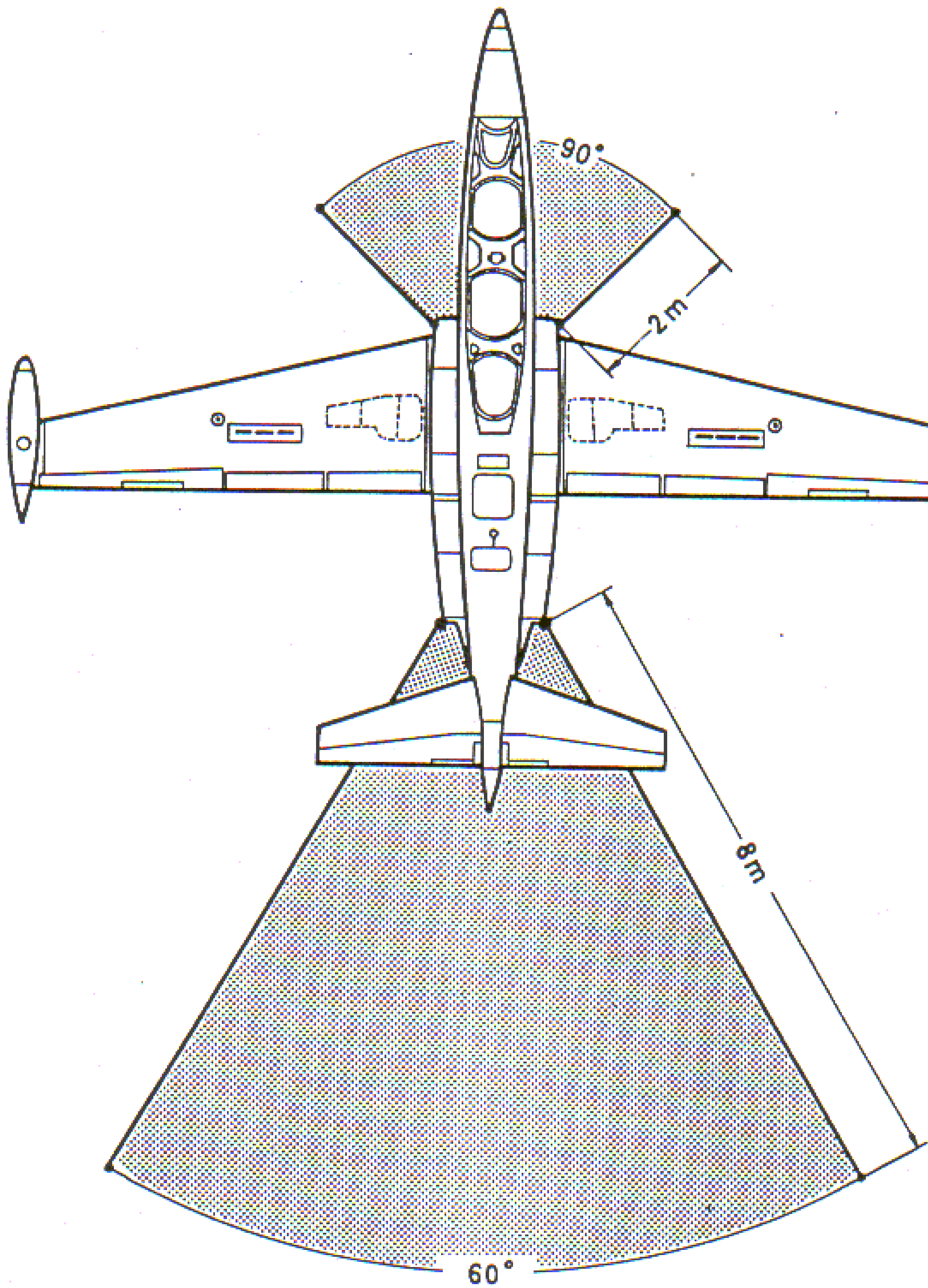


Figure 2-2

Rear Cockpit (Dual Flights) (continued).

c. Generator warning light.

d. Oil low pressure warning lights.

10. Push Test:

a. Landing gear (second system and 3 red).

b. Fire warning lights (2).

STARTING ENGINES.

Be sure that the danger areas are clear before starting. (See Figure 2-2.)

Note

Left engine will be started first.

1. Engine intakes - Clear.
2. Fire guard - On left side.
3. Throttles and fuel handles - OFF.
4. Starter switch - LEFT (check light on).
5. 1.200 RPM:

a. Ignition button - PUSH and HOLD (max. 10 seconds).

b. Two (2) seconds later:
Fuel handle - FULL OPEN.

c. Within ten (10) seconds:
EGT increase of 100°C - Release ignition button and check button OUT.

CAUTION

If the ignition button sticks, cut off battery and close fuel handle.

Note

Exhaust gas temperature must read 100°C more than EGT indication before starting the engines.

If Engine does not turn with Starter:

RECHECK:

Throttle - OFF.

CAUTION

Throttle has to be in the fully rear position (closed) to prevent disengagement of starter.

Circuit breaker - IN.

6. Starter switch at 5.000 RPM - NEUTRAL (light out).
7. After stabilization:

a. RPM - 6.500 min.

b. EGT - 450°C appr.

8. Throttle - 10.000 RPM.
9. Generator warning light - OUT.

a. Start with battery - 7.500 RPM appr.

b. Start with APU - If APU is disconnected.

10. Pitot heat - ON (light out).
11. Attitude indicator - Cage cautiously and switch ON.
12. Gyro-compass - ON, select "KREISELKOMPASS".
13. Radio main switch - BOTH (UHF). (For VHF equipped A/C - ON.)
14. Start right engine same as left engine.
15. Cabin pressure - ON (full warm, then back as desired).
16. Watch for Tiptank Pressure Check.

UNSUCCESSFUL STARTING ENGINE.

INDICATION: No increase of EGT after ten (10) seconds of ignition.

1. Ignition button - RELEASE.
2. Fuel handle - CLOSE.
3. Starter switch - NEUTRAL.
4. When engine stops - DRAIN.
5. After at least three (3) min. - RESTART.

AFTER STARTING ENGINES.

FRONT COCKPIT.

1. APU - Disconnected. (Recheck battery ON).

2. Speed brakes - IN.

3. Flaps - OUT-IN-15°.

4. Trim - -10 - +5 - 0.

5. Radio compass - LOOP, ANT, COMP (volume).

Note

Before switching to the COMP-position turn volume down.

6. Canopy - Closed (warning light OUT).

7. Voltmeter - 28,5 V ±0,5 V.

8. Hydraulic pressure - 250 HPZ. (Normal and emergency system).

9. Airspeed indicator - ZERO

CAUTION

If hydraulic pressure on either system is below 250 HPZ prior flight, do not take off.

10. Attitude indicator - SET and erected.

11. Compass - Synchronize (check against standby compass).

12. Vertical velocity indicator - ZERO.

13. Engine instruments - IN THE GREEN.

14. Altimeter - Set to field elevation. (Note difference of mb-reading.)

15. Clock - Set and running.

REAR COCKPIT (DUAL FLIGHTS).

1. Canopy - Closed (warning light OUT).

2. Airspeed indicator - ZERO.

3. Attitude indicator - Set and erected.

4. Compass - Check against standby compass.

5. Vertical velocity indicator - ZERO.

6. Engine instruments - IN THE GREEN.

7. Altimeter - Set to field elevation. (Note difference of mb-reading.)

8. Clock - Set and running.

TAXI CHECK.

The Fouga CM 170R is not equipped with nose wheel steering. The limit of nose wheel travel is thirty degrees either side of center. Any time turns are made, use the brakes only. The use of the rudder has no effect at normal taxi speed. Taxi time should be cut to an absolute minimum: Every minute on the ground requires approximately six liters of fuel with the engines at 10.000 RPM.

Wheel chocks - Removed.
Area in front of A/C - Clear.

1. Parking brake - Release.

2. Power - Advance to max. 15.000 RPM. Check throttle friction.

Note

Normal taxi power setting will be 10.000 RPM.

3. Brakes - Check before turning.

4. Flight instruments - Proper readings.

   a. Turn needle - Operating.

      (1) Ball - Free.

   b. Emergency turn needle - Operating.

      (1) Ball - Free.

      (2) Switch - OFF.

   c. Gyro-compass and standby compass - Proper movement and indication.

5. Flight controls - Check for proper movement.

6. Speed brakes - IN.

7. Flaps - Set at 15 degrees.

8. Trim - ZERO.

9. Cabin seal button - IN.

10. Oxygen - 100%.

11. Shoulder harness - Locked.

12. Warning lights - OUT.

13. Temperatures and pressures - NORMAL.

Note

During cold weather operation when oil temperature is below 20°C, do not exceed 15.000 RPM.

ENGINE RUN UP.

Aline the aircraft with the lane so that the nose wheel will be centered.

1. Brakes - HOLD.
2. Full power - 22.600 RPM.
3. EGT - 665°C max.
4. Temperatures and pressures - IN THE GREEN.
5. Gyro-compass - Check with runway direction.

TAKEOFF.

1. Brakes - Release.
2. Airspeed - 110 KIAS (safe airborne).

WARNING

If too much back pressure is applied, a too high pitch attitude results which materially extends takeoff roll, the takeoff speed is reduced, and the ability to remain airborne and accelerate to climb speed is doubtful.

CROSSWIND TAKEOFF.

Normal takeoff procedures are used for most crosswinds encountered. Hold sufficient aileron into the wind as the takeoff-roll is started to keep the wings level and maintain directional control. Hold the nose wheel on the ground until nose wheel lift-off speed is reached. When take-off speed is attained, make the pull-off definite to avoid side-skipping as the aircraft becomes airborne.

AFTER TAKEOFF.

1. Landing gear - Retract at a minimum of 11(KIAS. (Do not brake wheels).
2. Gear indicator lights - OUT.
3. Flaps - UP (min. 120 KIAS and 100 ft AGL).
4. Oxygen - NORMAL (1.000 ft AGL).

Note

- After takeoff from a wet-snow or slush covered runway, operate the landing gear and flaps, if practicable, through several complete cycles to prevent their freezing.
- After takeoff, climb straight ahead to a minimum altitude of 1.000 feet above terrain. Upon reaching this altitude, airspeed should be 200 KIAS.

CLIMB AND CRUISE.

CHECK PERIODICALLY (each 5.000 ft and after level-off)

1. H-ydraulic pressure - 250 HPZ.
2. E-lectric system - 28,5 V ± 0,5 V.
3. F-uel - Tip tanks feeding or fuel quantity.
4. O-xygen - Contents, blinker working.
5. E-ngine instruments - IN THE GREEN.

Note

Above 10.000 ft check cabin altimeter additionally.

Note

22.600 RPM is limited to fifteen (15) minutes operation. Then throttles back to 21.750 RPM. This engine speed is limited to thirty (30) minutes.

TYPICAL LANDING PATTERN

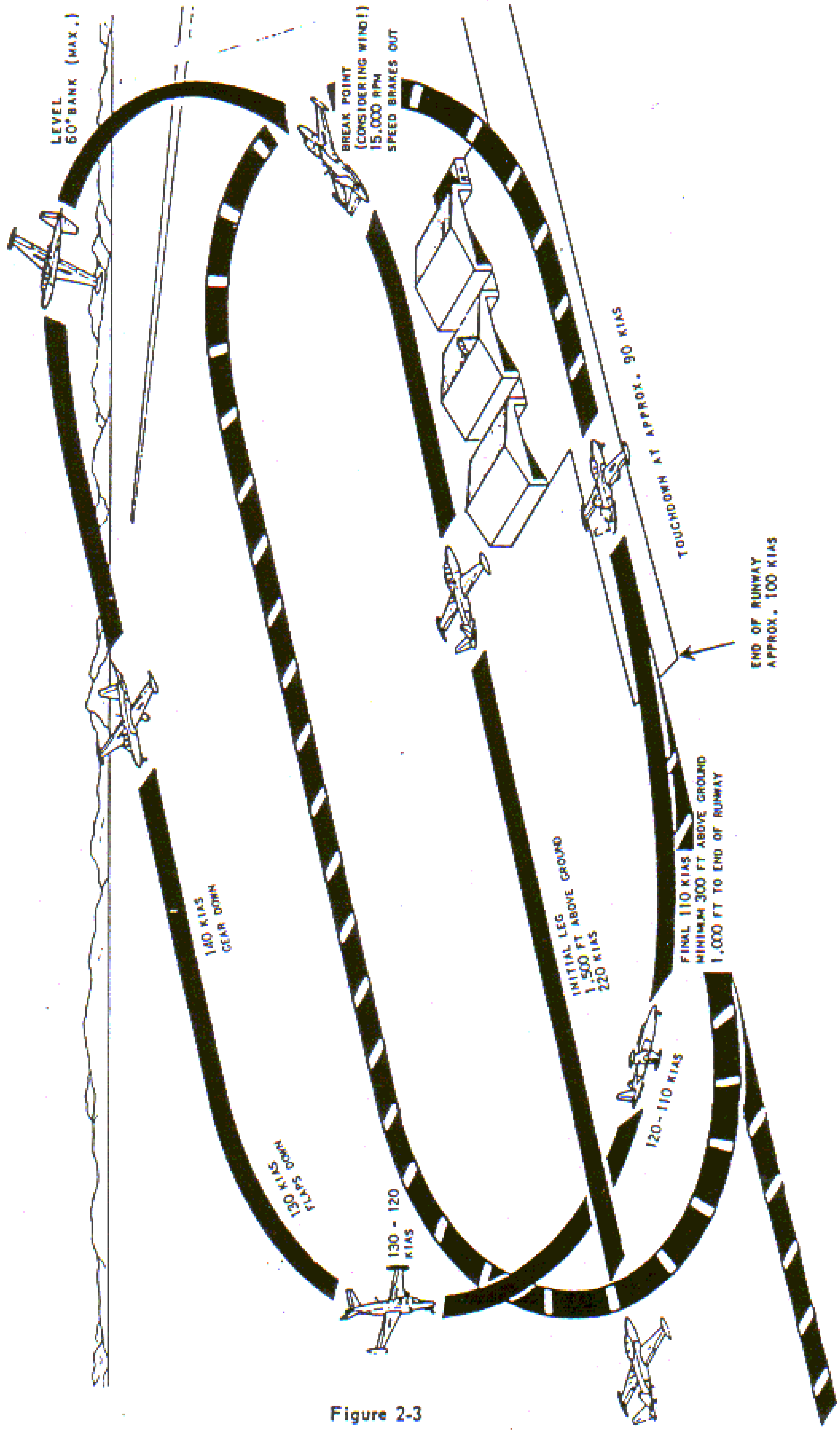


Figure 2-3

DESCENT.

For descent at the same or lower airspeed than used in straight-and-level flight, the power must be reduced as the descent is entered. In dives the power is left constant and the pitch attitude is adjusted to attain the desired airspeed.

BEFORE LANDING.

A 360° standard overhead landing pattern (as shown on figure 2-3) should be accomplished as follows:

1. HEFOE-Check - Perform.

Entry Leg.

The initial approach portion of the traffic pattern will be entered from a 45° angle. Watch for drift and make necessary correction so that the desired 45° track along the ground will be maintained. Refer to directional indicator to assist in correcting for known wind.

1. Airspeed - 220 KIAS.
2. Altitude - 1,500 ft AGL.
3. Power - Approx. 19,000 RPM.

The speed brakes may be used momentarily to dissipate excess airspeed, if necessary.

Initial.

The initial approach is made into wind 1,500 feet above terrain in the same direction as the landing runway. It begins at a point three nautical miles from the runway and terminates at the pitch point over the landing end of the runway. The turn from the entry to the initial approach should be at least a medium-banked turn with the rollout executed so that the ground track will be aligned with the center of the runway. The turn onto the initial approach will normally be in the same direction as the traffic pattern.

1. Airspeed - 220 KIAS.
2. Altitude - 1,500 ft AGL.

Break.

Over the approach end of the runway, roll smoothly into a bank of appr. 60°.

1. Throttles - 15,000 RPM.
2. Speed brakes - OUT.

Continue a level 180° turn to the downwind leg.

Note

A headwind will increase ground speed on the downwind leg, the pitchout turn should be started farther down the runway than for a calm wind. A tailwind has the reverse effect, so the pitchout should be started before reaching the runway.

Downwind.

When the airspeed is 140 KIAS on the downwind leg accomplish the following:

1. Landing gear - DOWN.
2. Flaps - DOWN at 130 KIAS.
3. Hydraulic pressure - Check.

Use power as necessary to maintain altitude and a minimum airspeed of 130 KIAS, if it is necessary to extend the downwind leg before starting the final turn.

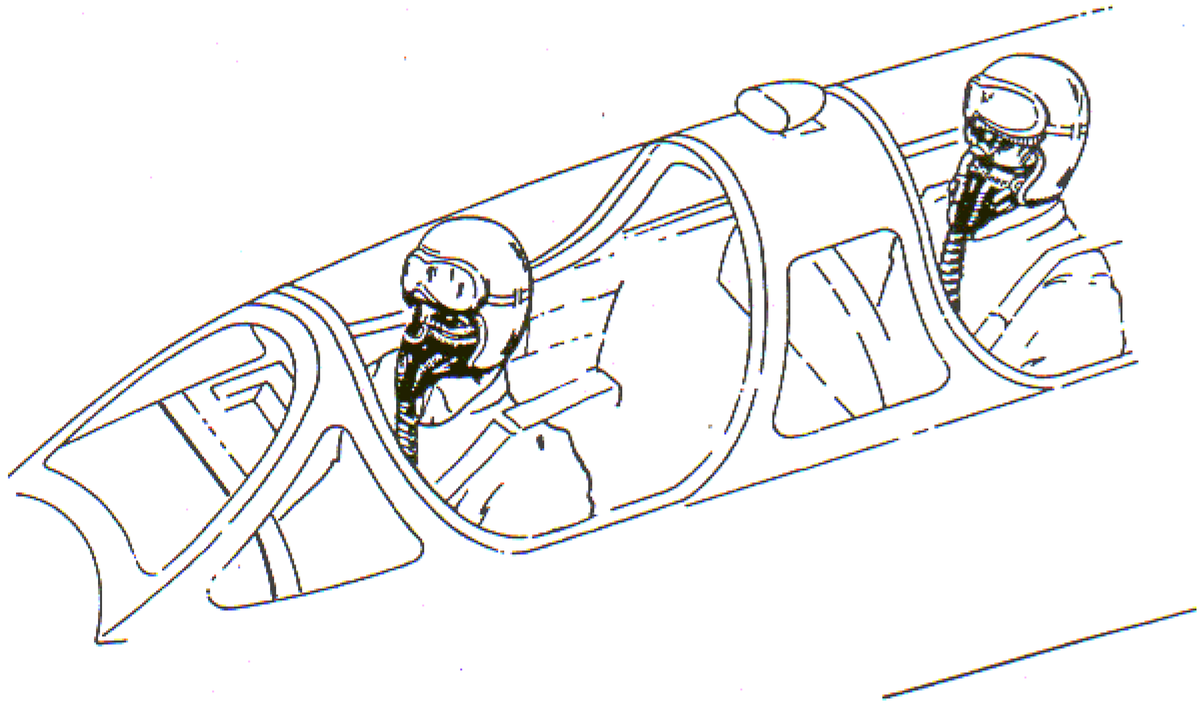
Base Leg - Final Turn.

During the 180° turn to final approach, the bank may be varied up to a maximum of 45° in order to rollout in line with the runway.

1. Airspeed - 130 - 120 KIAS.

Note

Gradually decrease airspeed during the final turn, using additional power, if required to adjust the rate of descent and maintain a circular flight path.



SECTION III EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION.

This section includes procedures to be followed to correct an emergency condition. The procedures, if followed, will ensure safety of the crew and airplane until a safe landing is made or other appropriate action is accomplished. Multiple emergencies, adverse weather, and other peculiar conditions may require modification of these procedures. Therefore, it is essential that aircrews determine the correct course of action by use of common sense and sound judgment.

Procedures appearing in bold face capital letters are considered critical. Procedures appearing in small letters are considered noncritical. Each is defined as follows:

CRITICAL. Those steps of procedures which must be performed immediately without reference to written checklists. These critical steps should be committed to memory.

NONCRITICAL. All other steps of procedure wherein there is time available to consult a checklist before attempting to alleviate an emergency condition.

To assist the pilot when an emergency occurs, three basic rules are established which apply to most emergencies occuring while airborne. They should be remembered by each aircrew member. The rules follow:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practicable.

GROUND STARTING FAILURE.

If an engine fails to start during ground start, shut off the fuel supply immediately. Allow the flow of air to continue for approximately 30 seconds, or until all traces of combustion disappear. Then investigate the cause of the failure to start before attempting another start.

ENGINE FAILURE.

WARNING

With one or both engines windmilling, 300 KTAS must not be exceeded to avoid structural damage.

The majority of jet engine flameouts are the result of improper fuel flow caused by a fuel system malfunction. The instruments will normally provide indications of fuel system failure prior to and during actual engine flameout. If flameout is caused by malfunction or mismanagement of the fuel system, and if time permits, an air start can usually be accomplished. If the failure is caused by an obvious mechanical failure within the engine, an air start should not be attempted. During partial power failure the engines should not be shut down unless the pilot finds he cannot maintain the exhaust gas temperature within limits. With partial power failure, it is easier to keep the engine running than to restart it.

ONE ENGINE FAILURE DURING TAKE-OFF.

The failure of one engine during take-off will result in a hardly noticeable yaw effect independent of the airspeed even if the operative engine runs at max. RPM. This yaw effect can easily be compensated by one-side braking until flight controls become effective, i.e. at 40 - 50 KIAS. Then use the rudder. Thus, in case of failure of one engine, the minimum control velocity (flight controls become effective) is of no importance for a successful take-off.

CAUTION

In case of puddles on the runway, water may be splashed up by the nose wheel and sucked into the air intakes causing flameout of one or both engines. If takeoff has to be continued (depending on remaining runway length, airspeed etc.) close fuel handle of corresponding engine, wait 2 minutes, and accomplish airstart.

DOUBLE ENGINE FAILURE DURING TAKE-OFF.

If complete power failure occurs during take-off: ABORT.

FLAT TIRE DURING TAKE-OFF.

The pilot will notice a skip to the side of the flat tire:

1. Take-off - ABORT IMMEDIATELY.
2. Throttle - OFF.
3. Wheel brakes - Apply brake of the intact wheel.
4. If the aircraft should skip off from the runway - CLOSE fuel handles immediately and switch off battery.

ENGINE FAILURE DURING GO-AROUND MANEUVERS.

A go-around maneuver with only one engine operative is very difficult because the aircraft accelerates very slowly with gear down and flaps and speed brakes extended. Therefore, do not extend wing flaps to more than 15°. Do not conduct final approach with the speed brakes extended.

Left Engine Inoperative.

1. Right engine - TO FULL POWER.
2. Speed brakes - IN.
3. If sufficient hydraulic pressure is left - RETRACT LANDING GEAR. (The landing gear has then to be extended by the emergency extension system.)
4. Wing flaps - RETRACT above 300 feet.

Right Engine Inoperative.

1. Left engine - TO FULL POWER.
2. Speed brakes - IN.
3. Landing gear - RETRACT.
4. Wing flaps - RETRACT above 300 feet.

In case of one engine inoperative, landing gear down and wing flaps extended to 15°, the aircraft will remain controllable. The optimum climb speed with one engine inoperative and wing flaps extended to 15° is 120 KIAS (500 feet/min.). The optimum climb speed with one engine inoperative and wing flaps retracted is 140 KIAS (1,000 feet/min.).

ONE ENGINE FAILURE DURING FLIGHT.

Note

The generator and the hydraulic pump are driven by the left engine. In case of failure of the left engine, extend landing gear and operate the speed brakes by means of the emergency system in order to conserve hydraulic and battery power.

Proceed as Follows:

1. Fuel handle - CLOSED.
2. Throttle - OFF.
3. Give EMERGENCY CALL.
4. Attempt AIRSTART.

The flight with one engine causes practically no yaw effect. A slight yaw effect has to be considered at high RPM and low airspeed only, i.e. in case of failure during take-off, go-around, and climb maneuvers. In these cases it can easily be compensated with the rudder pedals.

DOUBLE ENGINE FAILURE DURING FLIGHT.

1. Fuel handles - CLOSED.
2. Generator - OFF.
3. Give EMERGENCY CALL.
4. Attempt AIRSTART.
5. Oxygen diluter - 100%.
6. Landing gear - EXTEND (use emergency extension system).
7. Below 10,000 feet altitude - DEPRESSURIZE cabin.

RESTARTING ENGINES DURING FLIGHT.

If a flameout occurs that is not accompanied by fire, explosion, overheating, strong fuel fumes in the cockpit, heavy vibration, or other conditions indicating mechanical or materiel failure, an airstart should be successful. Engine flameout in flight is usually caused by one of the following conditions:

a. Pump failure.
b. Fuel supply system malfunction.
c. Filter stoppage etc.

Note

It is extremely important to conserve battery energy so that enough power will be available for the ignition, fuel transfer, radio operation, etc. If time permits, unnecessary electrical equipment should be turned OFF as soon as the flameout occurs.

AIRSTART.

CAUTION

- Do not use starter.
- Never try to restart a blocked engine.

Note

Best altitude for airstart is below 20,000 feet.

1. Fuel handle and throttle - CLOSED.

If left engine is inoperative:

2. Electrical load - REDUCE.
3. Airspeed - Appr. 120 KIAS.
4. RPM - 1000-1200.
5. Clock - ON (to check seconds for ignition).
6. Ignition button - PUSH.
7. Fuel handle - OPEN (SLOWLY).
8. Observe EGT and RPM - RISING within 30 seconds.
9. Above 300°C EGT - RELEASE IGNITION BUTTON.
10. Throttle - OPEN after stabilization of RPM.

Note

If EGT does not increase within 30 seconds, release ignition button and close fuel handle. Wait 2 - 3 minutes, descend to a lower altitude and try again.

GLIDE DISTANCES WITH DEAD ENGINES

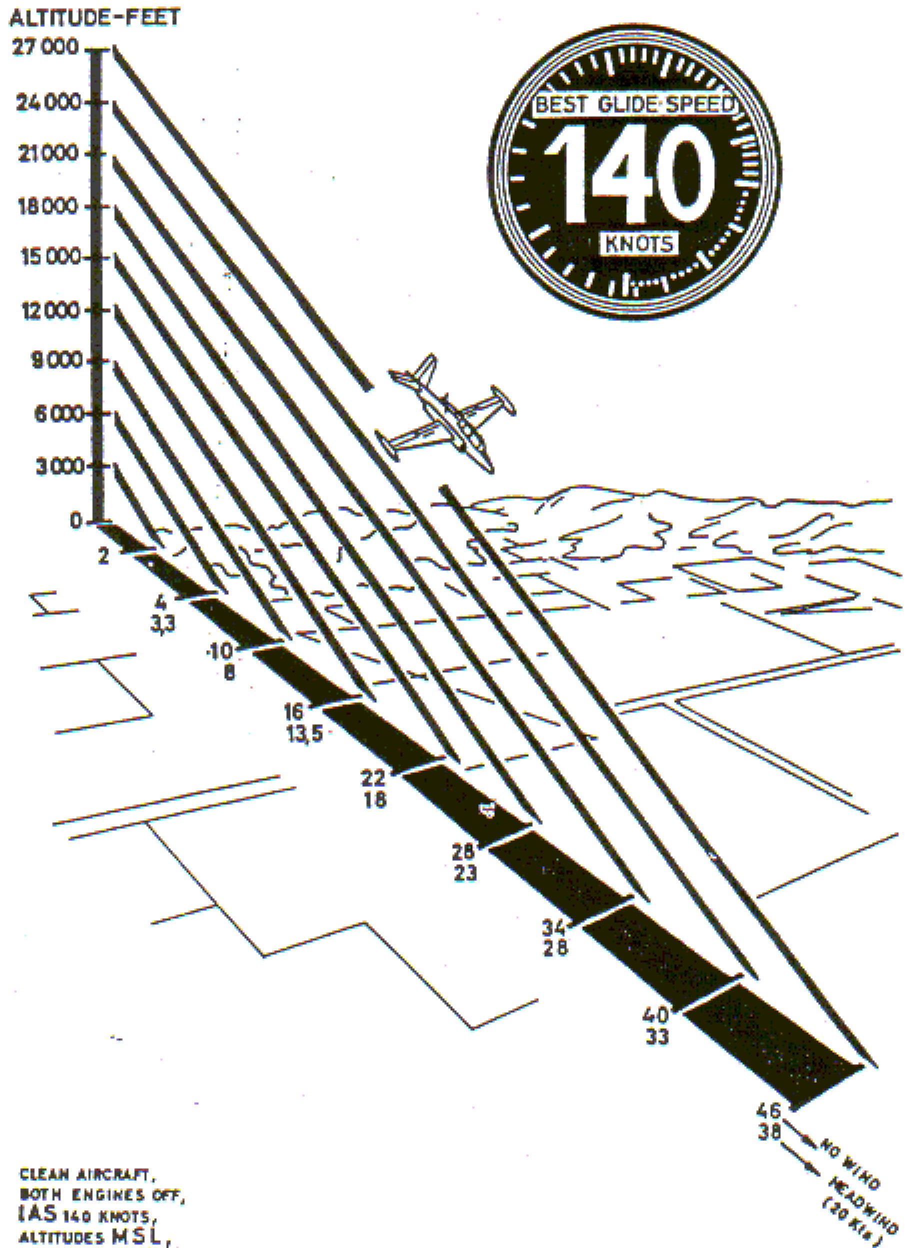


Figure 3-1

MAXIMUM GLIDE DISTANCES.

The flight characteristics of this airplane with dead engines are normal and rapid trim changes are not necessary. The recommended glide speed with a seized or windmilling engine is 140 KIAS. (See figure 3-1.) This speed should provide a windmill RPM of appr. 1000-1200 RPM which is sufficient for air starting. A glide speed of 140 KIAS is optimum for full fuel load. It is not necessary to change the glide speed according to fuel load. Glide ratio is approximately 13 : 1.

BAILING OUT VERSUS FORCED LANDING.

Because of the many variables encountered in an emergency, the decision to attempt a flameout landing or to bail out must remain with the pilot. It is impossible to establish a predetermined set of rules and instructions which would provide a ready-made decision applicable to all emergencies. The basic conditions listed below, combined with the pilot's analysis of the condition of the airplane, type of emergency, and his proficiency, are of prime importance in determining whether to attempt a flameout landing or to abandon the aircraft. These variables make a quick and accurate decision difficult. If the decision is made to bail out, the pilot should attempt to steer the airplane toward an area where the possibility of injury or damage to persons or property will minimized. Before decision is made to attempt a flameout landing, the following basic requirements should be considered:

a. The pilot has satisfactorily completed simulated flameout approaches in this airplane.

b. Flameout landings should only be attempted on a prepared or designated suitable surface.

c. Approaches to the runway are clear.

Note

No attempt should be made to land a flamed-out airplane at any field whose approaches are over heavily populated areas if a suitable area is available to abandon the airplane.

d. Weather and terrain conditions must be favorable and must not hamper the establishment of a proper flameout landing pattern.

Note

Flameout landings at night or under poor lighting conditions should not be contemplated regardless of weather or field lighting.

FORCED LANDING.

All forced landings should be made with the gear extended. However, if it should become necessary to land gear up, such as in engine failure on takeoff, the pilot must brace himself forward against the shoulder harness. With gear up, the aircraft will slide for some distance on the fuselage. When it stops, abandon the aircraft and stay at least 500 ft away. Whenever time permits get the gear down. The landing gear was built to withstand shocks. Tires can be replaced easily if blown out. A forced landing procedure is accomplished as follows:

1. Excessive speed - CONVERT TO ALTITUDE.
2. Select the next suitable field.
3. Airspeed - 140 KIAS.
4. Oxygen - 100%.
5. If altitude and time permit:
    a. Transmit on GUARD - MAYDAY.
    b. Give position report.
    c. Nature of emergency.
6. Attempt AIRSTART - DEPENDING ON ALTITUDE AND CIRCUMSTANCES.
7. Shoulder harness - LOCKED.

IF AIRSTART UNSUCCESSFUL:

8. Fuel handles - CLOSED.
9. Generator - OFF.
10. Cabin seal button - OFF (when below 10,000 feet).
11. Air vent - OPEN (when below 10,000 feet).
12. Tiptanks - EMPTY.
13. Try to establish a forced landing pattern.
14. Gear - DOWN (by emergency system) when field assured.
15. Hydraulic pressure - CHECK.
16. Flaps and speed brakes - AS REQUIRED.
17. Final:
    a. Battery - OFF.
    b. Speed - 110 KIAS (if flaps are lowered).
    c. Generator and fuel handles - RECHECK OFF.
    d. Canopy - Jettison (if leaving runway unintentionally).
18. Normal touchdown.
19. Emergency brake, if necessary.

Further airstarts may be attempted, if sufficient altitude remains and circumstances permit.

TYPICAL FORCED LANDING PATTERN

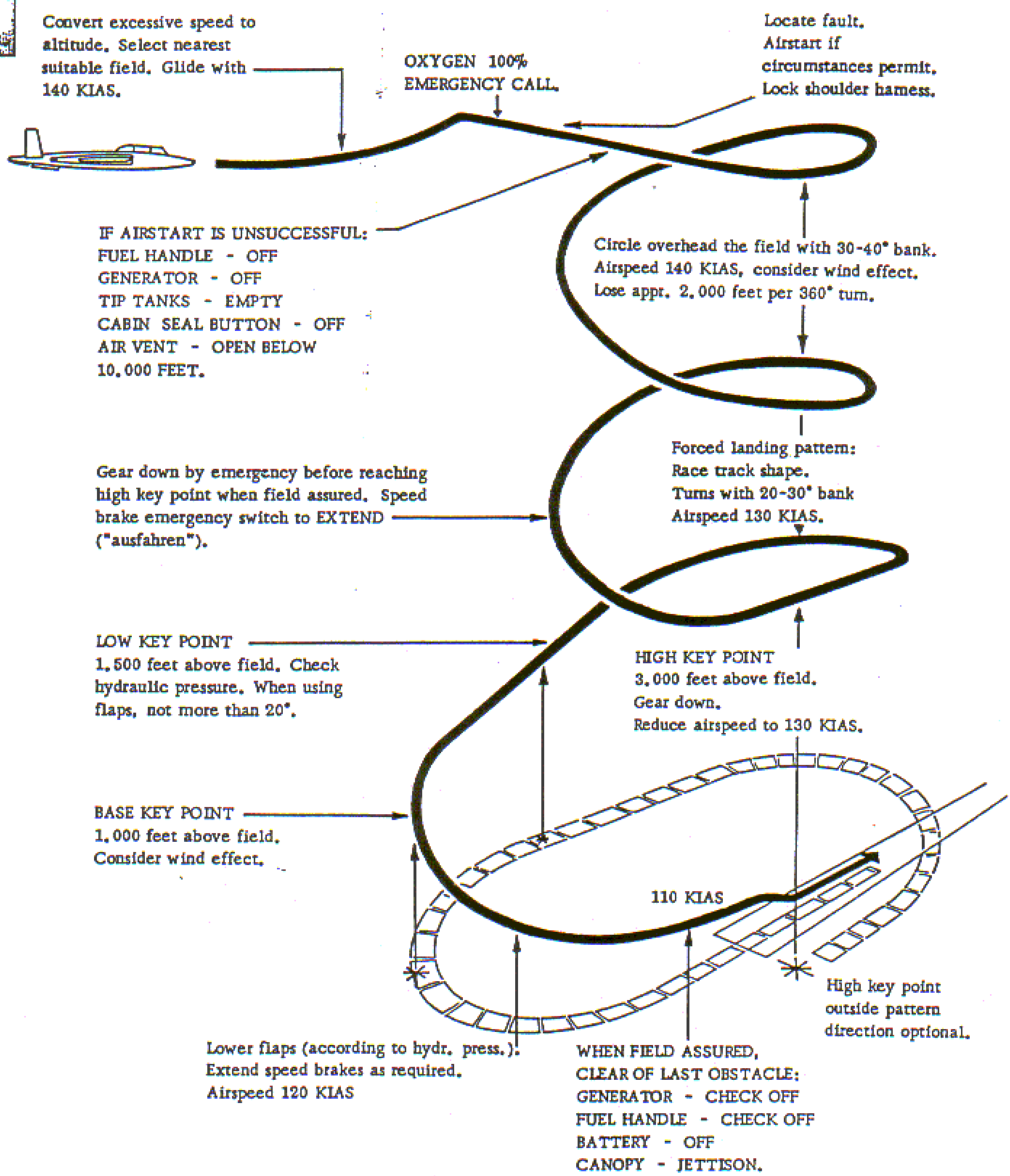


Figure 3-2

FIRE.

If the fire warning lights illuminate, check for presence of fire as follows:

a. Smoke in the cockpit.

b. Engine RPM loss.

c. Fluctuating fuel pressure and RPM.

d. Smoke trail behind the airplane.

Illumination of the warning lights generally results from the following:

a. Fire (generally located aft of the compressors).

b. A leaky tailpipe, tailcone, or connections.

c. Idling the engines for excessive periods when parked in a strong tailwind.

d. Improper isolation of, or a shorted warning light circuit.

Note

If the circuit is defective, remember that the wiring could have burned out from an existing fire.

e. Check for other indications of fire and land as soon as possible. If such a condition occurs before take-off, do not fly the airplane.

ON THE GROUND.

1. Fuel handles - CLOSE.
2. Battery - OFF.
3. ABANDON THE AIRCRAFT IMMEDIATELY.

DURING FLIGHT.

Fire warning light ON - EGT normal.

1. Throttle (affected engine) - IDLE.
2. Oxygen - 100%.
3. DIVE AIRCRAFT and CHECK FOR FIRE and SMOKE. If fire warning light goes out after 2 seconds and fire cannot be confirmed:
4. Throttle - RESET slowly.
5. Continuously check for fire - OBSERVE fire warning light and engine instruments.

IF FIRE WARNING LIGHT REMAINS ON:

6. Fuel handle - CLOSE.
7. LAND AS SOON AS POSSIBLE.

Fire warning light ON - EGT more than 675°C.

1. Fuel handle (affected engine) - CLOSE.
2. Oxygen - 100%.
3. CHECK FOR FIRE AND SMOKE.
4. Cabin pressure - OFF.
5. Cabin seal button - OFF.
6. Air vent - OPEN.
7. If fire persists - BAIL OUT.

IF FIRE DOES NOT COME FROM THE ENGINE:

8. Battery and generator - OFF.
9. Follow SMOKE IN COCKPIT-PROCEDURE.
10. If fire persists - BAIL OUT.

ELECTRICAL FIRE.

1. Battery and generator - OFF.
2. All circuit breakers - OUT.
3. If necessary:
   a. Oxygen - 100%.
   b. Cabin pressure - OFF.
   c. Cabin seal button - OFF.
   d. Air vent - OPEN.
   e. Canopy - JETTISON.
4. Battery and generator - ON.
5. Monitor voltmeter for low reading while turning units on one at a time.
6. Defective unit - OFF.
7. LAND AS SOON AS POSSIBLE.

SMOKE IN COCKPIT.

Smoke in the cockpit may be caused by oil that was spilled during the postflight or during maintenance or it may result from the oil filler cap coming off. This type of smoke is generally light grey or white and is no cause for immediate alarm. If there is smoke in the cockpit, proceed as follows:

Outlet of the heating system:

1. Turn cabin pressure switch to WARM, smoke (water vapor) will disappear.

IF SMOKING DOES NOT STOP:

2. CHECK fire warning light and EGT.
3. Cabin pressure - OFF.
4. Cabin seal button - OFF.
5. Air vent - OPEN.
6. LAND AS SOON AS POSSIBLE.
7. Canopy - JETTISON (if necessary).

Other sources:

Follow ELECTRICAL FIRE PROCEDURE.

WARNING

If smoke in the cockpit is caused by a short in the electrical wiring, turn all the electrical equipment OFF. Turn on the battery and generator switch. Turn on the electrically operated units one at a time and monitor the voltmeter until the malfunctioning unit, or system, is located. Isolate the unit from the electrical system and land as soon as possible.

BAIL OUT.

If the decision has been made to abandon the airplane in flight, escape should be made as follows:

1. If altitude and time permit:
   a. Transmit on GUARD - MAYDAY (3 times).
   b. Give position report.
   c. State nature of emergency.
2. Altitude - BELOW 20,000 feet, if possible.
3. Airspeed - REDUCE to 120 - 200 KIAS, if possible.
4. Aircraft - CLEAN, if time permits.
5. Trim - NOSE DOWN.
6. Personal equipment leads - DISCONNECT.
7. Helmet strap - TIGHT.
8. Visor - DOWN.
9. Canopy - JETTISON, HEAD DOWN. Unlock canopy, push canopy upwards, if necessary. The airflow will then open and free the canopies. The front canopy will be jettisoned first.

CAUTION

The canopies should be jettisoned below 200 KIAS. This airpseed makes it possible for the pilots to remain in the cockpits and to keep the aircraft under control for accomplishment of the necessary bail out procedure.

10. Harness - DISCONNECT.
11. Aircraft under control:
    a. Invert aircraft. Keep positive G-load until inverted, then quickly release stick and push free - HEAD DOWN.
       (1) For bail out above 14,000 feet - DELAY pulling D-RING until 14,000 feet are reached.
       (2) For bail out at low altitude - PULL D-RING as soon as clear of aircraft.
12. Aircraft out of control: (See figure 3-3.)
    a. The front pilot bails out first - underneath the wing.
       (1) Lean over the cockpit sill and keep as close contact with the fuselage as possible. When aircraft is in a turn, lean over inner canopy sill. In order to avoid contact with the wing, put feet on opposite canopy sill and push off as hard as possible downwards.
    b. The rear pilot bails out - over the wing. Same bail out procedure as for front cockpit, but lean over the air intake and try to glide over the wing. Push off with hands and feet.

BAIL OUT PROCEDURE

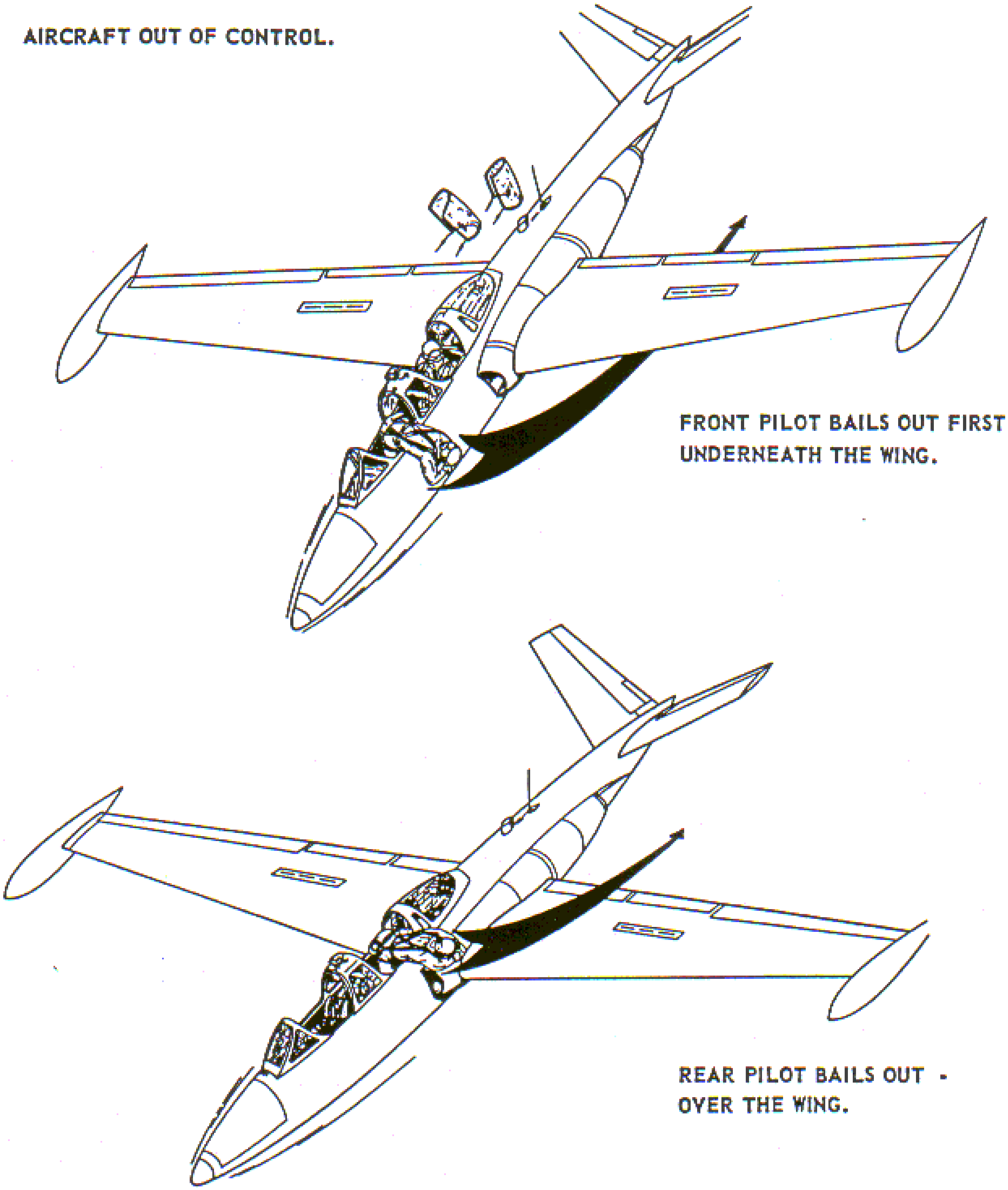


Figure 3-3

LANDING EMERGENCIES.

GEAR-UP BELLY LANDING PROCEDURE.

Before conducting a belly landing on prepared surfaces, notify the other occupant and ground agencies; then proceed as follows:

1. As the wing tip tanks are not jettisonable, make sure the tip tank fuel has been transferred. (Check fuel quantity indicator.) A belly landing with fuel in the tip tanks is a fire hazard and may result in an explosion.

CAUTION

In the event of a gear-up or belly landing, the canopies should be jettisoned before impact. This will prevent the canopies from becoming jammed.

2. Make sure shoulder harness is locked.

3. Extend wing flaps fully; speed brakes as required.

4. Carry out final approach at 110 KIAS. Do not apply extreme back pressure which will result in a severe impact of the nose on the ground.

5. Before contact with the ground, jettison canopy, close fuel handles, and switch off generator and battery.

ONE ENGINE INOPERATIVE.

Conduct a normal landing pattern and accomplish final approach as follows:

1. Landing gear - Extend.

2. Wing flaps - O° until landing is assured. Then wing flaps - OUT.

3. Speed brakes - OUT.

In case of failure of the left engine, extend landing gear and speed brakes by means of the emergency extension systems. Extend wing flaps and check remaining hydraulic pressure. With one engine inoperative, always accomplish a straight-in approach.

BOTH ENGINES INOPERATIVE.

A landing maneuver with both engines inoperative requires some precautions, but does not cause special difficulties:

1. Landing gear - Extend (with emergency extension system).

2. Wing flaps - Lower as required.

3. Speed brakes - As required (extension with the emergency system only.)

LANDING WITH DAMAGED AIRPLANE.

If structural damage occurs in flight, the pilot must decide whether to abandon the airplane or attempt a landing. If the airplane is flyable, simulate a landing pattern at a safe stall recovery altitude in order to determine whether the airplane is controllable at approach and landing speeds.

1. Climb - To a safe stall recovery altitude and simulate a landing approach.

2. Airspeed - Note the minimum controllable speed.

WARNING

Do not permit the airplane to stall. Recover immediately with nose down and with power when control becomes difficult, or at 100 KIAS, whichever occurs first.

3. Speed brakes, gear, and flaps - DOWN for descent to field.

4. Airspeed - 20 KIAS above minimum controllable speed during descent and in traffic pattern, but never less than 110 KIAS.

5. Traffic pattern - Fly a straight-in approach.

LANDING WITHOUT CANOPY.

If the canopy has come off or been jettisoned in flight, make a landing in the following manner:

1. Traffic pattern - Fly a straight-in approach 10 knots faster than normal.

2. Approach and landing - Make a flat approach and shallow flareout.

LANDING WITH FLAT TIRE.

If the nosewheel tire is flat, hold nosewheel off as long as possible. With a flat main gear tire, land on the side of the runway away from the flat. Lock the shoulder harness prior to touchdown.

AIRSPEED INDICATOR-OFF PATTERN.

In the event of airspeed indicator failure, perform the same procedures as for a straight-in approach. The time to decrease the airspeed to 140 KIAS from level flight with 18.500 RPM and clean aircraft by means of speed brakes and 15.000 RPM is 30 seconds. With a power setting of 18.500 RPM, gear down, flaps 15°, and speed brakes IN, the airspeed of 130 KIAS for level flight is assured. For descent, the extension of speed brakes and the vertical velocity of 800 - 1000 fpm will assure 130 KIAS, too. Start the normal descent as for a straight-in approach 3 NM from the end of the runway. If you get below the glide path due to a headwind or another reason, retract immediately the speed brakes and continue flying level until the proper glide path is reached again.

DITCHING.

Ditching is not recommended. If bail out cannot be accomplished and ditching is inevitable, proceed as follows:

1. Approach speed - 100 KIAS.
2. Wing flaps - to 15°.
3. Shoulder harness - Lock.
4. Personal leads - Disconnect.
5. Canopy - Jettison.

Select a heading parallel to the wave crests, if possible.

6. After the aircraft has come to a halt, get away from the wreck immediately.

HYDRAULIC SYSTEM FAILURE.

- If the hydraulic pressure is below 250 HPZ before flight, do not take off.
- If the hydraulic pressure is decreasing during flight, use emergency systems for gear lowering and speed brakes extension in order to save pressure for braking.
- If the hydraulic pressure on the normal system drops to 110 HPZ or on the emergency system (parking brake) to 90 HPZ, only one brake application is possible.

EMERGENCY LANDING GEAR EXTENSION.

Use the following procedure for emergency landing gear extension:

1. Airspeed - 140 KIAS.
2. Gear circuit breaker - OUT.
3. Landing gear system selector - EMERGENCY (red button IN).
4. Gear handle - DOWN.
5. Use hand pump.
6. Gear down and locked - Hand pump hard and CHECK INDICATION.

Note

When practicing emergency procedures in flight and the landing gear has been extended with the emergency system, wait two minutes before operating the landing gear through one cycle by means of the normal system before landing.

EMERGENCY SPEED BRAKE OPERATION.

In case of failure of the hydraulic system or flame-out of the left engine, the speed brakes can be operated with the emergency system. The manual hydraulic pump that delivers the necessary hydraulic pressure must be applied approximately seven times (increasing restistance will be noticed) to fully extend the speed brakes. In case of simultaneous extension of speed brakes and landing gear, the speed brakes will extend first.

Use the following procedure for emergency speed brake operation:

1. Speed brakes emergency switch - PROPER POSITION.
2. Use manual hydraulic pump.

WHEEL BRAKES MALFUNCTION.

In case of complete hydraulic pressure loss or in case of failure of one or both wheel brakes, use the parking brake as emergency brake. The parking brake is supplied by a separate hydraulic accumulator which allows about 25 parking brake applications. Proceed as follows:

Prop the thumb on the instrument panel (parking brake is installed in the front cockpit only) thus improving a gradual appliance of the parking brake. The parking brake operates on each wheel equally. Its effect is progressive but powerful.

If circumstances require retraction of the landing gear on the ground, depress the override push-button above the landing gear lever, then place the landing gear lever to the UP-position.

CAUTION

Electrical and hydraulic systems must be operating.

ELECTRICAL SYSTEM FAILURE.

Electrical system failure is evidenced by illumination of the generator-out warning light; zero or high voltmeter indications; failure of any or all of the electrical system components; overloaded circuits that have popped out their circuit breakers; and electrical failure.

Low voltmeter readings indicate an overloaded circuit which, if uncorrected, will eventually cause battery failure, battery burning, battery explosion, or complete electrical failure.

a. Overloading of voltmeter: (Voltage regulator inoperative

1. Generator - OFF.

2. Battery - ONLY LIMITED BATTERY CURRENT AVAILABLE, minimum use. The normal hydraulic system may be inoperative.

3. All electrical equipment not needed to sustain flight - OFF.

b. Voltmeter Zero:

1. All instruments operating, the voltmeter is inoperative.

2. All electrical equipment inoperative indicates complete electrical failure.

CAUTION

Normal hydraulic system for gear, flaps, and speed brakes inoperative too.

c. Generator inoperative, circuit changes automatically to battery and generator light comes ON:

1. Generator - SWITCH OFF.

d. Runway Trim:

1. Try to select trim by the elevator trim tab switch. When the trim indication passes the neutral position, pull out trim circuit breaker.

FUEL SYSTEM FAILURE.

If fuel system failure occurs, proceed as indicated in the following paragraphs.

BLOCKING OF ONE THROTTLE.

In case of blocking of one throttle the landing should be performed as follows:

1. Conduct normal approach.
2. Landing gear and wing flaps - Extend.
3. Fuel handle of respective engine - Close.
4. Conduct normal touchdown.

LINKAGE FAILURE OF ONE THROTTLE.

In this case the engine keeps a constant RPM because of the fuel control, i.e. 16,000 RPM at low altitudes. Conduct same landing procedure.

BOOSTER PUMP FAILURE.

Failure of the booster pump will not result in engine flame-out. The main function of this pump is to fill and refill the inverted flight reservoir. In case of failure of this pump, the inverted flight reservoir empties out. Boost pump failure is indicated by illumination of the fuel low pressure warning light. (Refer to Section I.)

WARNING

In case of illumination of the fuel low pressure warning light, do not accomplish inverted flight. In case the inverted flight reservoir becomes empty, the engines are no longer supplied with fuel and engine flame-out may occur.

STUCK FLOAT VALVE (OPEN).

In case of running engines, the fuel will escape through the vent outlet on bottom of the fuselage.

On the ground proceed as follows:

The fuel will drain on the ground. Shut down engines immediately.

During flight proceed as follows:

A siphon effect will suck the tip tank fuel into the fuselage tanks, indicating max. level on the fuel quantity gauge. This indication is the only possibility for the pilot to detect a malfunction of the float valve in the open-position:

1. Open dump valve of the tip tanks.
2. Return to base.

STUCK FLOAT VALVE (CLOSED).

In this case the fuel in the tip tanks cannot be transferred into the fuselage tanks. This malfunction is detected by the fuel quantity gauge not showing a constant fuel quantity of appr. 620 l during transfer of fuel from the tip tanks.

UNSYMMETRICAL TRANSFER.

It may happen that one tip tank empties out more rapidly than the other. Do not open dump valve but try to keep level flight until the transfer is finished.

TRANSFER FAILURE OF ONE TIP TANK.

A leaky filler neck or improper function of the air regulating valve may cause partial or complete fuel transfer failure from the tip tank into the fuselage tanks. Drain the fuel of the respective tip tank to regain balance. If the fuel cannot be drained, land with one full tip tank.

MALFUNCTION OF FUEL QUANTITY INDICATOR.

In case of malfunction of the fuel quantity indicator (loose contacts etc.) reduce flight duration.

OIL SYSTEM FAILURE.

In case of inconstant or zero indication (oil low pressure warning lights in rear cockpit illuminate) check oil temperature. If oil temperature remains constant, the pressure gauge is faulty and the flight may be continued with close surveillance of the temperature gauge.

In case of improper oil supply, the oil temperature will either rise or fall. Shut down the corresponding engine and land as soon as possible.

AIR CONDITIONING AND PRESSURIZATION SYSTEM MALFUNCTION.

CABIN PRESSURE TOO LOW.

If the indication of the cabin pressure altitude indicator in altitudes above 10.000 feet is higher than the indication of the altimeter, check the following:

1. Seals - Condition (inflated).
2. Fresh air inlets - Closed.
3. Switch the air conditioning and pressurization switch to "PRESS" or "DEGIVRAGE" (Defrosting).

If seals are inflated, fresh air inlets closed, and the air conditioning and pressurization switch in its respective position, the pressure regulator may be stuck in the open-position, causing air loss.

CABIN PRESSURE TOO HIGH.

In case of malfunction of the pressure regulator, the cabin pressure may rise excessively. Switch OFF pressurization or deflate seal in order to relieve pressure.

SMOKE IN COCKPIT.

In case of smoke development in the cockpit and pressurization ON, switch pressurization OFF and place the oxygen diluter to 100%. Neither deflate seals nor cabin pressure altitude indication. Pressure compensation will accelerate by descending to about 10.000 feet.

COCKPIT DE-ICING MALFUNCTION.

In case of cockpit de-icing malfunction, the air conditioning and pressurization switch remains in its selected position and cannot be switches to "DEGIVRAGE" (De-icing). In order to de-ice the cockpits (switch inoperative), descend to about 10.000 feet, deflate seals, and open fresh air inlets.

ICING OF THE PRESSURE COMPENSATING FABRIC BETWEEN AILERON AND WING.

Heavy rain on an airplane parked in the open may soak the fabric which is fastened between aileron and wing (pressure compensating fabric) and may cause blocking (icing) of the ailerons during climb. An exertion of to 2 to 3 kg on the control stick to the left and right will make the ailerons maneuverable again.

EXTERNAL STORES EMERGENCY JETTISON.

The tip tanks are not jettisonable. Open dump valves. Approximate time of draining the tip tanks: 4 minutes. When empty, close valves and reset switches to neutral.

BURST CANOPY.

Canopy burst may occur in high altitudes. The pilot will notice a heavy blow and icy cold. The vacuum pressure caused by the airspeed may cause heavy breathing and strong vibrations. Proceed as follows:

1. Decrease airspeed to less than 200 KIAS, extend speed brakes.

2. Set oxygen diluter to 100%, switch to "SECOURS" (emergency), if necessary.

3. Land as soon as possible. Do not exceed 200 KIAS.

Do not jettison a burst canopy. Actuate spoilers by pulling out the pin fastened on a chain on the front canopy sill.

WARNING

Move arm close to the head and along the side of the canopy where remainders of plexiglass are still in the canopy frame. The arm may be torn off by the airstream.

Conditions in the rear cockpit will be bearable up to 180 KIAS.

OXYGEN SYSTEM MALFUNCTION.

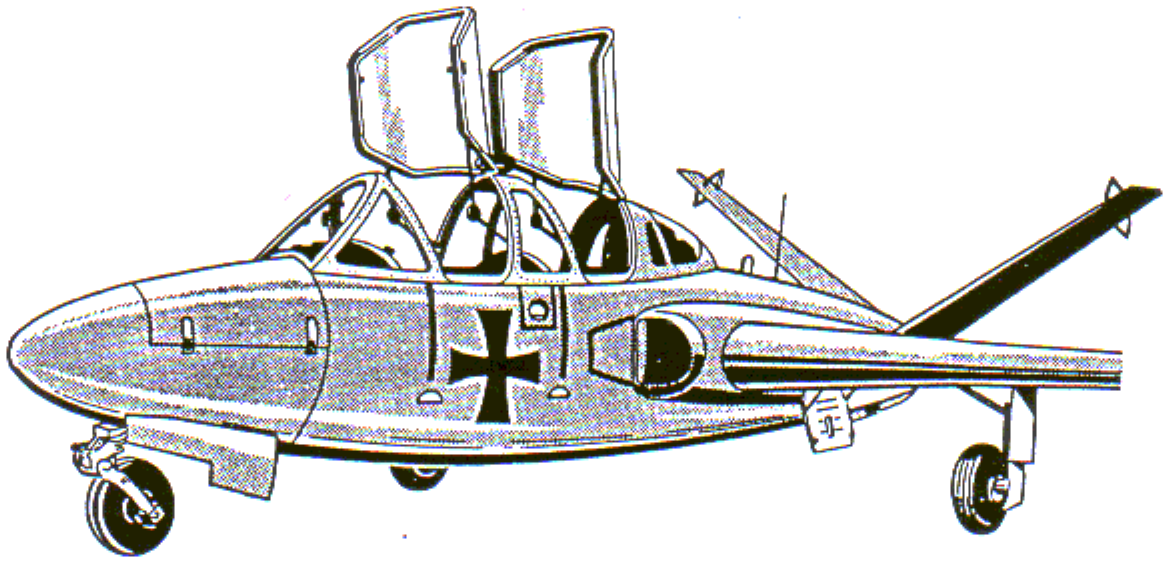
Switch oxygen diluter to 100% and descend until altimeter indicates 10,000 feet or less in case of:

1. Illumination of the red oxygen low pressure warning light.

2. Heavy breathing and indication of lack in oxygen pressure.

3. Decrease of oxygen pressure indication with each breath (filter clogged).

If the pilot does not feel better after switching the oxygen diluter to 100%, (blinker may be malfunctioning) switch to "SECOURS" (emergency supply) and descend to an altitude below 10,000 feet.



SECTION IV AUXILIARY EQUIPMENT

TABLE OF CONTENTS

AIR CONDITIONING AND PRESSURIZATION SYSTEM.

The cockpits are air conditioned and pressurized by air from the engine compressors as shown on figure 4-1. With one engine failing, air pressure is still available. Two check valves (one for each engine) are installed in the air ducts to prevent pressure from flowing back.

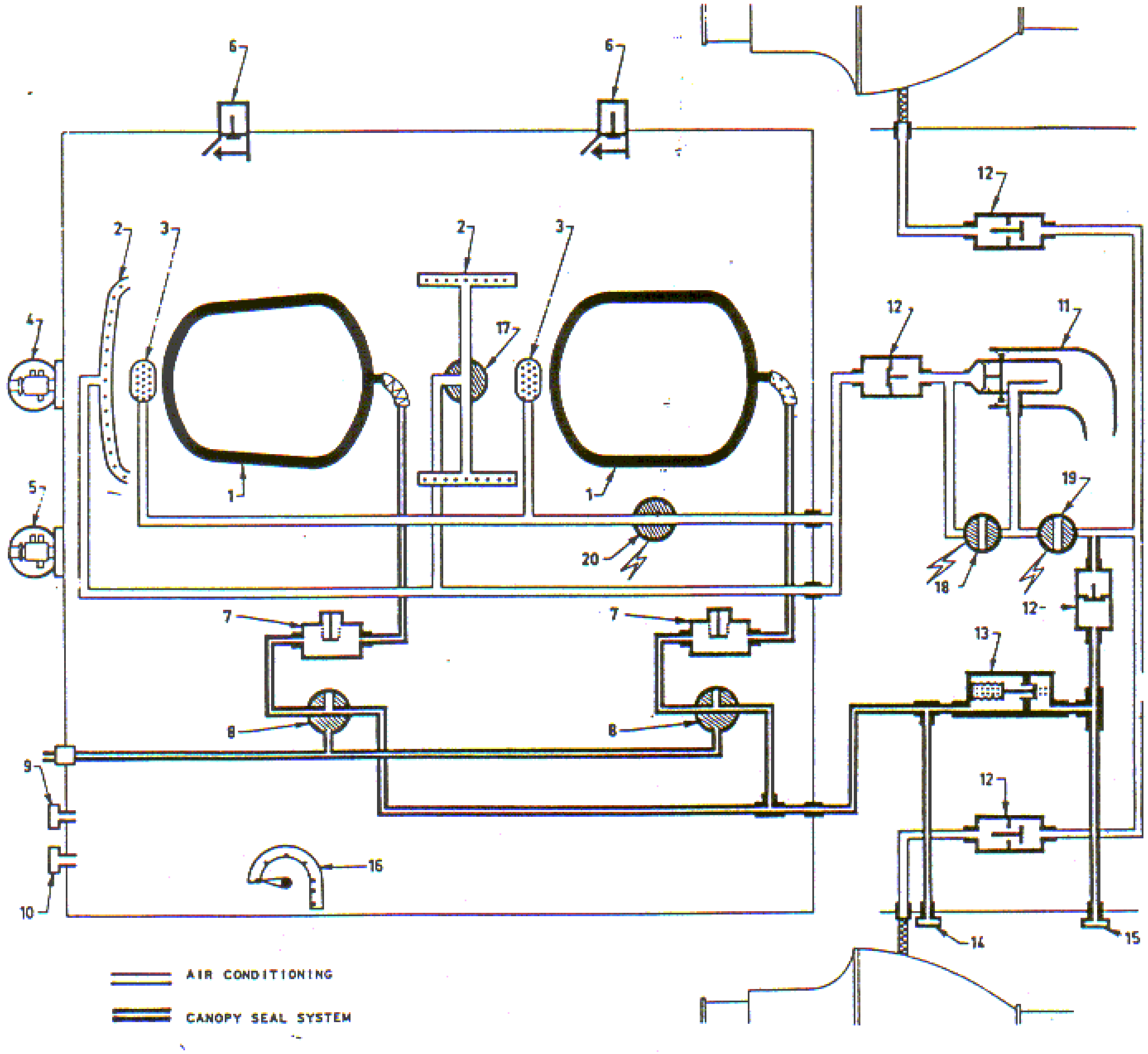
When the canopies are closed they are sealed by rubber seals inflated by the air system. Pressurizing air enters the cockpits through air inlets located between the rudder pedals, at the front and at the side windshields. Cabin pressure is maintained by a pressure regulator located in the nose section. A cabin pressure altitude indicator which indicates cabin pressure is located on the instrument panel in the forward cockpit.

Cabin temperature is regulated by the temperature regulating valve. This valve diverts a portion of the hot compressor air through a turbo cooler unit before entering the cockpits. The temperature regulating valve is controlled by the air conditioning and pressurization switch on the left console in the forward cockpit. The position of the temperature regulating valve is shown on the air conditioning indicator located on the left console in the forward cockpit next to the air conditioning and pressurization switch.

CANOPY SEALS.

The canopy seals are inflated by locking the canopies with the canopy locking handles provided that the buttons INFLATE (GONFL.) are depressed. The buttons DEFLATE (DEGONFL.) have to be depressed before

AIR SYSTEM



1 CANOPY SEAL
2 DEFROSTING OUTLETS
3 PRESSURIZED AIR OUTLETS
4 CABIN PRESSURE REGULATOR
5 PRESSURE RELIEF VALVE
6 FRESH AIR INLET
7 SAFETY VALVE
8 DISTRIBUTOR VALVE
9 GROUND CONNECTION - COCKPIT PRESSURIZATION
10 GROUND CONNECTION - CABIN PRESSURE INDICATOR
11 TURBO COOLER UNIT
12 CHECK VALVE
13 PRESSURE REDUCER VALVE
14 GROUND CONNECTION - MANOMETER (CANOPY SEAL)
15 GROUND CONNECTION - CANOPY SEAL INFLATION
16 AIR CONDITIONING AND PRESSURIZATION SWITCH
17 SIDE PANEL DEFROSTING VALVE
18 TEMPERATURE REGULATING VALVE
19 SHUT-OFF VALVE
20 TWO-WAY VALVE

Figure 4-1

unlocking the canopies. During flight the seals may be deflated below 10.000 feet for ventilation (fog, smoke, etc. in the cockpit).

WARNING

In case of solo flight, make sure the button INFLATE (GONFL.) in the rear cockpit is IN.

CABIN PRESSURE REGULATOR.

Cabin pressure differential is automatically maintained by the cabin pressure regulator. From sea level to 10.000 feet the cabin pressure equals the outside pressure; between 10.000 and 20.000 feet the cabin pressure maintains an equivalent altitude of 10.000 feet. Above 20.000 feet the cabin pressure differential is maintained at 235 g/cm^2 (3.3 PSI) above outside air pressure.

TEMPERATURE REGULATING VALVE.

A temperature regulating valve located in the fuselage diverts a portion of the compressor air through the turbo cooler unit to control cabin temperature. The temperature regulating valve is controlled by the air conditioning and pressurization switch on the left console in the front cockpit.

AIR CONDITIONING AND PRESSURIZATION SWITCH.

The air conditioning and pressurization switch (figure 4-2) on the left console in the front cockpit pressurizes the cockpits and controls cabin temperature and windshield defrosting. This switch has the following positions:

OFF (FERME = GESCHLOSSEN);
PRESSURE COLD (PRES FROID = DRUCK KALT);
PRESSURE (PRES = DRUCK);
PRESSURE HOT (PRES CHAUD = DRUCK WARM).

DEFROSTING (DEGIVRAGE = ENTEISUNG) with HOT (CHAUD = WARM) and COLD (FROID = KALT).

To pressurize the cabin this switch has to be placed to the PRESS. position first. To change the temperature in the cockpits, the pilot has to switch to either PRESS. HOT or PRESS. COLD position. This switch is spring-loaded, that means if the switch is released it returns to PRESS position and engages. The temperature regulating valve remains then in its new position until the temperature is changed again. The position of the valve is shown on the air conditioning indicator.

AIR CONDITIONING AND PRESSURIZATION SWITCH

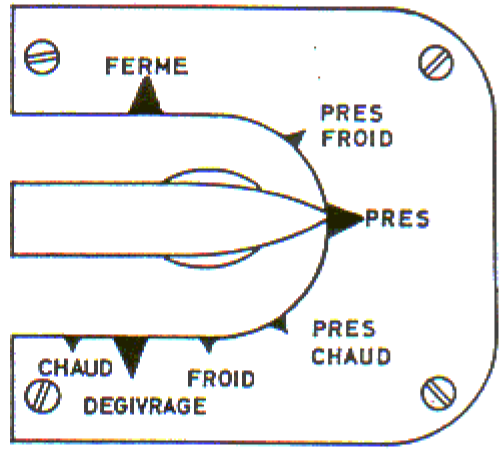


Figure 4-2

AIR CONDITIONING INDICATOR.

The air conditioning indicator (65, figure 1-4) is located on the left console in the forward cockpit next to the air conditioning and pressurization switch. The instrument indicates the last selected position of the temperature regulating valve.

FRESH AIR INLETS.

A fresh air inlet is installed above the right console in each cockpit (86, figure 1-5 and 53, figure 1-7) providing fresh air in the cockpits. The inlets should be opened in altitudes below 10.000 feet only.

WARNING

- In altitudes above 10.000 feet the fresh air inlets must be closed.
- In case of solo flight the fresh air inlet in the rear cockpit must be closed.

WINDSHIELD DEFROSTING.

Air for defrosting the windshields is bled from the engine compressors through tubes. Placing the air conditioning and pressurization switch in the position DEFROSTING (DEGIVRAGE = ENTEISUNG) all air is directed to the slotted defrosting tubes on the front and side windshields without any supply of air to the air inlets located between the rudder pedals. To shut off the air inlet in the rear cockpit a cock is provided on the rear instrument panel.

OUTER WINDSHIELD DEFROSTING.

The necessary isopropyl alcohol for the outer windshield defrosting is contained in a reservoir with a capacity of appr. 1,5 l. (See figure 1-19.) The reservoir is installed in the nose section of the aircraft. Fluid is sprayed out on the outer windshield by a pump located above the instrument panel in the front cockpit (7, figure 1-3) allowing appr. 65 pump storkes. In order to use the pump, unlock the pump by turning the grip.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT (UHF CONFIGURATION).

The communications and associated electronic equipment installed in the airplane are listed in six categories: type, designation, function, primary operator, range, and the location of the controls. (See figure 4-3.)

MICROPHONE AND HEADSET CONNECTIONS.

The microphone and headset connections are located on the right side in the forward (91, figure 1-5) and rear cockpit (56, figure 1-7).

Microphone Button.

A microphone button is installed on each control stick. It is used to control the transmitter of the AN/ARC-34 UHF command radio.

TEAM IV-T-3 INTERPHONE.

The TEAM IV-T-3 interphone system consists of the BH-554 terminal box with amplifier and two C-553 control units in the forward and rear cockpit. The equipment permits intercommunications of the crew, modulation and monitoring of the ARC-34 command radio, and monitoring of the ADF-100 radio compass.

C-553 INTERPHONE CONTROL UNIT.

The control units (figure 4-4) are located on the forward right console and on the rear cockpit instrument panel. The system is switched on by the TELEPHONE switch on the forward right console. When operating the entire communication system, this switch must always be in the ON position. A mode selector switch with the positions N (normal) and H (emergency), and three (BT, UHF, and FK) potentiometers are located on the front panel of each control unit. These controls provide for the following operation modes:

1. Intercommunications of the crew without actuating any switch. It is only necessary to select the desired audio volume on the BT (interphone) potentiometer of each control unit.

2. With the mode selector switch (position N) in UHF position, the transmitter of the ARC-34 is used by that crew member who actuates the microphone button on the control stick.

In this position the rear cockpit control unit has priority, i.e. if both control units are ready for communications over the ARC-34 command radio when placed in the UHF ("N") position, the rear cockpit microphone button automatically overrides the forward cockpit channel. For monitoring ARC-34 reception, the desired audio volume can be selected on each control unit by adjusting the respective UHF-potentiometer.

3. Using the FK (radio compass)-potentiometer, the incoming signals of the ADF-100 can be fed to the headsets.

4. A TELEF RUF (interphone call)-button located on the rear cockpit instrument panel provides for communications with the forward cockpit even then when the BT-potentiometer of the forward cockpit is turned off.

The amplifier installed in the control unit permits mixing of the three audio channels: BT, UHF, and FK. If the amplifier and (or) the transmitting relay in the control unit fail, pilots intercommunications and reception of ARC-34 and ADF-100 signals are possible by switching the mode selector switch to "H" (emer-

TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT
(UHF EQUIPMENT)

Type	Designation	Function	Operator	Range	Location of Controls
UHF Command Radio	AN/ARC 34	Two-way voice communication	Either crew member	Line-of-sight	Right hand console front and rear cockpit
Interphone	TEAM IV-T-3	Intercommunications of the crew	Either crew member	Crew station within aircraft	Right hand console front cockpit. Instrument panel rear cockpit
Radio Compass	LEAR ADF-100	Reception of voice and coded signals for direction finding and bearing	Either crew member	Line-of-sight	Right hand console front and rear cockpit

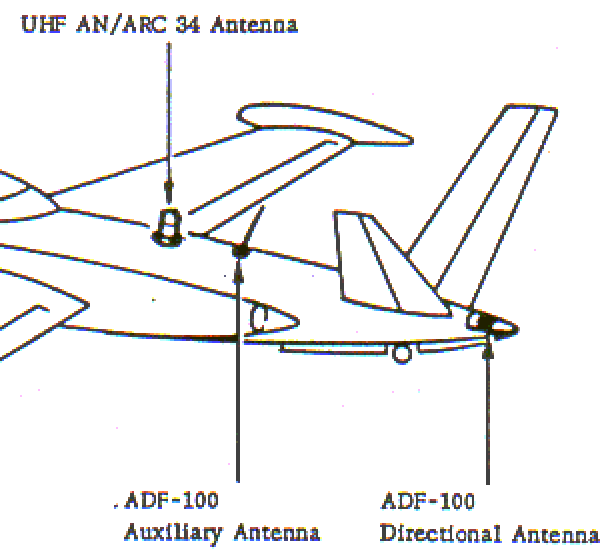


Figure 4-3

C-553 INTERPHONE CONTROL UNIT

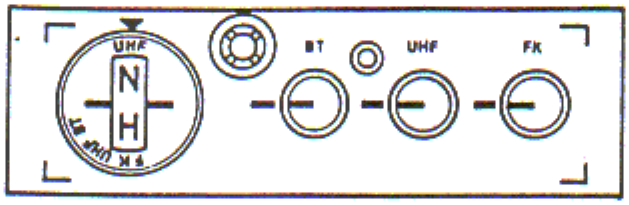


Figure 4-4

gency) position. Mixing of the individual audio channels is impossible, however. Only audio volume of the unit in operation can be controlled. Priority of the rear cockpit continues existing. The TELEF RUF (interphone call)-button is out of operation.

AN/ARC-34 UHF COMMAND RADIO.

The AN/ARC-34 UHF command radio provides voice transmission and reception in the UHF frequency range. This range permits a frequency for each one-tenth of a megacyle from 225.0 through 399.9 megacycles, resulting in 1750 possible frequencies. Any of the 1750 frequencies may be preset on a channel selector to facilitate immediate use. In addition, any one of the remaining frequencies may be set up manually without disturbing the preset frequencies. Receiver and transmitter tuning is automatically accomplished after a channel or frequency change. In addition to the main receiver a separate, fixed-tuned guard receiver with a frequency of 243 megacycles is installed to provide a constantly alerted emergency channel.

C-1057/ARC-34 CONTROL UNIT.

The control unit (figure 4-5) is located on the right console in the forward and rear cockpit. On the front panel of the control unit the following controls and indicators are installed.

Manual Frequency Selector Knobs.

Four manual frequency selector knobs are provided across the top of the panel to set up any desired operating frequency which is not preset on the channel selector. From left to right the first knob selects the

C-1057/ARC-34 CONTROL UNIT

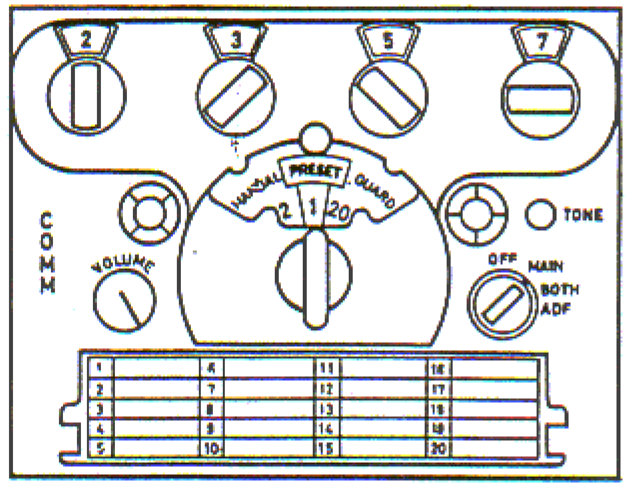


Figure 4-5

proper number for hundreds of megacycles, the second knob selects tens of megacycles, the third knob selects units of megacycles, and the fourth knob selects tenths of megacycles. These numbers appear in a window above their respective knobs and any frequency in the UHF band can be selected manually.

CAUTION

If a frequency below 225 megacycles is set up with the manual frequency selector knob while the set is in operation, the set must be turned OFF immediately. A frequency above 225 megacycles must be reset and then, after about 10 seconds, the unit can be switched ON again.

Mode Switch.

The mode switch selects the method of frequency selection. When the switch is in the MANUAL position, operation on the frequency selected by the manual frequency selector knobs is permitted. The PRESET position permits use of the channel selector for operation on any of the 20 preset frequencies. When the switch is in the GUARD position, the transmitter and main receiver are automatically adjusted to the emergency frequency of 243 megacycles. Transmission and reception are possible on this frequency only. When the main receiver is still operative, the function switch must be set to MAIN. If the main receiver is inoperative and the emergency frequency must be used,

ADF-100 RADIO COMPASS MODEL 5456 CONTROL UNIT

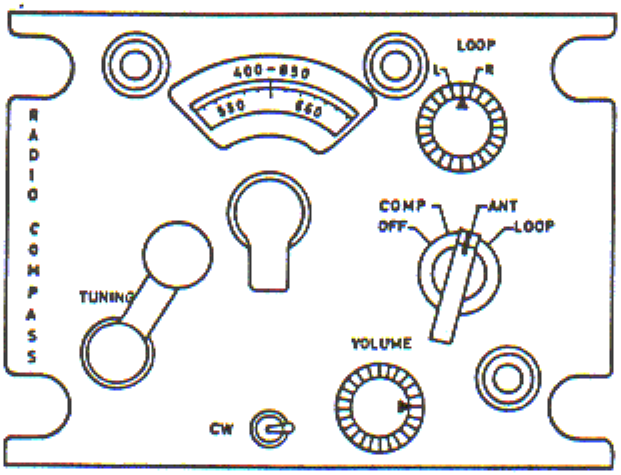


Figure 4-6

Volume Control.

Volume control is effective with the function switch in ANT position only. General audio volume of the radio compass is controlled by the FK control on the C-553 interphone control unit.

CW Switch.

With the switch in CW position, unmodulated signals are made audible by a beat note. When the receiver is not properly tuned, the beat note produces a whistling tone. The higher the frequency of this tone is the more the set frequency of the receiver deviates from that of the transmitter to be received. Therefore tuning accuracy effects that the beat note is no longer audible (zero beat). In this position the unit is properly tuned to the transmitter. After tuning is accomplished, place CW switch to OFF to avoid erroneous compass indication.

Band Switch.

The band switch is used to select the frequency bands listed in the ADF-100 radio compass paragraph.

Tuning Crank.

The tuning crank is used for frequency selection in accordance with a scale calibrated in kc/s. The crank is mechanically connected to the receiver by a flexible shaft. The two ADF-100 radio compass control units are coupled to each other through a T-gear. When tuning the receiver, it is imperative to pay attention to the following: Due to the length of the flexible shaft, rotation of the shaft may lead to mechanical spring tension resulting in tuning changes after a certain time, that may cause an erroneous radio compass indication. To take off any tension from the tuning shaft, it is recommended to select the desired transmitter by rotating the tuning crank to the left and to the right.

Control shift switches for ADF-100 and ARC-34

A control shift switch (pushbutton) for ADF-100 and one for ARC-34 located on the right console of each cockpit, are used to transfer control of either the ARC-34 or ADF-100 from one cockpit to the other. Changeover is actuated by one each changeover relay for ARC-34 and ADF-100. After deenergizing the electrical power supply system the forward cockpit has control of both the ARC-34 and ADF-100 equipment.

RADIO LIGHTING.

All control units of the communication system are provided with a floodlight system. Brightness is controlled by a rheostat labeled "BEL. RADIO" (radio lighting) installed on the right console of the forward cockpit.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT (VHF CONFIGURATION).

The communications and associated electronic equipment installed in the airplane are listed in six categories: type, designation, function, primary operator, range, and the location of the controls. (See figure 4-7.)

TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT (VHF EQUIPMENT)

Type	Designation	Use	Operator	Range	Location of Controls
VHF Command Radio	SARAM 5-52 VHF1 Command radio	Two-way voice communication	Forward crew member only	Line-of-sight	Right hand console front cockpit
Emergency VHF Command Radio	LMT/TRAP 1A VHF2 Command Radio	Two-way emergency voice communication	Forward crew member only	Line-of-sight	Right hand console front cockpit
Interphone	TEAM TF-AP-4A Interphone	Intercommunications of the crew	Either crew member	Crew stations within aircraft	Right hand console front cockpit. Instruments panel rear cockpit
Radio Compass	NR-AG-2A	Reception of voice and coded signals for direction finding and bearing	Forward crew member only	Line-of-sight	Right hand console front cockpit

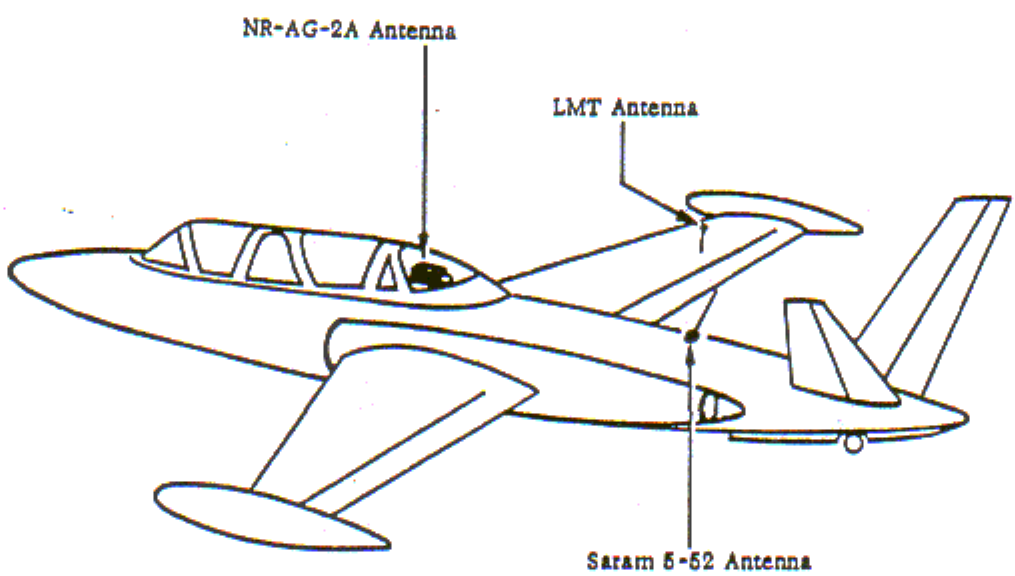


Figure 4-7

MICROPHONE AND HEADSET CONNECTIONS.

The microphone and headset connections are located on the right side of the forward and rear cockpit.

Microphone Button.

A microphone button is installed on each control stick. It is used to control the transmitter of the VHF1 "SARAM 5-52" and the VHF2 "LMT/TRAP 1A" command radio.

TEAM TF-AP-4A INTERPHONE.

The TEAM TF-AP-4A interphone system consists of the BJ-35A terminal box, electrical power supply with the BA-55A amplifier, and two KR-30-A control units. The equipment permits intercommunications of the crew, modulation and monitoring of the VHF1 and VHF2 command radio, and monitoring of the NR-AG-2A radio compass.

KR-30-A INTERPHONE CONTROL UNIT.

The control units (figure 4-8) are located on the forward right console and the rear cockpit instrument panel. The system is switched on by the TELEPHONE switch on the forward right console. When operating the entire communication system, this switch must always be in the ON position. Four potentiometers (VHF1, VHF2, RC, T.B.), a rotary switch for SARAM 5-52-LMT ("EMISSION"), and a rotary switch NORMAL-EMERGENCY operation ("SECOURS") are located on the front panel. These controls provide for the following operation modes:

NORMAL OPERATION: The emergency operation switch ("SECOURS") is in NORMAL position. (The two triangles are opposite each other.)

1. Intercommunications of the crew without actuating any switch. It is only necessary to select the desired audio volume on the T.B. (interphone)-potentiometer of each control unit.

2. With the transmitter switch ("EMISSION") select the desired transmitter (VHF1, VHF2). The transmitter is used by that crew member who actuates the microphone button on the control stick. In this position the rear cockpit control unit has priority, i.e. if both pilots want to transmit on the same VHF set simultaneously, depressing the microphone button on the

KR-30-A INTERPHONE CONTROL UNIT

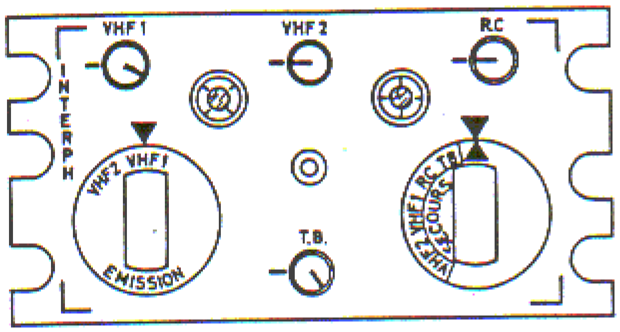


Figure 4-8

aft control stick automatically interrupts transmission in the forward cockpit, provided the emergency operation switch is in NORMAL. For monitoring reception, the desired audio volume may be selected on each control unit by adjusting the potentiometer of the selected unit.

3. Using the RC (radio compass)-potentiometer, audio volume of the radio compass may be controlled on each control unit.

4. A red APPEL TELEPHONE (interphone call) button located on the rear cockpit instrument panel provides for communications with the forward cockpit even then when the T.B. (interphone) -potentiometer of the forward cockpit is turned off.

The (VHF1, VHF2, RC, T.B.) audio channels may be mixed in any combination. To switch off a channel the corresponding potentiometer must be set to ZERO, i. e. the potentiometer must be rotated in the lefthand direction to the stop.

EMERGENCY OPERATION: If the amplifier and (or) the transmitting relay in the control unit fail, pilots intercommunications and reception of radio signals are provided by switching the emergency operation switch ("SECOURS") to the correspondingly marked position (VHF2, VHF1, RC, T.B.). Mixing of the individual signals is no longer possible. Only audio volume of the unit in operation may be controlled. The rotary switch ("EMISSION") is out of operation and the interphone call button is not functional.

SARAM 5-52 CONTROL UNIT

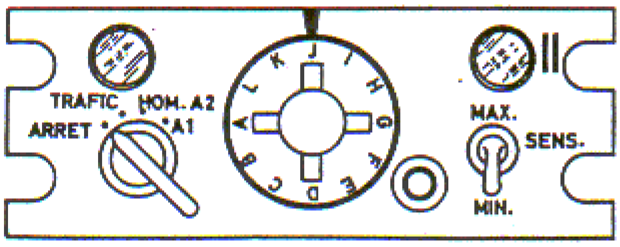


Figure 4-9

LMT CONTROL UNIT

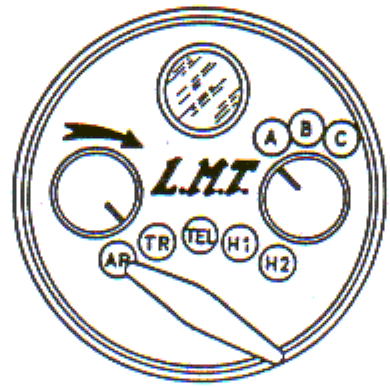


Figure 4-10

SARAM 5-52 VHF1 COMMAND RADIO.

The SARAM 5-52 VHF1 command radio provides voice transmission and reception in the VHF frequency range of 100 - 160 megacycles. Within this range, twelve different preset frequencies may be selected with a rotary switch. Receiver and transmitter tuning is accomplished automatically.

SARAM 5-52 CONTROL UNIT.

The control unit (figure 4-9) is located on the right console in the forward cockpit. On the front panel of the control unit the following controls and indicators are installed.

Channel Selector.

The rotary channel selector provides selection of any one of the twelve frequencies. The scale of the control unit is marked with the letters A through L for selecting the twelve frequencies. Tuning of the individual frequencies is accomplished automatically (approximate time: 6-8 seconds).

Signal Light.

During frequency selection the signal light goes out and illuminates again when the unit is adjusted to the selected frequency and is ready for operation. Brightness of the signal light may be controlled by rotating the outer ring of the control.

Function Switch.

The function switch selects the following positions.

ARRET. (OFF) - For deenergizing the equipment.

TRAFIC (ON) - For energizing the equipment.

HOM. A2 and HOM. A1 - These positions are not functional.

Sensitivity Switch.

This switch is used to control the noise suppressor. The switch is usually set to "MIN". This position assures a noiseless reception (noise suppressor is switched on). In the event of poor reception, the switch must be set to "MAX". The noise will be louder, however (noise suppressor is switched off). The "VHF1" potentiometer on the interphone system control unit is used to control audio volume of reception.

LMT/TRAP 1A VHF2 COMMAND RADIO.

The LMT/TRAP 1A VHF2 command radio is used for emergency operation. It operates in the frequency range of 116-126 megacycles. Within this range, three preset frequencies may be selected. The equipment may also be used as emergency interphone system.

LMT CONTROL UNIT.

The control unit (figure 4-10) is located on the right console in the forward cockpit. On the front panel of the control unit the following controls and indicators are installed.

Channel Selector.

The channel selector has three positions (A, B, C) and provides selection of any one of the three preset frequencies.

Function Switch.

The function switch selects the following positions:

AR (OFF) - For deenergizing the equipment.

TR (ON) - For energizing the equipment.

TEL - This position is used for providing pilots intercommunications in the event the normal interphone system has failed.

H1 and H2 - These positions are not functional.

Volume Control.

The volume control may remain in MAX. position. Audio volume is then controlled by the VHF2-potentiometer on the interphone control unit.

Indicating Light.

The green light illuminates when the equipment is energized. Brightness may be controlled.

NR-AG-2A RADIO COMPASS.

The NR-AG-2A radio compass is a superheterodyne receiver indicating the direction of a received signal on the radio compass indicator. Reception may be audibly monitored through the interphone system control unit. The compass operates in the frequency range of 0, 15 - 2, 0 megacycles subdivided into four ranges: 0, 15 - 0, 30 megacycles; 0, 30 - 0, 58 megacycles; 0, 58 - 1, 10 megacycles; 1, 10 - 2, 00 megacycles. The radio compass indicators are located on the instrument panels of the forward and rear cockpit.

RADIO COMPASS CONTROL UNIT

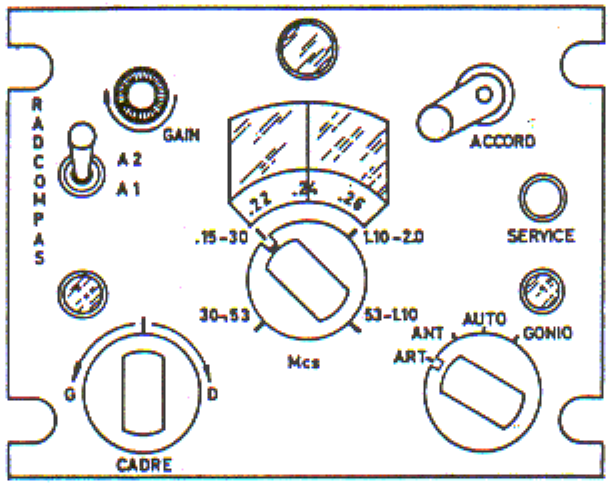


Figure 4-11

RADIO COMPASS CONTROL UNIT.

The control unit (figure 4-11) located on the right console in the forward cockpit has the following controls and indicators.

Function Switch.

The function switch selects the following positions:

ART (OFF) - For deenergizing the equipment.

ANT - The compass is operating as a receiver without direction indication. This position is used for searching and identifying the transmitting stations.

AUTO - The compass function as an automatic direction finder.

GONIO (LOOP) - The unit is operating as minimum direction finder with manual control of the directional antenna by use of the loop left-right switch (CADRE).

Band Switch.

The band switch is used to select the frequency bands listed in the radio compass paragraph.

Tuning Crank.

The tuning crank is used for frequency selection in accordance with a scale calibrated in megacycles.

CW Switch.

The CW switch is used as tuning aid. The switch has the positions A1 and A2. When the receiver is not properly tuned, the beat note produces a whistling tone. The higher the frequency of this tone is the more the set frequency of the receiver deviates from that of the transmitter to be received. Therefore tuning accuracy effects that the beat note is no longer audible (zero beat). In this position the unit is properly tuned to the transmitter. After tuning is completed, place switch to A2 to avoid erroneous compass indication.

Loop L-R Switch (Cadre).

This switch is used for turning the direction finding loop to the left or right. Direction of rotation is indicated above the control: G (left), D (right). The direction finding loop is electrically connected to the radio compass indicator.

Volume Control.

The volume control provides selection of the desired level of audio.

RADIO LIGHTING.

Brightness is controlled by a rheostat labeled "BEL. RADIO" (radio lighting) installed on the right console of the forward cockpit.

LIGHTING EQUIPMENT.

LANDING AND TAXI LIGHTS.

One landing and taxi light is mounted on the nose section. The switch (71, figure 1-4 and 66, figure 1-8) located on the forward lefthand console, has three positions: OFF (lever aft), TAXI (middle position), LANDING (lever forward).

COCKPIT LIGHTING.

The instrument panel in each cockpit is lighted by 2 UV lights in each cockpit. The switch (69, figure 1-4) is located on the left console in the forward cockpit only. Brightness may be controlled by a rheostat (73, figure 1-4 and 40, figure 1-7) located on the left console in each cockpit.

Lighting for the left and right consoles in each cockpit is provided by 3 red lights (2 in the forward cockpit and 1 in the rear cockpit). Brightness cannot be controlled.

In the event of malfunctioning lighting equipment (bulbs etc.), emergency lighting controlled by a turning knob on the left console of each cockpit is provided by red lights, adjustable for brightness, in the cockpits.

NAVIGATION AND FUSELAGE LIGHTS.

Navigation and fuselage lights are installed on each tip tank, on the tip of the aft fuselage, and on top and at the bottom of the fuselage. The navigation light switch (68, figure 1-4) is located on the left console in the forward cockpit. This switch has three positions: OFF (middle positions); STEADY (EIN) (the lights on the tip tanks and on the tip of the aft fuselage are ON, while the lights of the fuselage are not functional); BLINK (blinking) (all navigation and fuselage lights flash at 60 cycles per minute).

LANDING GEAR LIGHTS.

Two lights are provided under each wing which illuminate automatically whenever the landing gear is extended and locked.

OXYGEN SYSTEM

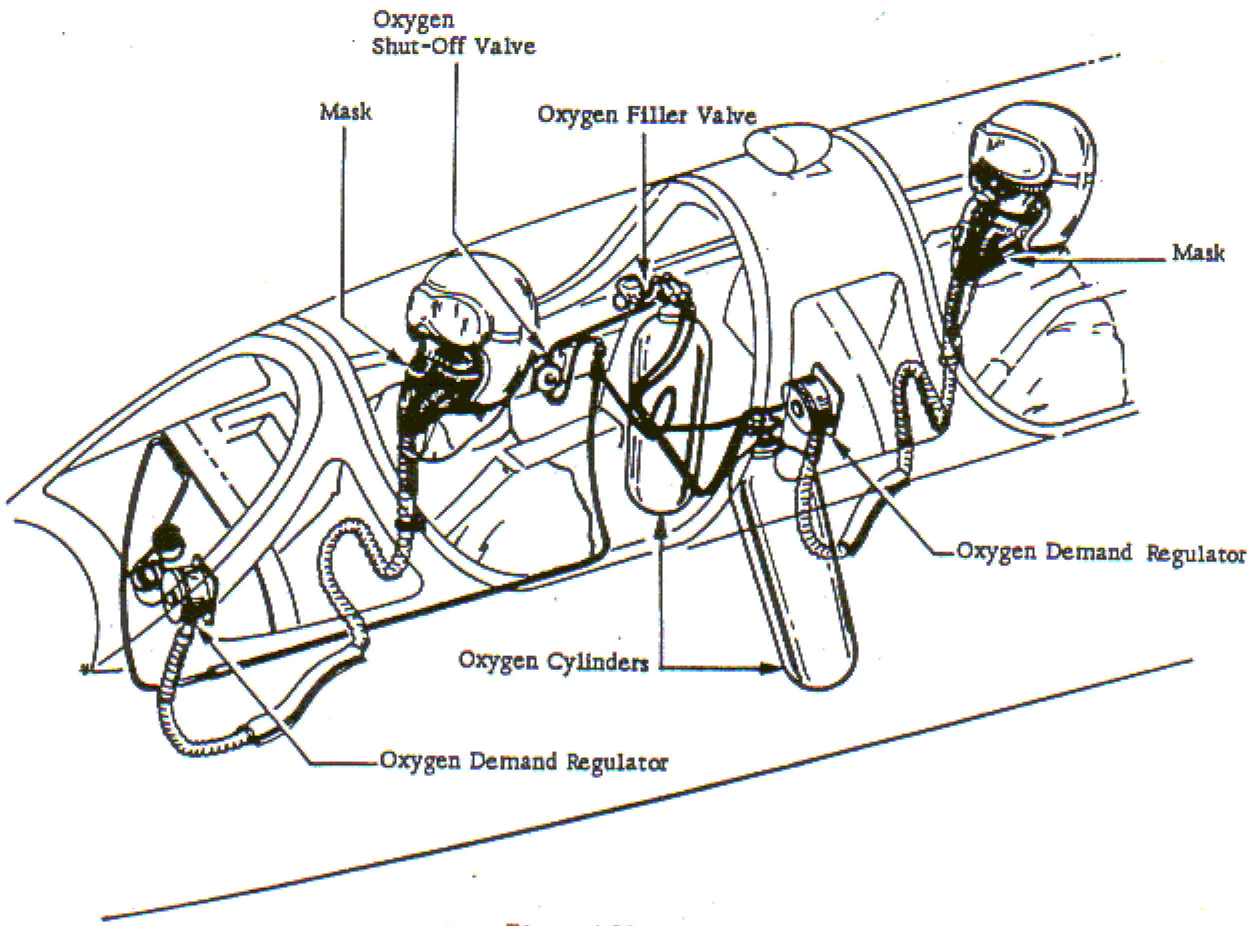


Figure 4-12

OXYGEN SYSTEM (GASEOUS).

An oxygen system, consisting of 2 oxygen cylinders, is installed between both cockpits. The total cylinder capacity is 13,33 l. The system may be refilled through a single filler valve located on the right side behind the forward seat. The oxygen demand regulator (31, figure 1-3 and 24, figure 1-6) is located on the instrument panel in each cockpit.

OXYGEN DEMAND REGULATOR.

The oxygen regulator is a demand pressure breathing regulator without any automatic excess pressure. Two knobs are located on each oxygen regulator. The left one has the positions NORMAL (diluted oxygen) and 100% (pure oxygen). The right knob has the positions NORMAL (demand regulation) and SECOURS (emergency supply). A blinker located on the upper left portion of the regulator is installed to check functioning of the oxygen system in the NORMAL position. A white disc appears with inhaling oxygen. An oxygen pressure indicator is located on the upper right portion of the regulator. Its scale is calibrated in quarters of the normal pressure of 150 kg/cm^2 (2133,5 PSI). A red warning light located in the middle of the instrument, illuminates when pressure drops below 40 kg/cm^2 (568,9 PSI).

Note

When the oxygen system is not in operation, switch system to 100% to prevent the filter from being clogged by dust particles.

NAVIGATION EQUIPMENT.

C-2A COMPASS EQUIPMENT.

The C-2A compass system consists of the gyrosyn compass indicator, the gyrosyn compass repeater indicator, the gyrosyn compass amplifier, and the flux valve. The system is slaved to the flux valve located in the left wing. The C-2A compass combines the functions of both the directional gyro indicator and the magnetic compass. This flight and navigation instrument is fundamentally a directional gyro with a magnetic "sense" - a directional gyro synchronized with the earth's magnetic meridian by means of the flux valve. The compass system receives ac power from the inverter and dc power from the airplane dc system and operates whenever the circuit breaker on the lefthand console in the forward cockpit is pushed in. Approximately 2 or 3 minutes are required for the rotor to come up to speed; it is then ready for setting.

Note

The slave gyro system of the C-2A compass may occasionally become 180 degrees out of phase. Periodic cross-checking with the magnetic compass is recommended.

SETTING THE INSTRUMENT.

As the precession rate is 3 to 6 degrees per minute, the instrument has to be manually synchronized before each flight. In order to synchronize, press the knob on the gyrosyn compass indicator and with pressure on it, rotate it in the direction indicated by the cross (X) or dot (•) arrow on the knob. This action synchronizes the indicating dial with the direction "sensed" by the flux valve. From then on the gyrosyn compass indicator will act automatically.

CAUTION

The knob must not be depressed for periods longer than two minutes as the heavy current drain which occurs at that time would ultimately damage the clutch mechanism.

C-2A COMPASS LIMITATIONS.

The gyro in the gyrosyn compass indicator is free to operate within 85 degrees from level flight in dive and climb, and in right and left bank. At the limits, it strikes mechanical stops which render the indications of the instrument inaccurate. If the operating limits have been exceeded, rest the instrument. Acrobatic maneuvers, especially those of a complex and continuous nature, may result in heading errors of more than 5 degrees. The gyro will nevertheless automatically recover its erect and slaved positions at a rate of 3 to 6 degrees per minute. The flux valve remains pendulous through 30 degrees on both sides of the vertical in pitch and roll. When these limits are exceeded, the spider picks up the vertical component of the earth's field which distorts its sending and thus gives false signals. This results in small temporary variations during accelerated turns. Restoration of the airplane to an attitude within these limits renders the unit pendulous again, and it automatically resumes correct sensing.

Compass Slaving Cut-Out Switch.

This switch located on the forward instrument panel (33, figure 1-3), is used when sensing on the part of the flux valve is not wanted, or over portions of the earth's area where the horizontal lines of magnetic force dip at an angle of 84 degrees or more. It interrupts the circuit from the gyrosyn amplifier to the precession coils in the indicator.

MAGNETIC COMPASS.

The magnetic compass (standby compass), located on the forward instrument panel (2, figure 1-3) is a standard type to be used as a check on the operation of electrically operated compass systems or in the event of an emergency. The magnetic compass may be illuminated by a light incorporated in the instrument. The switch (10, figure 1-3) is located on the upper instrument panel in the forward cockpit.

MISCELLANEOUS EQUIPMENT.

PITOT AND STATIC SYSTEMS.

The pitot and static systems of the cockpits are completely independent. Two heated pitot tubes are installed in front of the windshield in order to supply the instruments with pitot pressure. The lefthand pitot tube heater is operated from the front cockpit; the righthand pitot tube heater is operated from the rear cockpit.

Two static pressure inlets close to each pilot's feet supply the instruments with static pressure.

The instruments supplied are:

Front cockpit: machmeter (5, figure 1-3); airspeed indicator (13, figure 1-3); altimeter (19, figure 1-3); and vertical velocity indicator (15, figure 1-3).

Rear cockpit: airspeed indicator (5, figure 1-6); altimeter (12, figure 1-6); and vertical velocity indicator (7, figure 1-6).

PITOT TUBE DE-ICING SYSTEM.

The pitot tubes are electrically heated. A switch (35, figure 1-3) and a control light (32, figure 1-3) are located on each instrument panel. The control lights illuminate in case of malfunction of the pitot heater circuit, or if the pitot tube is not switched ON.

PERISCOPE.

A periscope is installed on top of the aft instrument panel for forward view of the rear pilot.

REAR VIEW MIRRORS.

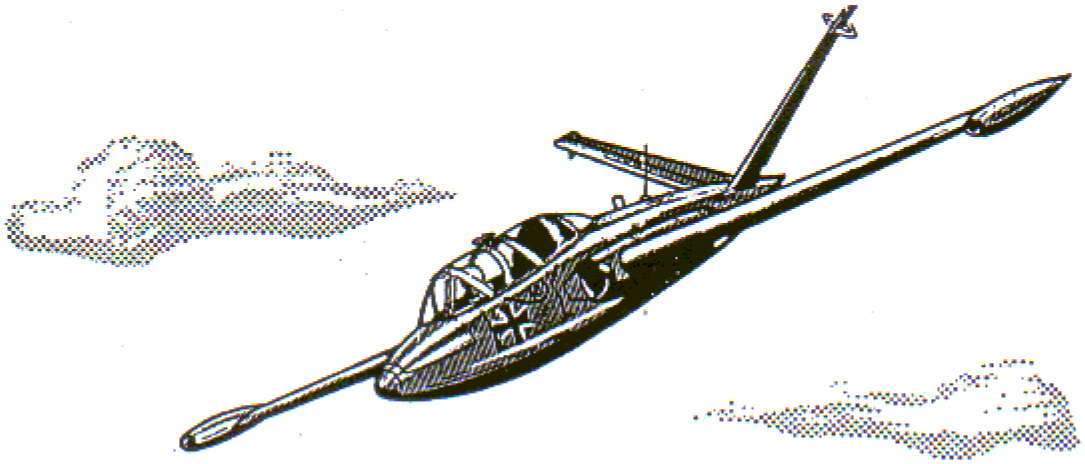
One adjustable rear view mirror is installed in each cockpit on the lefthand side of the canopy frame.

BLIND FLYING HOOD.

The rear cockpit may be equipped with a blind flying hood.

CLOCK.

A clock with stop mechanism (1, figure 1-3) installed on top of the forward instrument panel, and in the rear cockpit at the left side of the instrument panel (10, figure 1-6). Prior to each flight the clock has to be wound up with a knob below the clock face. Setting the clock is accomplished by pulling out the control on the lower right side of the clock, and turning the winding knob in clockwise direction. Initiating, stopping and resetting of the stop mechanism is accomplished by pushing the small knob below the winding knob.



SECTION V OPERATING LIMITATIONS

TABLE OF CONTENTS

OPERATING LIMITATIONS.

Operating limitations are derived from extensive flight testing and operational experience to ensure your safety and to help obtain maximum utility from the equipment. The instrument dials are marked as shown on figure 5-1 as a constant reminder of airspeed and engine limitations which in some cases, are rounded off. Additional limitations on operational procedures, acrobatics, and airplane loading are given in the following paragraphs.

MINIMUM CREW REQUIREMENT.

The minimum crew required to operate this airplane is one pilot in the front cockpit. An additional crew member, as required, will be added at the discretion of the Commanding Officer.

INSTRUMENT MARKINGS.

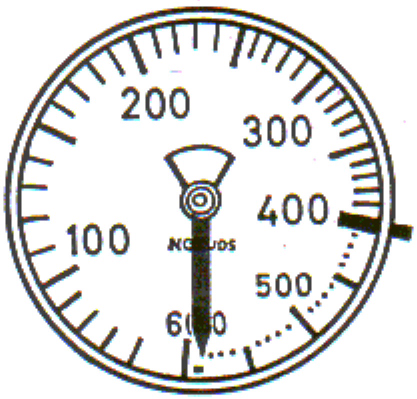
Cognizance must be taken of the Instrument Markings diagram, figure 5-1, since it represents limitations not necessarily repeated elsewhere.

ENGINE LIMITATIONS.

The maximum permissible engine speed for takeoff and climb is 22,600 ±200 RPM. It is recommended that engine speeds used for cruise not exceed 21,000RPM except when absolutely necessary. Engine ground operation up to 6,500 ±300 RPM must be limited to fifteen minutes. The Engine Limitations table (figure 5-2) indicates maximum values that must not be exceeded.

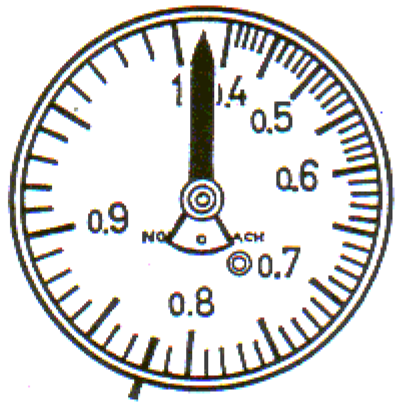
INSTRUMENT MARKINGS

AIRSPEED INDICATOR



130 KNOTS - MAXIMUM WING FLAPS EXTENDED
140 KNOTS - MAXIMUM LANDING GEAR EXTENDED
400 KNOTS - MAXIMUM AIRSPEED

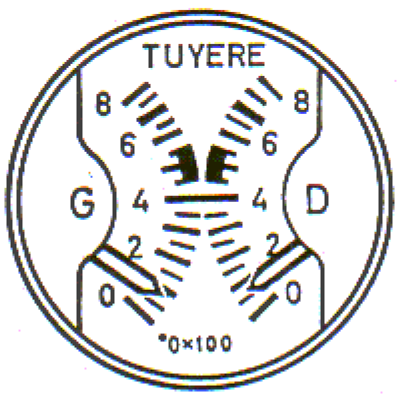
MACHMETER



0.82 MACH - MAXIMUM AIRSPEED

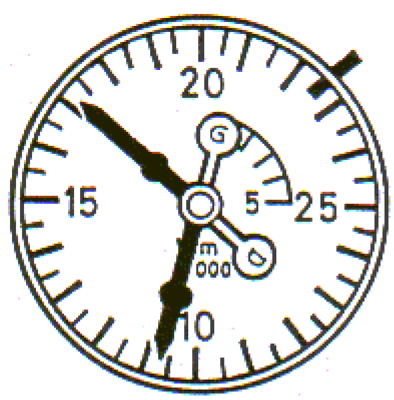
BASED ON
MIL-J-5624 (JP-4) FUEL

EXHAUST GAS TEMPERATURE



675° C - MAXIMUM FOR TAKEOFF
450-550°C - CONTINUOUS OPERATION

TACHOMETER

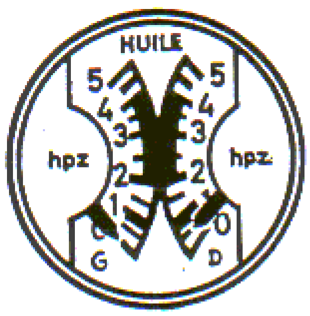


22,600 RPM - MAXIMUM

Figure 5-1 (Sheet 1 of 2)

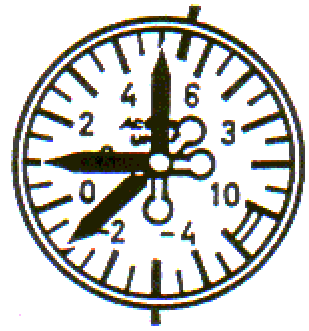
INSTRUMENT MARKINGS

OIL PRESSURE



0,5 HPZ (7,5 PSI) - MINIMUM DURING FLIGHT
4 HPZ (60 PSI) - CONTINUOUS OPERATION
4,5 HPZ (65 PSI) - MAXIMUM ALLOWABLE

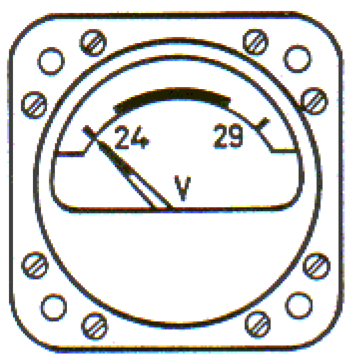
ACCELEROMETER



+5.5 G MAXIMUM WITH OR WITHOUT TIP TANKS CONTAINING ANY AMOUNT OF FUEL

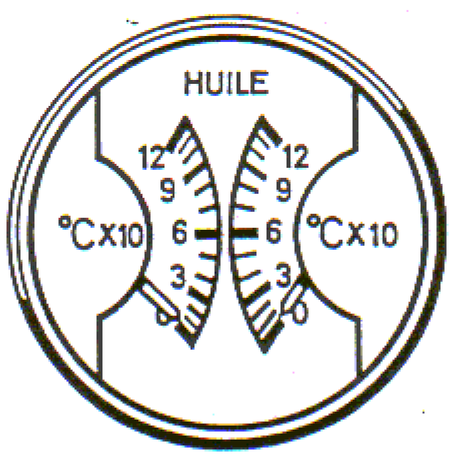
- 3 G MAXIMUM WITH OR WITHOUT TIP TANKS CONTAINING ANY AMOUNT OF FUEL

VOLTMETER



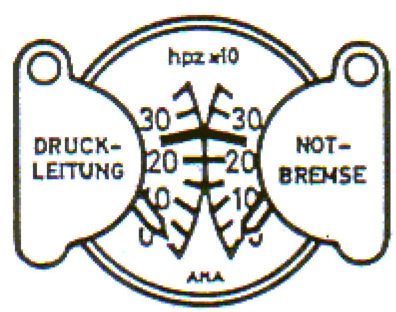
25,5 - 28 V

OIL TEMPERATURE



30 - 60°C

HYDRAULIC PRESSURE



210 HPZ - MINIMUM
250 HPZ - NORMAL AND MAXIMUM

Figure 5-1 (Sheet 2 of 2)

ENGINE LIMITATIONS

PHASE	POWER SETTING	EGT	STATIC THRUST	DURATION
Take-off	22.600 RPM ± 200	675° C	880 lbs	
Climb	22.600 RPM ± 200	675° C	880 lbs	15 min
Climb after 15 min	21.750 RPM	600° C	790 lbs	30 min
Max cruise	21.000 RPM	550° C	705 lbs	Unlimited
Idle at ground	6.500 RPM ± 300	500° C	33 lbs	15 min

Figure 5-2

ENGINE TEMPERATURE LIMITS.

The EGT during normal starts is limited to 600° C. For the left engine and for an ambient temperature below -10° C, the EGT during normal starts is limited to 650° C. If the EGT during starts lies between 600 and 700° C, any of these hot starts should be recorded in the DD Form 781-2. Five hot starts up to 700° C are permissible. After five hot starts or after a hot start exceeding 700° C, an overhaul of the engine is required. The minimum engine temperature for takeoff is 600° C.

OIL SYSTEM LIMITATIONS

	MINIMUM	NORMAL	MAXIMUM
Oil pressure	HPZ 0,5 (PSI 7.5)	HPZ 2 to 4 (PSI 30 to 60)	HPZ 4,5 (PSI 65)
Oil temperature	30° C	40° - 70° C	80° C

Figure 5-3

OIL SYSTEM LIMITATIONS.

The rear cockpit instrument panel is not equipped with an oil pressure gauge, but two red lights (one for each engine) which are lighting up if the oil pressure drops below 0,5 HPZ (7.5 PSI).

Despite zero oil pressure, if absolutely necessary, an engine may be run for ten to fifteen minutes. Shutting down the engine will somewhat reduce the damage although the windmilling speed is fast enough to damage the engine after some time.

The oil tank cooling air intake duct cannot be adjusted in flight but on the ground only. The operating range is wide enough to keep within the limits during normal utilization.

ACTUATING THE THROTTLES.

In flight, the throttles may be moved as rapidly as needed owing to the acceleration control box. The engine acceleration time depends upon altitude and airspeed. For example, at low altitude, it takes about ten seconds at 110 KIAS, to accelerate from idle to full power.

On the ground, since there is no practical effect of the acceleration control, the throttles should be moved smoothly to avoid compressor stall similar to the sounds of gun fire.

PROHIBITED MANEUVERS.

Inverted flight or any maneuver resulting in prolonged negative acceleration will result in engine flameout after one minute and twenty seconds. After this time, there is no means of ensuring a continuous flow of fuel or of maintaining oil pressure for more than thirty (30) seconds in this attitude. All other acrobatics are permitted, except loops forward and snaps.

AIRCRAFT LIMITATIONS.

The limitations indicated in the following paragraphs refer to both aircraft configurations, with or without the installation of tip tanks, either full or empty.

AIRSPEED LIMITATIONS.

The maximum permissible indicated airspeed is 400 knots or Mach 0.82 (see instrument dials, figure 5-1), whichever occurs first.

ACCELERATION LIMITATIONS.

The maximum permissible load factors are as follows: Positive pullout 5.5 g, negative pullout 3 g.

CEILINGS.

Efficient ceiling: 34.000 feet.

Maximum ceiling: 40.000 feet.

CENTER OF GRAVITY LOCATION.

In all cases of possible loadings (one or two pilots, with or without armament, tip tanks, full or empty), the aircraft remains within the approved center of gravity positions.

AIRCRAFT SYSTEMS LIMITATIONS.

LANDING GEAR.

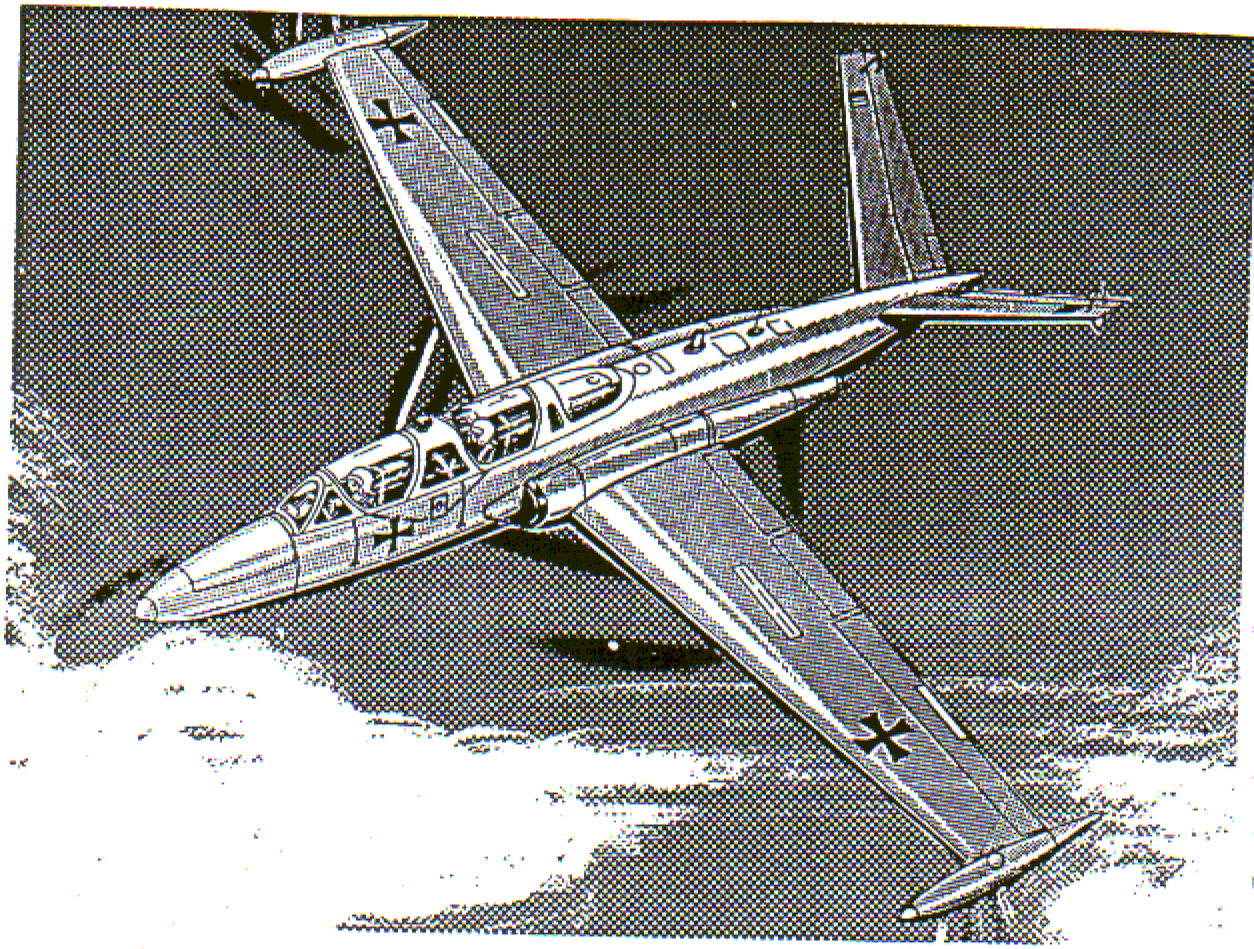
The landing gear should be locked up or lowered at a maximum of 140 KIAS. Duration of operation: Extension 5 seconds, retraction 3.5 seconds.

WING FLAPS.

The wing flaps should be retracted at a maximum airspeed of 130 KIAS. Extension of the flaps to 15° requires a maximum airspeed of 130 KIAS. Extension of the flaps between 15° and 40° requires a maximum airspeed of 130 KIAS.

SPEED BRAKES.

No limitations.



SECTION VI FLIGHT CHARACTERISTICS

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INTRODUCTION.

The operational capabilities of this airplane include flight speeds to 0.82 Mach number and altitudes to 34,000 feet. The airplane is directionally and longitudinally stable at all approved center-of-gravity positions. Laterally, the airplane is neutrally stable, a characteristic that does not require any special technique other than frequent reference to the lateral attitude.

MACH NUMBER.

Mach number represents a percentage of the speed of sound. For example, if you are flying at 0.5 Mach, your speed is 50 percent of the speed of sound. The speed of sound, being a function of air temperature only, decreases as you climb, since the air temperature decreases with altitude up to 35,000 feet, then the air temperature stays constant.

STALLS.

The CM170 has proved itself to be a very stable aircraft. Stalls are characterized by buffeting, exceptionally good lateral control, and rapid recovery. No uncontrollable rolling tendencies occur. Elevator control is very good throughout the stall.

CONFIGURATION	AIRSPEED KNOTS	REMARKS
Cruise - Speed brakes IN	87	Buffeting beginning at 90 kots
Cruise - Speed brakes OUT	90	Buffeting added to the vibrations due to the speed brakes
Wing flaps 15°, speed brakes IN	85	Slight warning buffeting
Wing flaps 40°, speed brakes IN	78	Slight warning buffeting
Wing flaps 40°, speed brakes OUT	80	Buffeting beginning at 85 knots
No flaps, speed brakes OUT	92	Slight buffeting beginning at 95 knots

Figure 6-1

STRAIGHT-AHEAD STALLS.

When a straight-ahead stall is encountered, the aircraft nose usually drops straight forward. Recovery from a straight-ahead stall may be initiated at any time by releasing back pressure on the stick. Altitude loss is about 500 feet. If the wings are not quite level with the ball in the center of the turn-and-slip indicator when the stall occurs, a wing may drop on either side. In this event, recovery will be prompt by releasing back pressure on the stick and simultaneously rolling the wings level. Altitude loss is somewhat more than 500 feet.

TURNING STALLS.

In a turn, the stall, often characterized by a sudden roll, is preceded by a slight buffeting. As prescribed in paragraph "Straight-Ahead Stalls", recovery from a turning stall may also be initiated by relaxing the stick pressure and rolling the wings level.

STALL RECOVERY.

During stall recoveries, the throttles should be advanced smoothly to 22.600 RPM with the aircraft nose down. Then return the nose to the straight-and-level flight attitude. After the stall recovery has been safely attained, the aircraft should immediately be returned to normal cruising flight.

SPINS.

NORMAL SPINS.

The minimum altitude for a spin entry is 17.000 feet or more above the terrain. Check aircraft clean, tiptanks empty, and trim neutral. Reduce power to idle and decelerate to 110 KIAS and a nose-high attitude of 15 - 30 degrees. At the first stall indication, smoothly apply full rudder in the desired direction of spin and bring the stick all the way back, keeping the ailerons neutral. The aircraft enters a spiral, reaches an inverted position after approximately half a revolution and then the nose drops down and swings back up to or above the horizon.

Approximately one turn after the controls have been applied, the nose drops and the aircraft really enters the spin. Continue to hold the controls firmly against their stops keeping the ailerons neutral until the spin stabilizes.

During the next two turns, rather distinct pitching, roll and yaw oscillations are recorded, as well as severe elevator buffeting. Latest after three revolutions, the spin is more quiet and practically stabilized at about a 45 degree nose-low attitude. The altitude loss is approximately 1.000 - 1.200 feet per turn.

SPIN RECOVERY.

After the spin has stabilized, recover by applying brisk full opposite rudder to the maximum deflection, - and hold. After one to two seconds push the stick straight forward slightly over the neutral position. When the aircraft's spin rotation has definitely stopped, neutralize the rudders as rapidly as possible. Check wings level, ball centered and recover from ensuing dive.

CAUTION

> Do not neutralize the rudders until the rotation has completely stopped, but consider failure to centralize the controls promptly when the rotation stops may cause the aircraft to spin in the opposite direction.

When the nose of the aircraft reaches the horizon, adjust power to 20.000 RPM, and level off or regain altitude by a maximum performance climbing turn.

ACCIDENTAL SPINS.

When entering an unintentional spin, recovery is accomplished by using the "Spin Recovery Procedure". If the spin was entered with gear and flaps down, do not let the speed increase during recovery and retract the flaps before the gear.

INVERTED SPINS.

Intentional spinning inverted is prohibited in the CM170. However, you may enter unintentionally an inverted spin by excessive forward movement of the control column and extreme misuse of rudder, for example during the half roll of the Immelmann or after an incorrect recovery from a normal spin.

If spinning inverted you will be on the outside of all rotation and experience negative "G"s. The direction of spin is dictated by the direction of yaw and whilst in a normal spin, this is the same direction as the roll in an inverted spin, however, the yaw is in the opposite direction to the roll. You will normally be far more conscious of the direction of rotation or roll than of the direction of yaw.

INVERTED SPIN RECOVERY.

Apply full rudder in the direction of rotation, i.e. in opposite direction to the turn needle. Hold the ailerons neutral and bring the stick progressively back.

Immediately the spin stops, centralize all controls a recover from the ensuing dive.

During inverted spin recovery, the aircraft may pi through the vertical after rudder has stopped the in yaw. If all controls are not immediately centrali at this point, spinning may continue. The inver spin recovery action will now become normal pro- control. The direction of roll will be the same previously, but the direction of yaw will be reve If this pitch change occurs during inverted spin covery, it indicates that the spin has been converte to a normal one and an aggressive normal-spin reco action is now to be taken.

Note

> If in doubt as to whether the aircraft is spinning inverted or normally, the turn needle of the turn-and-slip indicator should be observed before starting recovery procedure.

VERTICAL RECOVERY.

Before entering the maneuver, adjust the throttle 20.000 RPM. Dive to attain an entry airspeed of 2 KIAS. Level the wings and raise the nose smoothly level flight.

When the nose reaches this attitude, begin applyi greater back pressure to increase the pitch attitude a a more rapid rate. Use aileron and rudder pressure keep the wings level and to maintain directional co trol. Use the attitude indicator and the turn-and-sl indicator to help maintain wings level and directio Since this maneuver is accomplished with a high ent airspeed, you should use smooth pressure in flying t the vertical attitude.

At approximately the vertical attitude, continue ba pressure and aileron pressure to initiate a roll. If th aircraft is not perfectly vertical, this roll should made toward the low wing; otherwise, the directi is optional.

CAUTION

> Caution must be used to avoid a stall from excessive back pressure, but sufficient back pressure must be applied to keep the aircraft's nose coming smoothly down toward the horizon.

Continue these control pressures to execute approx mately a one-quarter roll and fly the aircraft smooth down through the horizon. As the nose reaches th horizon, it should be inverted with wings approximately level. Continue with a coordinated roll in the same direction to return the aircraft to upright level flight.

Note

If insufficient airspeed is available to perform the type of recovery described before, hold control firmly in the centralized position until the aircraft takes up a nose-down attitude of its own accord. Then, when the speed increases, carry out the recovery from a dive.

INVERTED FLIGHT RECOVERY.

The correct recovery procedure from inverted flight is to execute a roll back to the level-flight attitude. Apply aileron pressure in the direction you want to roll. The direction of the roll depends on the attitude of the aircraft. It should be made in the direction of the shortest turning radius.

Whenever possible, maintain a fairly constant pitch attitude as the recovery is made. If this cannot be done because of low airspeed, lower the nose of the aircraft while performing the roll back to the level-flight attitude. This prevents an excessive loss of altitude.

DIVE RECOVERY.

The pullout from any dive should be made with smooth back pressure and started before the airspeed will approach the maximum allowable limits. Retard the throttles, extend the speed brakes, and raise the nose of the aircraft.

The recovery from a high-speed dive will be made by retarding the throttles, and extending the speed brakes, and applying smooth back pressure until a level-flight attitude is reached. The trim will not be used during this maneuver. Never exceed 0.81 Mach or 400 KIAS, whichever occurs first.

CAUTION

All above mentioned maneuvers are to be recovered above 10.000 feet AGL, except spins, which are to be recovered above 13.000 feet AGL.

LEVEL FLIGHT CHARACTERISTICS.

SLOW FLYING.

Flying this airplane at slow speeds is pointless, since operation at speeds below the normal cruising range results in a waste of fuel and actually decreases the range and endurance. However, if slow flying is necessary, it should be done whenever possible in the clean configuration (gear, wing flaps, and speed brakes retracted), because the fuel consumption will be increased with gear, flaps, and speed brakes extended.

Slow Flight Technique.

The slow flight characteristics of this airplane are normal. All controls are effective down to the stalling speed. Slow flight should be practiced at a safe altitude. Reduce the airspeed by retarding the throttles to 17.000 RPM, extend speed brakes, and maintain altitude by holding the nose up. Trim the aircraft. When the desired airspeed has been attained, it can be maintained by varying the thrust. When descending at low airspeeds, retard the throttles to IDLE and decelerate to speeds at which the landing gear and wing flaps may be extended. After the gear and wing flaps have been extended, set up the desired rate of descent by adjusting the power as necessary.

COMPRESSIBILITY EFFECTS.

INTENTIONAL COMPRESSIBILITY RUN.

Level off with full power at 28.000 feet or above. Do not start to dive before reaching at least 200 KIAS. Trim the aircraft and do not actuate the tab any further. Dive at an angle of about 40°. At Mach 0.78, slight vibrations occur and the elevator stick force weakens. At Mach 0.79, stick force is lighter and vibrations increase. At Mach 0.80, the elevator stick force is zero. In aircraft without aileron boost, slight aileron snatches tend to put the aircraft into roll. At Mach 0.82, a light force to pull on the stick develops and the aileron snatches are more accentuated.

COMPRESSIBILITY RECOVERY.

Recovery may be effected in different ways, either by pulling up, by reducing the power, or, by extending the speed brakes.

Note

Keep a close watch on the airspeed indicator so as not to exceed 400 knots IAS.

It is recommended to start the dive at a steeper angle and to make a more accentuated recovery, rather than the "run after" the intended Mach number, so as not to exceed the maximum permissible indicated airspeed.

It should be noted that the change in stick forces is more accentuated with a rear center-of-gravity location.

UNINTENTIONAL COMPRESSIBILITY RUN.

Rarely encountered with this type of aircraft, it is not serious if Mach 0.82 is not exceeded.

Pullout is carried out as indicated in the preceding paragraphs.

FORMATION FLYING.

There is no special difficulty in performing formation flying in this type of aircraft. Speed brakes can be very helpful due to their characteristics: efficiency and partial extension possibilities.

TAKEOFF IN FORMATION.

Set flaps 15°. Adjust power to 22.000 RPM for the leader and 22.000 RPM for the wingman, hold the brakes and take off normally. The leader maintains 21.750 RPM during the climb.

CAUTION

In case of water puddles on the runway, do not perform formation takeoff.

INDIVIDUAL TAKEOFF AT 10 SECONDS INTERVALS.

Each aircraft should take off with full power. When the leader reaches 150 KIAS, he reduces to 21.750 RPM and does not fly beyond the rejoining airspeed of 200 KIAS. As soon as the gathering is completed, the formation continues in the normal climb.

NORMAL FORMATION.

The wingman's angle back from the leader should be about 30°. In this position, only wingtip and canopy clearances are observed.

In turns, the same position as in level-flight is maintained in respect to the leader; the wingman inside the turn drops down and the wingman outside the turn pulls up to maintain the same relative position.

CLOSE FORMATION.

In close formation maneuvers, all clearances will be neglected. The smooth response of the engines to the throttle displacement and the efficiency of the speed brakes make it easy for the wingman to maintain position.

WEATHER FORMATION.

If the weather becomes too thick or turbulent to maintain wing position, advise the leader and start a gentle turn away from the leader and fly your own instruments. Continue the turn for 45° from the formation heading, and fly for 30 seconds. Then turn and parallel the leader's heading. Rejoin the formation on top or follow instructions of the leader or ground control.

LOST WINGMAN PROCEDURE.

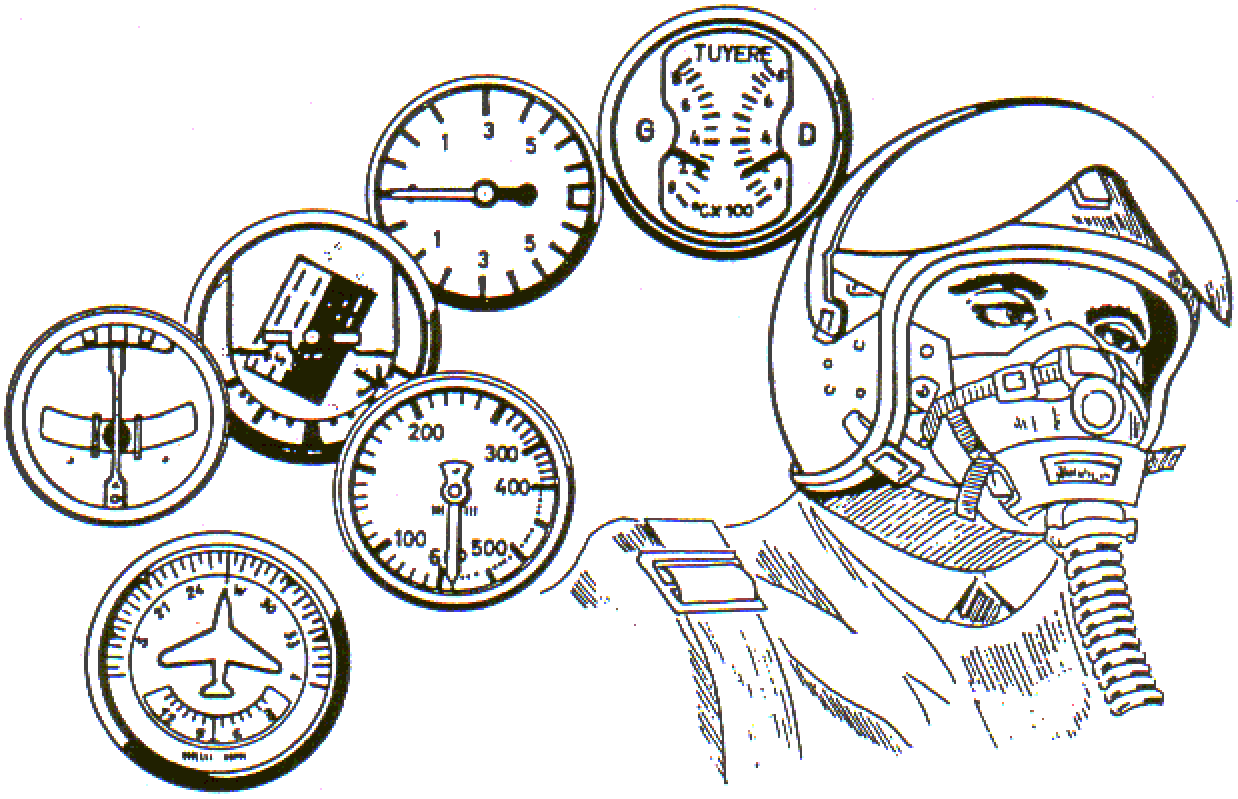
If turning and outside and if you loose the leader or if it is difficult to maintain position, advise the leader, roll out and level off. Follow instructions of the leader or ground control.

If flying inside and if you loose the leader or if it is difficult to maintain position, advise the leader and continue the turn. Simultaneously reduce power and extend the speed brakes. When the airspeed is reduced for a minimum of 20 knots, roll out and retract the speed brakes. Establish level flight and follow instructions of the leader or ground control.

If you loose your leader on GCA final approach, turn away, level off immediately, and follow GCA Missed Approach Procedure.

CAUTION

All maximum performance maneuvers and aerobatics during formation flying are to be recovered above 10.000 feet AGL.



SECTION IX ALL WEATHER OPERATION

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Note

Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ from or are in addition to the normal operating instructions covered in Section II and IV.

INSTRUMENT FLIGHT PROCEDURES.

This airplane has the same stability and flight handling characteristics during instrument flight conditions as when flown under VFR conditions. However, like most jet airplanes, it is sensitive to changes of control pressure and requires constant attention to flight instrument indications. For best results, make all changes in pitch, bank, and power smoothly and keep the airplane properly trimmed. The range and endurance factors are critical, so special attention should be given to cruise control during preflight planning or IFR flights. Allow for delays and additional fuel required for departure, letdown, and recovery. The following techniques are recommended from takeoff to touchdown under instrument and night flying conditions. These techniques are applicable when using any type of radio or radar aids to navigation and when making letdowns or landing approaches under instrument flying conditions.

INSTRUMENT TAKEOFF AND CLIMB.

Complete the normal taxi and before-takeoff checks as prescribed in Section II. Make certain the directional indicator is checked against the standby magnetic compass. Check the directional indicator against a known heading such as the runway, to make certain it is not out of phase. Reset the miniature aircraft of the attitude indicator to the zero position.

Hold the aircraft with the brakes while applying full power (22.600 RPM) and check the instruments. Any deviation in heading must be corrected immediately. When the aircraft leaves the ground, control the pitch and bank attitude by reference to the attitude indicator until the vertical velocity indicator and the altimeter show a climb. At this time, retract the gear. Establish and maintain a pitch attitude of 1.000 ft/min on the vertical velocity indicator which will result in a continuous climb and a smooth increase in airspeed. Raise the flaps when a safe altitude (100 feet AGL) and an airspeed of 120 KIAS has been attained. When the flaps are retracted, adjust the pitch attitude to compensate for the loss of lift. Climb at 22.600 RPM and 220 KIAS.

The climbing airspeed is 235 KIAS at MSL and reduces by 3 knots each 1.000 feet. Calibrate the turn-and-slip indicator as soon as possible in the climb. Normal turns (30° bank) will be used for instrument climbs when possible.

INSTRUMENT CRUISING FLIGHT.

After leveling off from climb with the appropriate climbing airspeed, it may be necessary to maintain high power until cruising airspeed is established. Although it is seldom necessary to exceed a 30-degree bank in routine instrument flight, the airplane can be controlled in steep turns up to 60 degrees of bank. The attitude indicator may precess in pitch and bank during turns, so a constant cross check of other flight instruments is necessary to maintain the desired attitude.

Q.G.H. LETDOWN AND DIRECT LETDOWN.

Airspeeds and power settings are the same as for VFR flights (see Normal Procedures, Section II).

CAUTION

Prior to descending, set the air conditioning and pressurization switch to DEFROSTING (DEGIVRAGE) to prevent ice from developing on the windshield. (See Section IV).

G.C.A. LETDOWN.

A G.C.A. letdown is performed throughout with a power setting of 18.500 RPM. At the end of the descent with the speed brakes extended, reduce airspeed in level-flight without moving the throttles.

At 140 KIAS, lower the gear and retract the speed brakes. On the final approach, lower the flaps 15°. Airspeed will then stabilize around 120 KIAS in level-flight. On instructions from G.C.A., start the descent at 120 KIAS using the speed brakes to get the proper rate of descent (approx. 500-600 ft/min). Correct the vertical velocity with the elevator and increase RPM if the airspeed drops below 120 KIAS or if the aircraft is coming too low on glide path with the correct airspeed.

HOLDING.

When instructions to hold have been received, the aircraft is considered to be in the holding pattern at the time of initial passage of the holding fix. Reduce power to 18.750 RPM when entering the holding pattern and neglect the airspeed.

Except as otherwise specified for wind drift correction, execute all turns during entry and while in the holding pattern at a rate of 3° per second or at 30° angle of bank whichever requires the lesser degree of bank.

When holding at or above flight level 200 use the minimum allowable power setting for this altitude even though when descending, if necessary, use speed brakes. Descending below flight level 200 reduce power to 18.750 RPM. To leveloff use normal rule (10% of vertical velocity indication) for lead, and adjust power.

The first outbound leg after the initial holding fix passage will be flown for one minute if holding at or below 14.000 feet and one and a half minutes if holding above 14.000 feet, unless the published procedure or ATC requires a different time, or when compensating for headwind.

If there is a headwind or tailwind when holding, all outbound values may be increased or decreased as necessary to compensate for the wind. If it is known that a headwind is existing when flying outbound, all outbound time values may be increased by not more than one minute.

CROSSWIND CORRECTION.

After having established the holding pattern, the pilot may compensate for wind drift as follows. Shallow the turns into the wind and steepen them downwind one degree for each degree of drift correction necessary to maintain the inbound course. In no case, however, the angle of bank should be shallowed to less than 15° nor steepened to more than 30°. Use the same amount of drift correction on the outbound leg as to maintain the inbound course.

PENETRATION.

Before starting the penetration (figure 9-1) check de-icing equipment for proper operation and set QNH. At high station (usually 20,000 feet) reduce power to 18,750 RPM and simultaneously lower the aircraft nose by reference to the attitude indicator (approximately 10°). This pitch attitude is maintained on the attitude indicator until the airspeed approaches 200 KIAS. As the airspeed passes 200 KIAS, extend speed brakes. Trim the aircraft to relieve pressure during this procedure. Vertical velocity will be about 4,800 ft/min.

The descent is made at 220 KIAS, 18,750 RPM, and speed brakes extended. If a penetration turn is to be made, use 30° of bank.

At approximately 1,000 feet above leveloff altitude, decrease pitch attitude by about 1/2. When approximately 200 feet above the desired altitude, smoothly adjust pitch to a level flight attitude and let the airspeed decrease to 140 KIAS. If the approach is to be made as a low approach, roll out final approach course and check the radio compass.

During the turn to intercept the final approach course, do not attempt to steepen or shallow the angle of bank in an effort to roll out on course.

INSTRUMENT APPROACHES.

Procedure Turns.

A procedure turn is assigned to place the aircraft on the final approach course to the terminal fix being used for the approach. Normally the altitude for a procedure turn will be given by the Air Traffic Control, however it may happen, in the event of radio communication failure, that the pilot has to choose by himself an altitude which is just high enough to perform a procedure turn for a low altitude instrument approach. In this case, take that altitude which is published for the climb during the missed approach after a normal ADF-low approach.

The approach/landing configuration is established according to the rules for a normal approach. The procedures outlined below are designed to keep the aircraft within the procedure turn maneuvering area. This maneuvering area is situated on the same side from the inbound course as the penetration turn.

a. In a procedure turn utilize 30° of bank or a rate-of-turn of 3° per second, whichever requires the lesser degree of bank.

b. When arriving the approach fix on a heading within 70° of the inbound course on the maneuvering side, turn outbound on the depicted maneuvering side to parallel the reciprocal of the inbound course.

c. When arriving at the approach fix on a heading not within the 70° area, turn the shortest direction outbound to parallel the reciprocal of the inbound course.

CAUTION

> If the first outbound turn places you on the side opposite the maneuvering side, turn to intercept the reciprocal of the inbound course. It is recommended to apply an interception angle of not less than 20° to intercept course. If the reciprocal of the inbound course is intercepted prior to completion of the maximum time outbound, maintain course outbound.

d. Upon arrival at the approach fix on a heading nearly aligned with the reciprocal of the inbound course, the teardrop procedure turn may be flown on the maneuvering side at the pilot's discretion. The course flown outbound should be 30° removed from the reciprocal of the inbound course.

TYPICAL ADF PENETRATION AND APPROACH

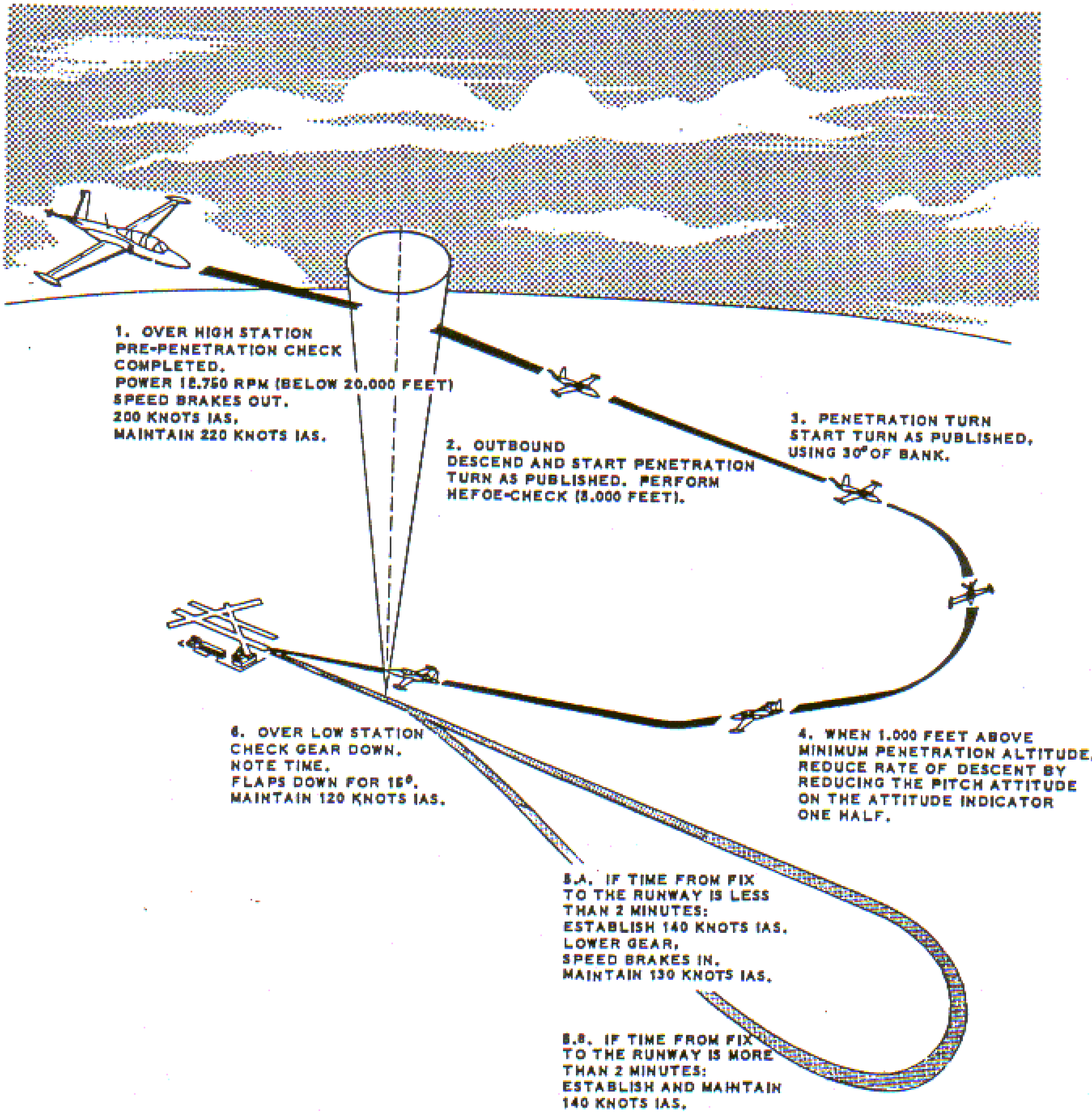

Figure 9-1

e. The outbound leg will be flown for not more than 1 1/2 minutes with a power setting of 18,500 RPM. Timing for the outbound leg will commence when the aircraft is on an outbound heading over the approach fix or abeam, whichever occurs last.

f. If there is a headwind or tailwind when flying outbound, compensate for it by increasing or decreasing the outbound time value as well as in a crosswind a wind correction angle should be applied.

g. Upon completion of the outbound leg, turn the nearest direction to intercept the inbound course. If you are on the reciprocal of the inbound course at the completion of the timing outbound, turn on the maneuvering side to intercept the inbound course. Plan the turn so as to roll-out on the inbound course with 140 KIAS.

Low Approach.

After completion of penetration, roll out on the final approach course and establish 140 KIAS. When within 20° of the final approach course and within 10 NM from the station, begin the descent to the published low station altitude. if not, intercept the final approach course and then descend.

If the airfield is located less than two minutes at approach airspeed from the radio fix, lower gear and attain 130 KIAS prior to reaching the fix.

If the airfield is located two minutes or more at approach airspeed from the radio fix, lower gear and establish 120 KIAS over the fix.

Over the fix, note time and lower 15° of flaps. Adjust power to maintain 120 KIAS. Maintain outbound course (± wind drift correction) and immediately descend to published minimum altitude prior to arrival over the field. The time flown outbound will be as published and in case the field is then not in sight, initiate a missed approach.

Missed Approach.

Advance the throttles to 22,600 RPM and retract the speed brakes. Establish a 3° climbing attitude (approximately 1,000 ft/min). When definitely climbing, raise gear and flaps. When the airspeed reaches 150 KIAS, reduce power to 21,000 RPM. Let the airspeed increase to 170 KIAS and maintain a constant-airspeed climb until reaching the missed approach altitude. Cross-check all instruments to insure proper heading and climb. Leveloff and maintain 170 KIAS. Follow instructions given by approach control etc.

Radar Approach.

A radar approach (figure 9-2) usually begins with the aircraft arriving over a radio fix. The type of radar approach pattern is determined by the physical setup of the field and the instructions given by the controller.

All changes of headings in the initial-approach phase should be made by establishing an angle of bank that will approximate a standard rate turn for the true airspeed being flown (not to exceed 30 degrees of bank). For turns during final-approach phase use an angle of bank equal to the number of degrees to be turned (not to exceed 1/2 standard rate).

Note

> A radar approach may also begin within a penetration turn, after completion of penetration turn, or you may be handed-over by another radar station. When you are picked up within or after a penetration turn, retract the speed brakes when the level off is completed and you are under positive radar control.

Airspeeds, power settings, and procedures are as follows:

Downwind leg will be flown with clean configuration and 18,500 RPM (airspeed approximately 200 KIAS). Its location will be determined by the instructions from the controller and is further from the airfield than the downwind leg of a VFR landing pattern. The initial cockpit check will be performed here. Use the speed brakes if descending. When advised to turn to base leg extend speed brakes to reduce speed and turn to given heading. When you reach 140 KIAS, lower the landing gear, obtain 130 KIAS, and descend to given altitude. Maintain the airspeed at 130 KIAS and retract speed brakes. Maintain 130 KIAS on base leg (approximately 18,500 RPM) and perform final cockpit check.

When on the final approach heading, lower 15° flaps and allow the airspeed to decrease to 120 KIAS (approximately 18,500 RPM). Altitude and heading should remain constant.

When advised by the ground controller to enter the glide path, extend speed brakes, maintain 120 KIAS and simultaneously establish a rate descent of 500-600 ft/min. The glide slope airspeed is normally 30 knots above stalling speed in the landing configuration. No change in configuration should be made after glide slope interception.

The controller will advise when you are passing through minimum altitude. After having established visual contact with the ground, lower full flaps and reduce airspeed to 110 KIAS when passing the field boundary.

TYPICAL RADAR APPROACH

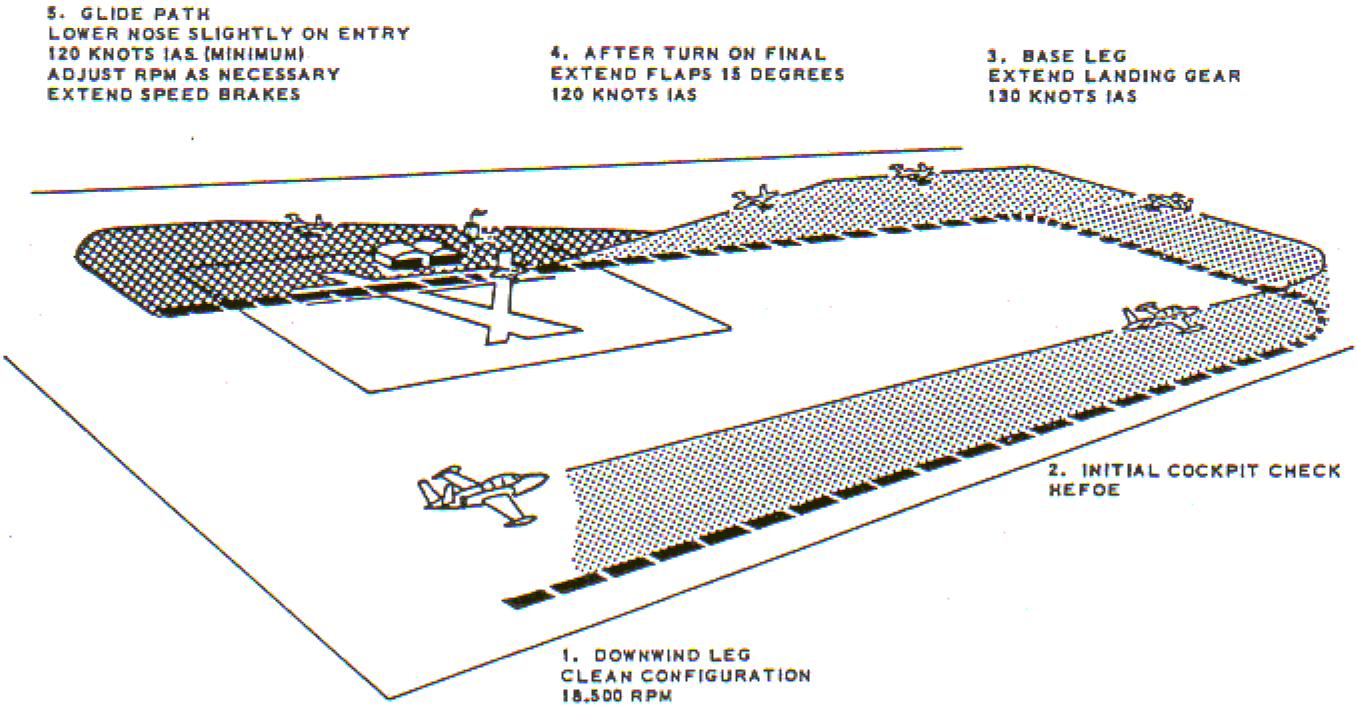

Figure 9-2

ICE AND RAIN.

If mist or rain is reported, vision through the windshield is relatively poor. Under these conditions, better visibility is obtained by looking through the lateral front windows. If landing on a slippery runway while it rains, use caution with the brakes to prevent the airplane from skidding.

If ice, clear or rime, forms along the leading edges of the wings, the lift will decrease. Critical accretion may be prevented by climbing to clear air above the clouds or by climbing to an altitude where ambient temperature is low enough to preclude further ice accretion. If a climb is impractical, a descent to a temperature level above freezing is often the best solution.

No incident caused by engine icing has yet been reported with the CM170R.

To prevent icing of the windshield, use the alcohol de-icing pump.

In case the airspeed indicator and altimeter indications become obviously erroneous (static pressure inlet iced over), the cabin altimeter gives a rough approximation. Indications of the airspeed indicator and altimeter may be correct again if the pilot breaks the machmeter or vertical velocity indicator glass (use the radio plug), and shuts off pressurization (cockpit seal deflated when exterior pressure and cabin pressure are about the same).

TURBULENCE AND THUNDERSTORMS.

Routine instrument flights may require the penetration of turbulent air areas or thunderstorms. If this becomes necessary the power setting and pitch attitude required for penetration should be established prior to entry. If this power setting and pitch attitude is maintained in the turbulence area, the airspeed and altitude will remain fairly constant regardless of false airspeed and attitude indications. The recommended speed for this airplane is 210 KIAS which corresponds to roughly 18,000 RPM. Make a thorough analysis of the general weather situation to determine thunderstorm areas and prepare a flight plan which will require the least possible thunderstorms. Be sure to check the proper operation of all flight instruments, navigation equipment, and instrument panel lights before attempting flight into thunderstorm areas. If the storm cannot be seen, its proximity may often be detected by crash static. Turn off any radio equipment rendered useless by static and turn cockpit lights to full bright to minimize blinding effect of lightning. Do not lower landing gear or wing flaps since they do not increase aerodynamic efficiency. While in the storm maintain power setting and pitch attitude. Hold these constant and the airspeed will remain approximately constant regardless of the indicated airspeed. Expect turbulence, precipitation, and lightning. Concentrate principally on holding a level attitude to the attitude indicator. Do not chase the airspeed indicator; doing so could result in extreme airplane attitudes. Use as little elevator and aileron control as possible to maintain airplane attitude in order to minimize the stresses imposed on the airplane.

NIGHT FLYING.

For night flying check the lighting equipment thoroughly and be familiar with the location of all switches in the cockpit. Switch locations and lighting equipment may differ in various airplane serial groups, so be familiar with the particular airplane you are going to fly and be sure to carry a functioning flashlight. Instrument light should be adjusted to minimum brightness to avoid undue tiring of the eyes and to keep canopy reflections to a minimum. Know your cockpit procedures for taxiing as well as flying. This will eliminate confusion and the need for turning on the cockpit lights unnecessarily.

USE OF OXYGEN AT NIGHT.

During local night flying use 100% oxygen during taxi, takeoff, and climb to 1.000 feet above the ground. After final landing, switch to 100% oxygen again, until the aircraft is parked. This will ensure that you suffer no loss of vision from the inhalation of noxious fumes from other aircraft or any other source.

During night operation in the area or on night navigation flights, use 100% oxygen until 5.000 feet MSL. When performing the HEFOE-CHECK at 5.000 feet, switch the oxygen automix lever to normal. During descent back to the traffic pattern or after completion of penetration, turn switch back to 100% oxygen.

BEFORE EXTERIOR INSPECTION.

In addition to the normal daytime exterior check, the following checks should be made:

All exterior lights should be operational. Make sure all glass and plastic surfaces are clear. Scratches and dirt cause reflection. Keep cockpit lights turned down as low as possible when taxiing or flying. This includes the three gear-down lights. Bulb covers which glow under emergency conditions should not be twisted to dimming.

Perform a complete instrument cockpit check before takeoff. Allow sufficient time for gyros to reach operating speed. Check the directional indicator while taxiing to see if it is indicating turns properly. Compare it with the standby magnetic compass. Be sure the attitude indicator is adjusted as for an instrument takeoff. Set the correct altimeter setting and always reset before landing, particularly at night. Know the height of obstructions in your area.

TAXI.

Judgment of speed and depth is poorer by night than by day. Be aware of this fact. Follow the daytime procedures with extra care. Taxi with the taxi light on. Get tower guidance for night taxiing whenever needed. Get a radio clearance from the tower for crossing runways. If taxiing toward a landing runway, use caution with the taxi light to keep from blinding the pilots of landing aircraft. Radio procedures for night flying will be as directed locally.

TAKEOFF.

Turn the taxi light off after the aircraft is aligned with the runway. When the aircraft is airborne (vertical velocity indicator and altimeter giving definite climb indications) retract the gear, retract the flaps and let the speed increase in a slight climb. (Refer to Instrument-Takeoff.)

CAUTION

On takeoff, do not hurriedly retract the gear at night. There may be a tendency to fly the aircraft back into runway.

LANDING.

Make sure by every means possible that the gear is down and locked before turning final. Line up with runway lights when the turn to final is completed. Turn the landing lights on after completing the turn to the final approach and after having obtained clearance to land.

CAUTION

Avoid taxiing with the left engine idling. Keep at least 10.000 RPM to assure generator charging normally.

APPENDIX PERFORMANCE DATA

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Part 1 — Introduction

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APPENDIX SCOPE AND ARRANGEMENT.

This appendix contains the performance data, necessary for accurate flight planning, for aircraft operating with tip tanks. Kg-per-liter charts are included for operation with tip tanks. A part-type arrangement groups the material as needed for planning general phases of each flight. Descriptive text in each part discusses and explains the use of the types of charts provided. Profile-types charts, presenting range and endurance performance information, are included to supplement the graphical performance data.

PERFORMANCE DATA BASIS.

Flight planning information shown in this appendix is based on the results of manufacturer's flight tests. Unless specifically stated, it is consistent with the recommended operating procedures and techniques set forth elsewhere in the Flight Manual. The charts are based on performance under standard atmospheric conditions. Flight test data is based on engines which deliver approximately 400 kp static installed thrust at sea level. Takeoff and climb performance will be affected if thrust of the engines installed in the airplane varies from this value.

FUEL AND FUEL DENSITY.

The normal fuel density figure (for JP-4 fuel) used in preparation of the Flight Manual is 0.78 kg per liter. Present day fuel densities for JP-4 fuel range from 0.749 to 0.801 kg per liter, which can cause variations in aircraft gross weight, resulting in some variation in performance. Also, if the fuel density has been reduced it can be assumed that the heat content of the fuel has changed. (If the heat content of fuel has been reduced aircraft performance per pound of fuel is reduced and less range will be available). Because of the variation in fuel density and heat content of fuel, specific range and rates of fuel flow quoted in terms of liters may show a discrepancy.

If JP-4 (or equivalent) fuel is not available, as an alternate, use JP-1 fuel.

STANDARD CORRECTION CHARTS.

Readings obtained directly from flight airspeed and altimeter instruments must be subjected to certain standard corrections prior to use. Standard correction charts showing the necessary corrections are presented in figures A1-2 through A1-5. These figures include a temperature conversion chart, a compressibility correction to calibrated airspeed chart, a chart on the relationship between TAS, CAS, Mach Number and pressure altitude, and a density altitude chart.

Compressibility correction to calibrated airspeed can be determined from figure A1-3. It is important that the instrument be calibrated if error is suspected. Failure to use airspeed-compressibility correction data properly can result in apparent inability to realize predicted aircraft performance.

A density altitude chart is given to facilitate the calculation of true airspeed and density altitude under different temperature conditions.

SYMBOLS AND DEFINITIONS

SYMBOL	DEFINITION
IAS	Indicated airspeed, airspeed indication uncorrected for instrument error. Where this symbol is used on the performance charts, mechanical error is assumed to be zero.
ΔV_i	Airspeed position error correction.
CAS	Calibrated airspeed. Indicated airspeed corrected for position error: CAS = IAS + ΔV_i.
ΔV_c	Airspeed compressibility correction.
EAS	Equivalent airspeed. Calibrated airspeed corrected for compressibility: EAS = CAS + ΔV_c.
TAS	True airspeed. Equivalent airspeed corrected for atmospheric density.
M	Mach number.
OAT	Outside air temperature.
GS	Groundspeed. True speed relative to the ground. True airspeed corrected for the wind component velocity. GS = TAS + V_w.
H_d	Density altitude, that value obtained from the Density Altitude chart, figure A1-5, at which air density at the observed pressure altitude equals air density as defined by the NASA for standard atmospheric conditions.
Hp or Zp	Pressure altitude.
H_p	Pressure altitude.
ΔH	Altimeter position error.
Atm	Atmosphere.
Vs	Versus.
ρ	Air density at altitude.
ρ_o	Standard air density at sea level.
σ	Relative air density (ρ/ρ_o).
pi	Impact air pressure.
ps	Static air pressure.
pso	Static pressure at ground level.
Zp or Hp	Pressure altitude.
Vi	Is indicated in IAS.
V_w	Wind component velocity.
% RPM or N	Engine speed.
kn (kts)	Knot (Knots).
Lb	Pounds.
Ft	Feet.
Min	Minutes.
nmi	Nautical miles.
W	Aircraft gross weight in pounds.
S.B.	Speed brakes
Co	Speed of sound at standard ground level.
N or % RPM	Engine speed.
mb	Millibar.

Figure A1-1

TEMPERATURE CONVERSION CHART

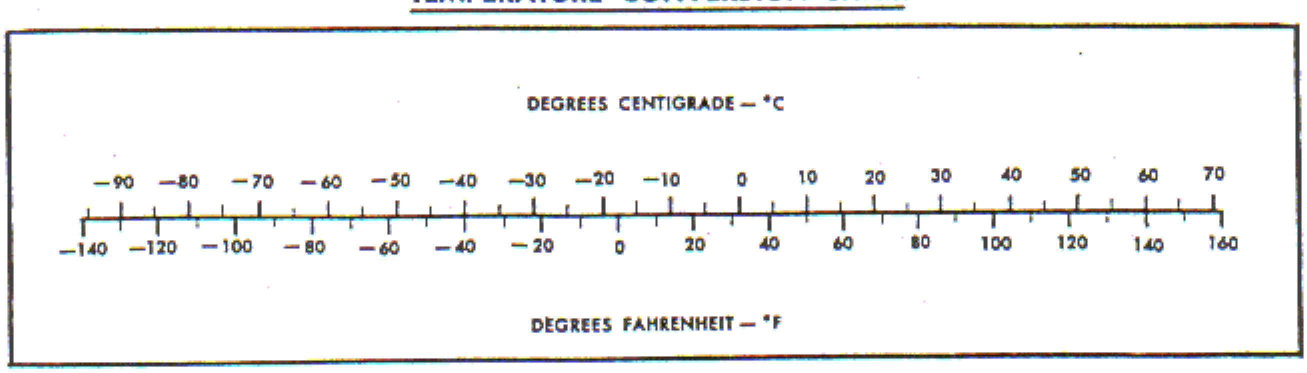
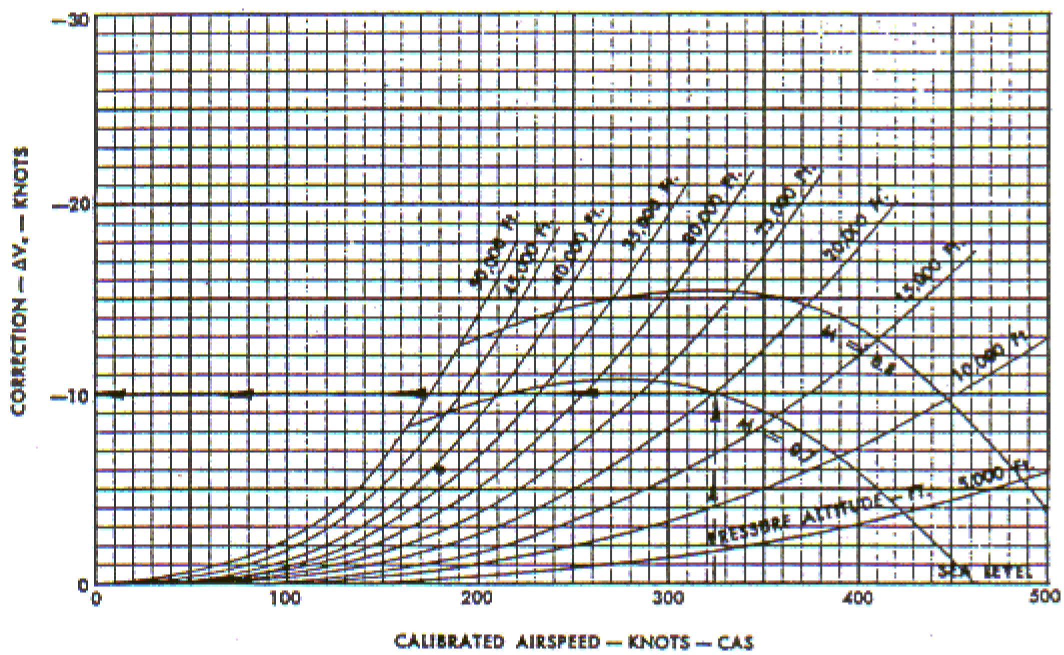


Figure A1-2

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: CALCULATION

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4



REMARKS: ADD COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED ($V_T\sigma^{1/2}$)

E.A.S. = C.A.S. + ΔV_c C.A.S. = E.A.S. − ΔV_c

E.A.S. = EQUIVALENT AIRSPEED ($V_T\sigma^{1/2}$)

C.A.S. = AIRSPEED CORRECTED FOR INSTRUMENT AND POSITION ERRORS

M = MACH NUMBER

Figure A1-3

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: CALCULATION

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

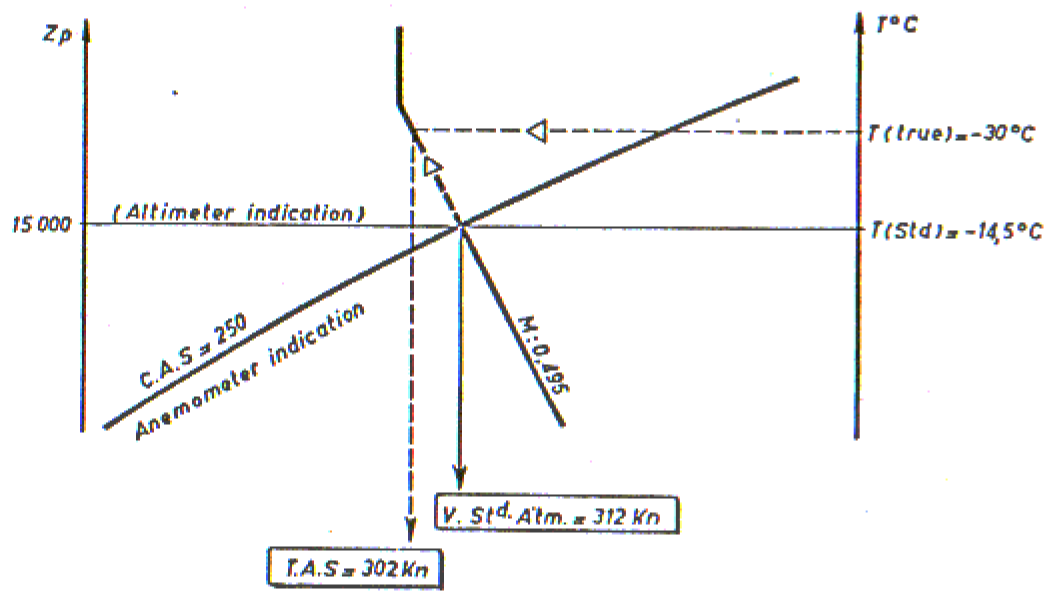
RELATIONSHIP BETWEEN THE TRUE AIRSPEED - T.A.S. CALIBRATED - AIRSPEED - C.A.S. MACH NUMBER - M PRESSURE - ALTITUDE - Zp

CALIBRATED AIRSPEED C.A.S

1. At each altitude, calculate pi-ps Vs. ps & M by the equation $\frac{pi-ps}{ps} = f(M)$
2. At each value of pi-ps, a C.A.S. value has been made to correspond, by means of the equation $\frac{pi-ps}{ps_0} = f\left(\frac{CAS}{Co}\right)$

Co = The speed of sound at standard ground level
ps_0 = Static pressure at ground level

UTILIZATION IN NON-STANDARD ATMOSPHERE



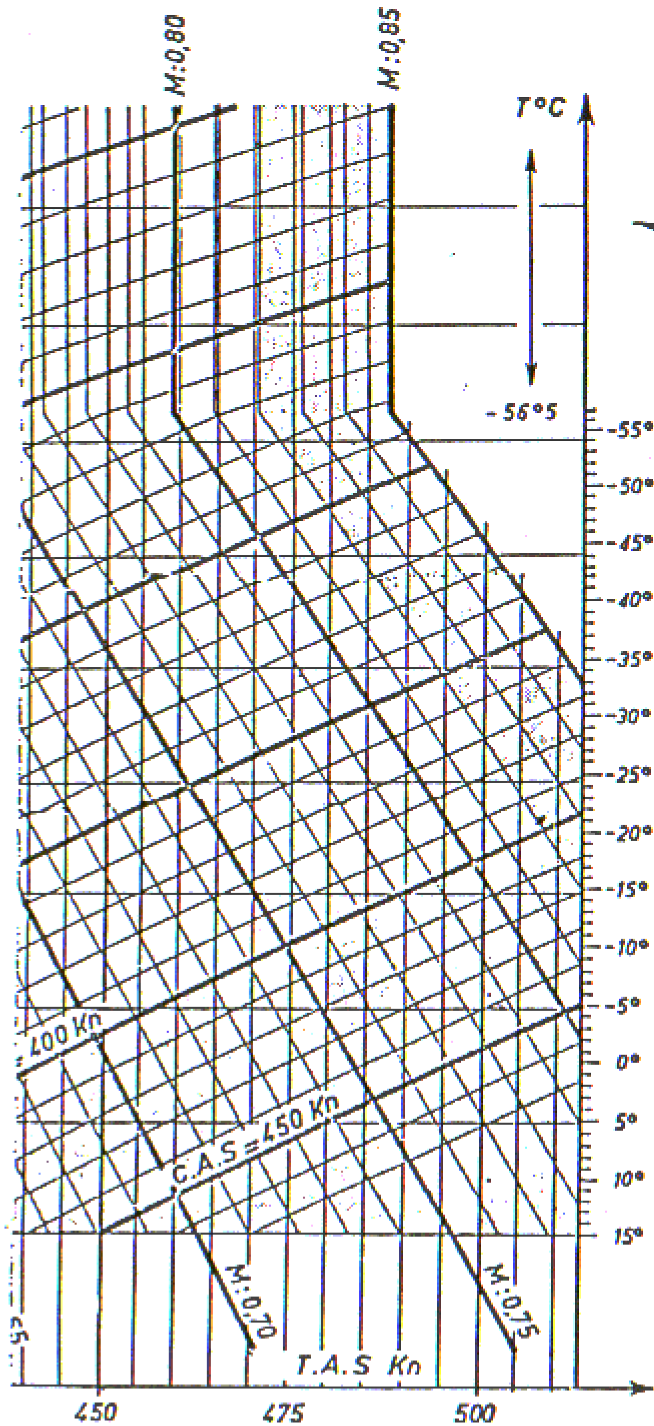


Figure A1-4 (Sheet 1 of 2)

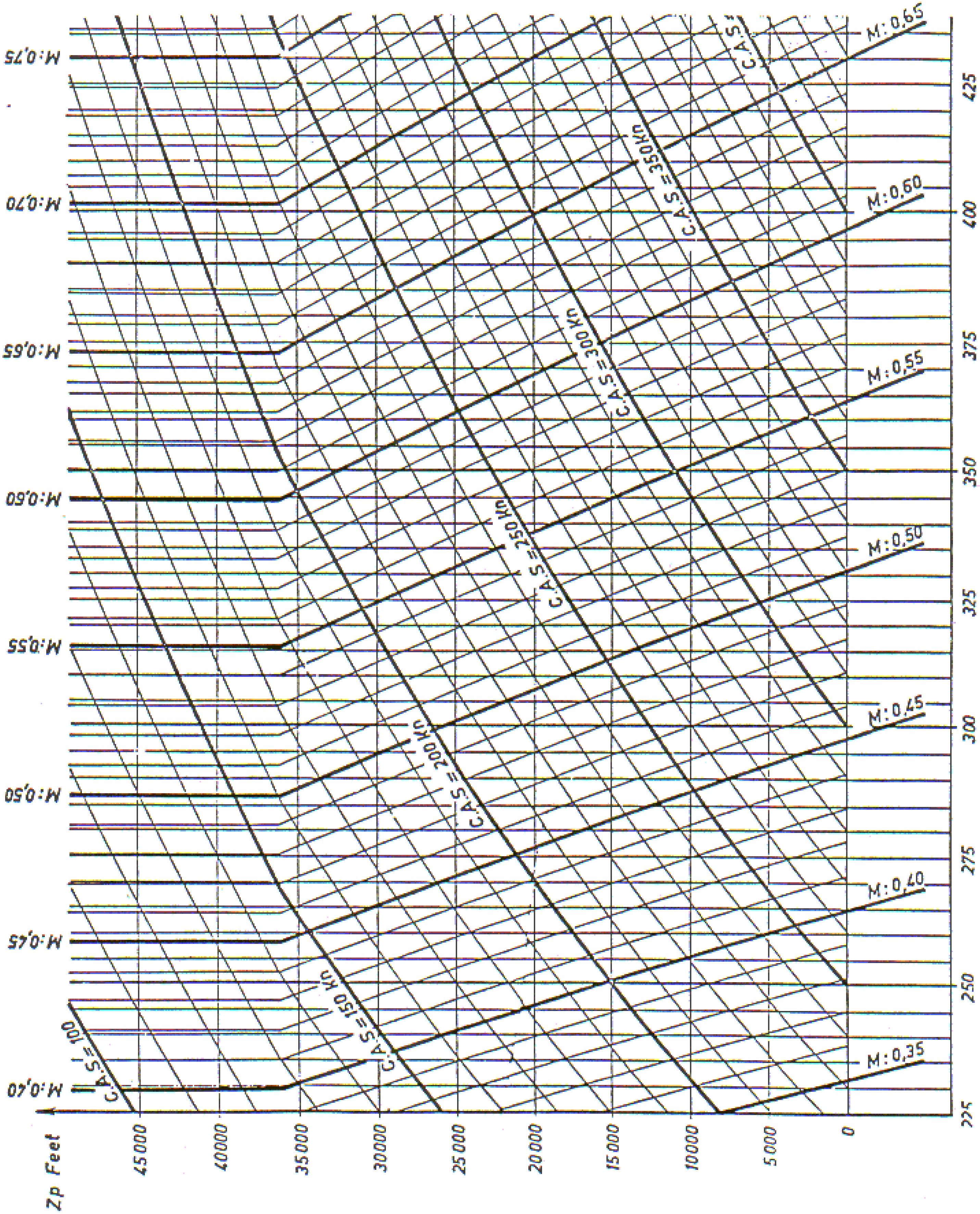


Figure A1-4 (Sheet 2 of 2)

DENSITY ALTITUDE CHART

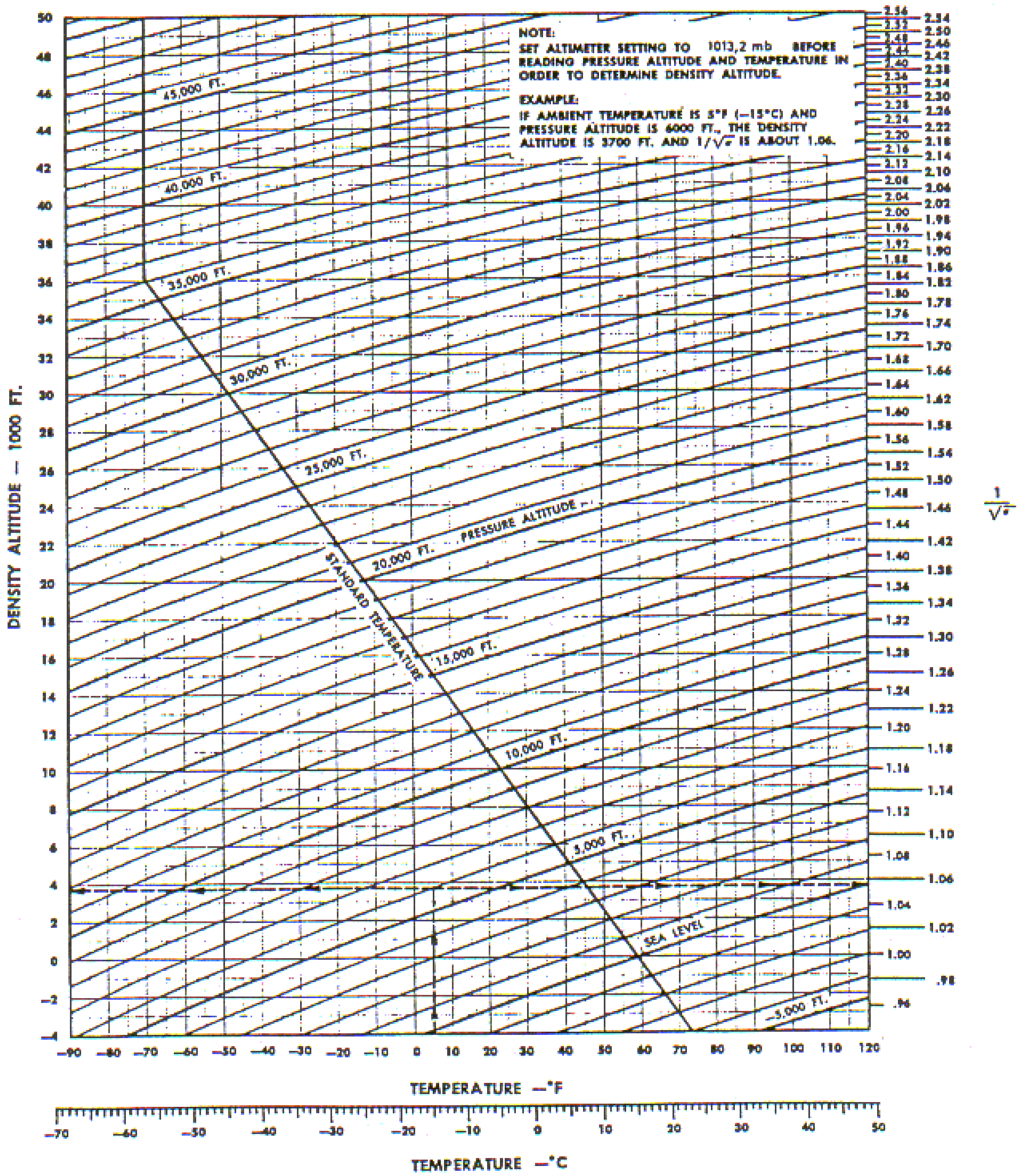


Figure A1-5

Part 2—Takeoff

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RUNWAY WIND COMPONENT.

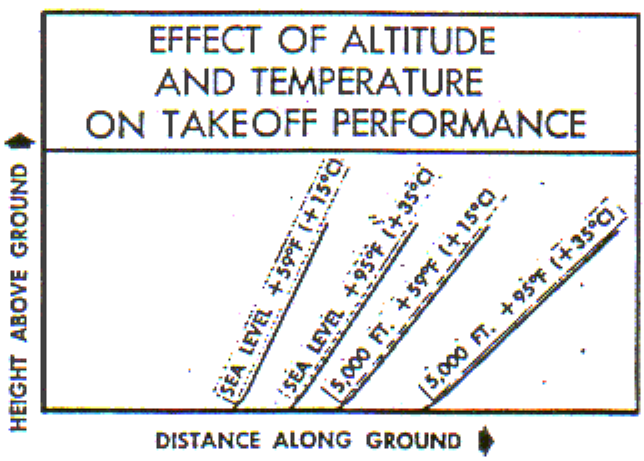
The Wind Component chart is used to determine the wind component parallel and perpendicular to the runway. The crosswind component must be based on maximum gust velocities. Figure A2-1 presents a chart for computing the runway component, crosswind component, and the minimum nosewheel lift-off (or touchdown) speed.

TAKEOFF PERFORMANCE.

The effects of various altitudes, temperatures, and gross weights of 6,400 and 6,850 lbs respectively, on take-off distances are shown on the Takeoff Distance chart (figure A2-2).

EFFECT OF ALTITUDE AND OUTSIDE AIR TEMPERATURE ON TAKEOFF PERFORMANCE.

Engine thrust decreases as altitude or outside air temperature increases. Consequently, greater takeoff distances are required at higher altitudes and on warm days. Representative performance showing the effects of altitude and air temperature on takeoff distances are shown on the following sample curve. Note the rates at which both ground run distance and distance to attain a certain elevation above ground increase at higher outside temperatures and altitudes.



REFUSAL SPEED.

Refusal speed is the highest speed to which the aircraft can be accelerated, assuming normal acceleration, and still be stopped on the runway remaining. The Refusal Speed curve (figure A2-3) gives data which account for normal weight, normal atmospheric conditions, and actual runway lengths. Refusal speed should always be checked when operating from short runways. Refusal speed may be less than acceleration check speed.

REFUSAL DISTANCE.

Refusal distance is that distance at which the aircraft will reach the refusal speed, assuming normal acceleration. Refusal distance is obtained from figure A2-3. This chart is plot of ground run distance versus indicated airspeed and shows a normal acceleration guide line that indicates the speed-distance relationship for normal weight and normal atmospheric conditions.

ACCELERATION CHECK SPEED AND DISTANCE.

The acceleration check distance for this aircraft is a point 2000 feet from the start of the takeoff run. Abort the takeoff if airspeed is less than the minimum acceleration check speed at the check distance point.

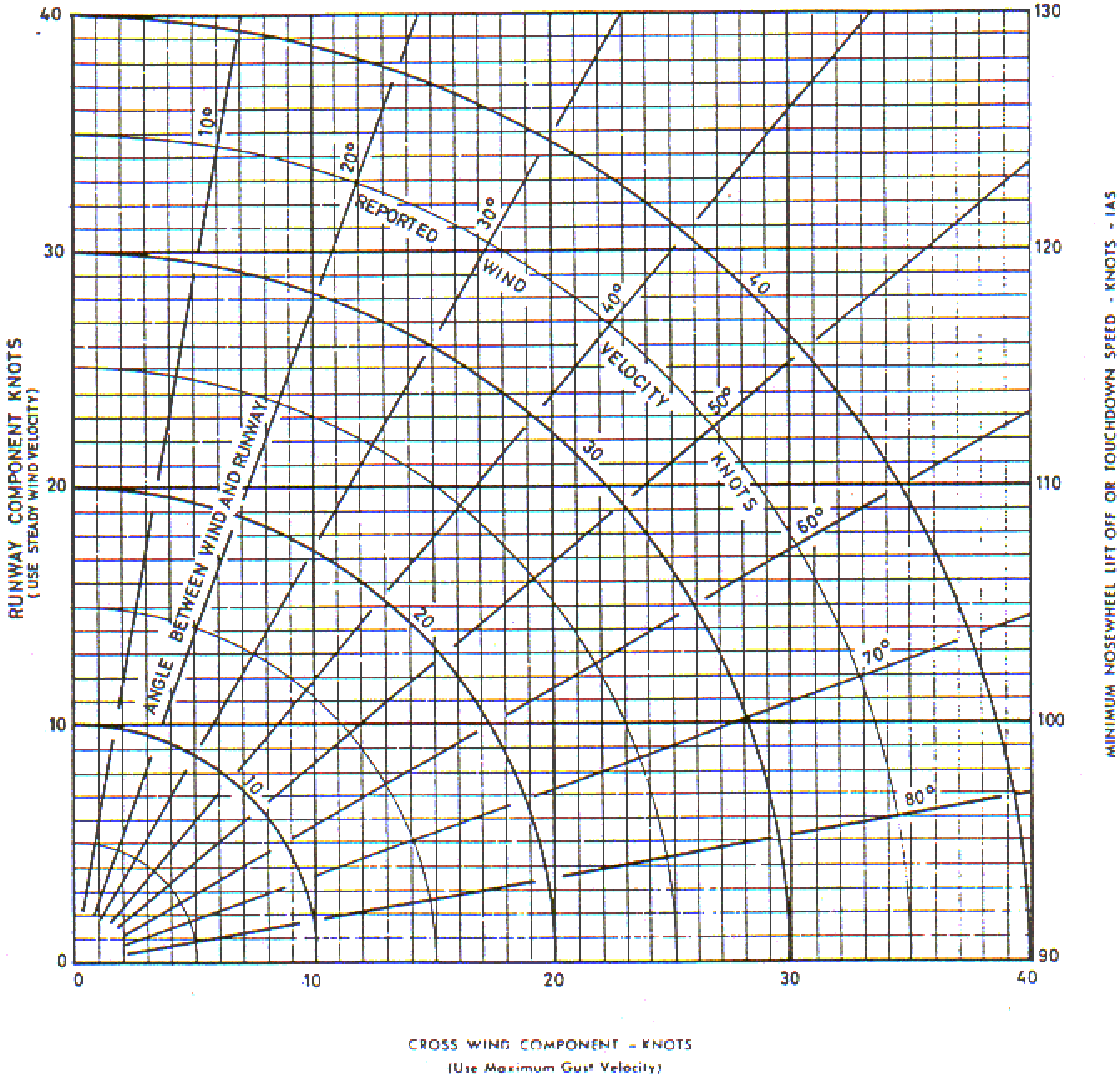
TOTAL DISTANCE TO TAKE OFF AND CLEAR 35 FEET.

The total distance to takeoff and clear a 35-foot obstacle is the sum of the ground run distance and the air distance traveled while attaining a height of 35 feet above the runway. A total distance curve in figure A2-3 is provided. Distances are shown for normal conditions.

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: CALCULATION

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

TAKEOFF AND LANDING WIND COMPONENT CHART



THE "NOT RECOMMENDED AREA" MAY BE OBTAINED BY LOCAL INSTRUCTIONS OF RESPECTIVE AIRBASE.

Figure A2-1

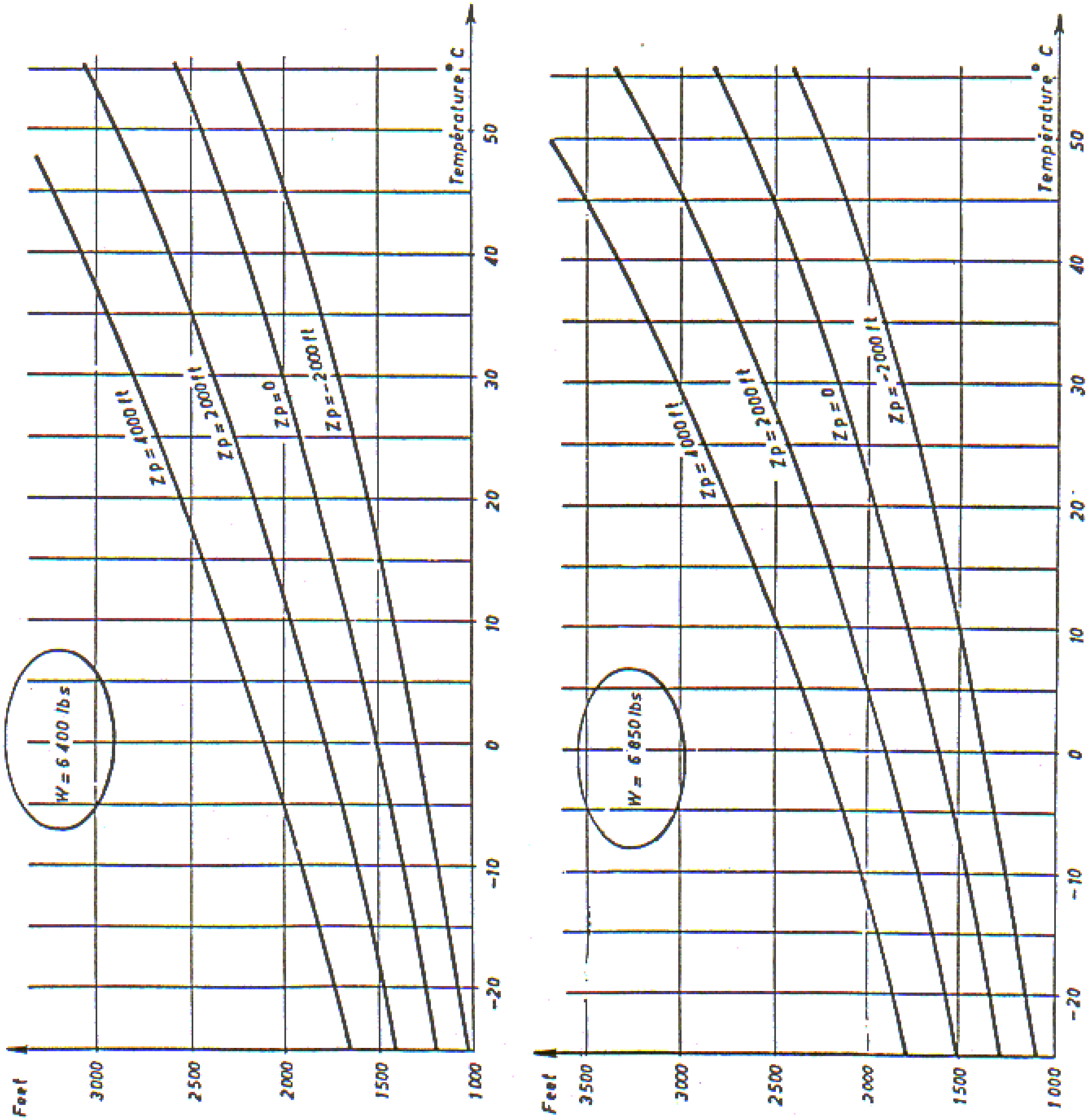
MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

TAKEOFF DISTANCE

(RELATED TO TEMPERATURE AND PRESSURE ALTITUDE)

FLAPS 15°



Note

6400 lbs = no weapons,
2 pilots, empty tip tanks.

Note

6850 lbs = no weapons,
2 pilots, all tanks full.

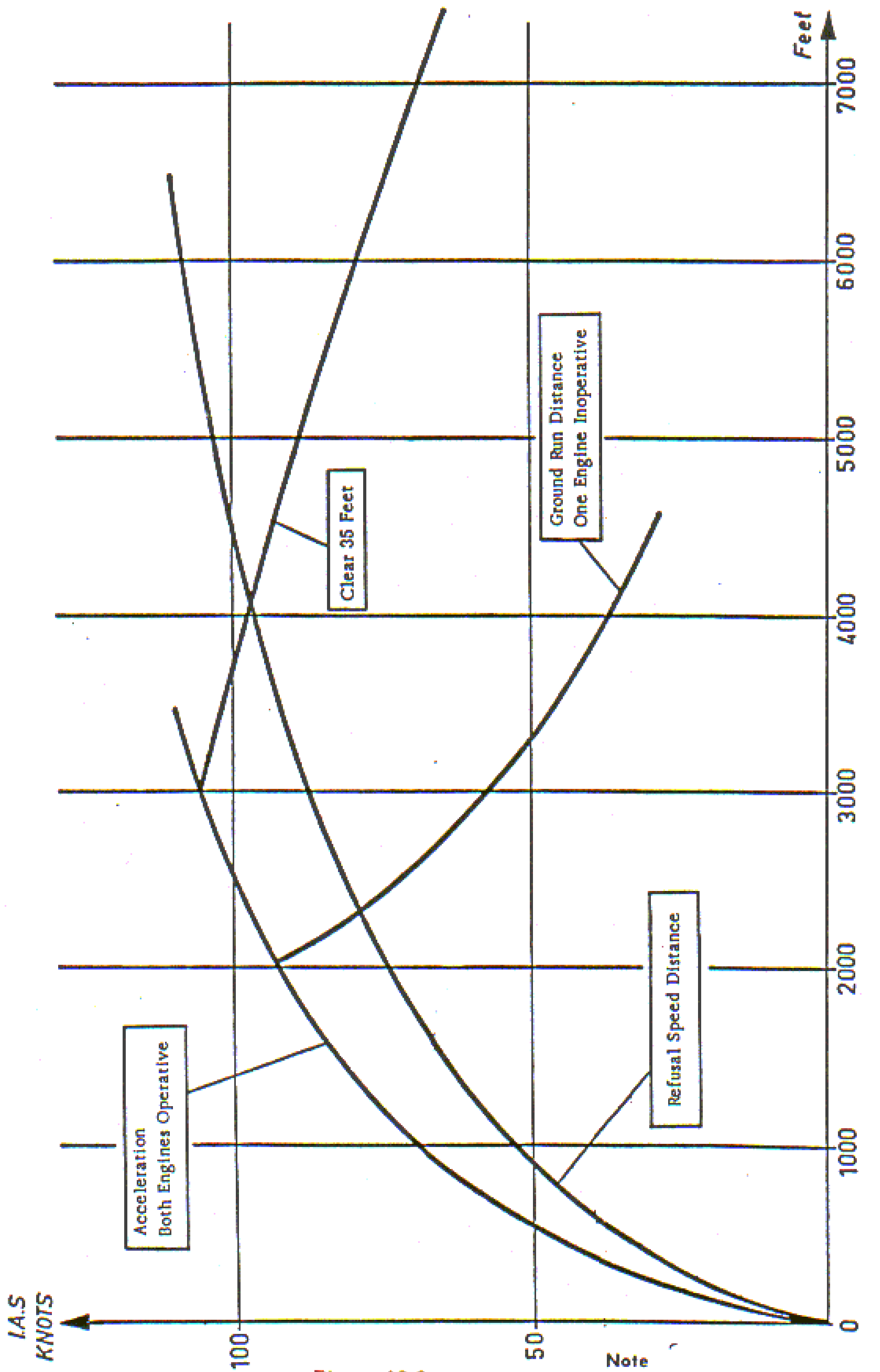
Figure A2-2

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

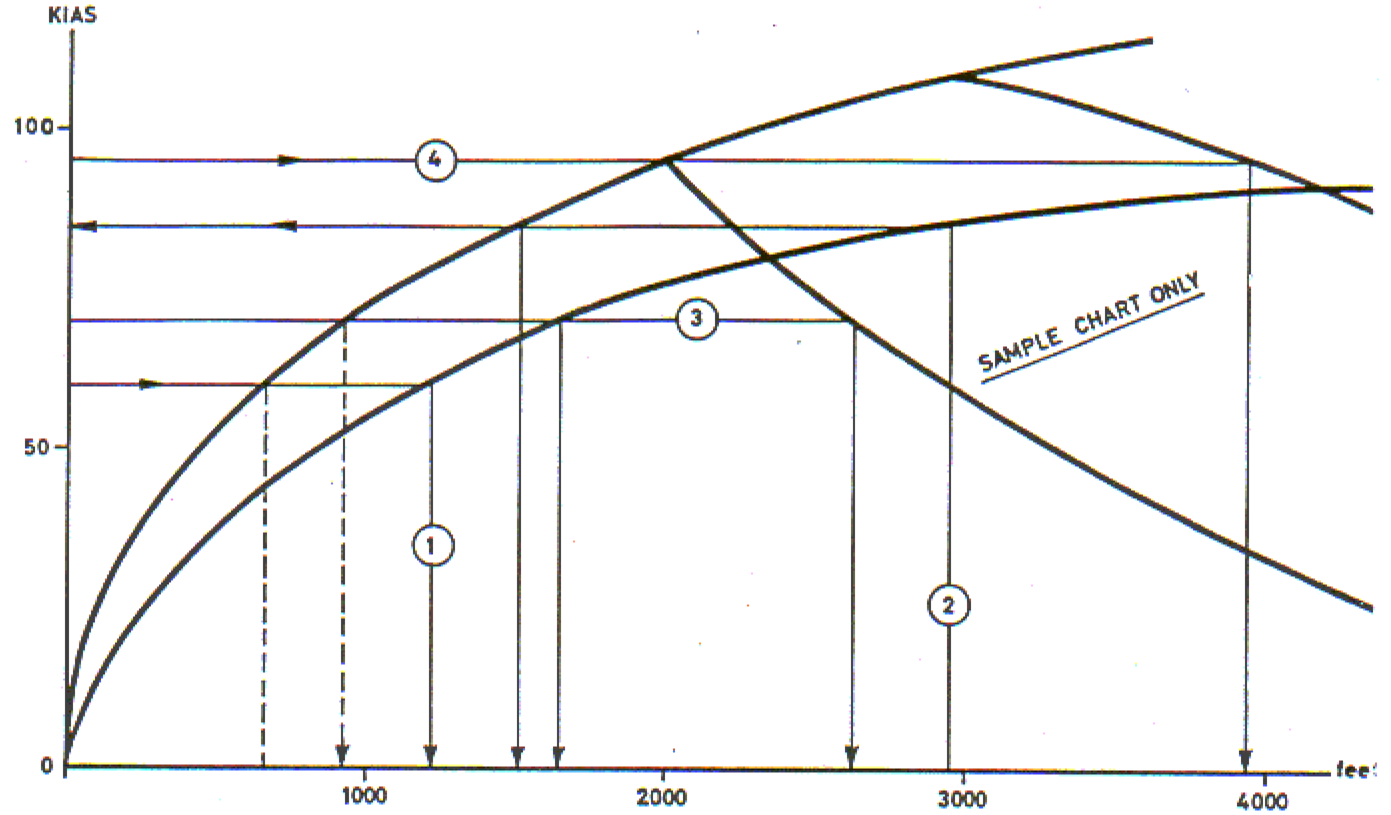
REFUSAL SPEED AND OBSTACLE CLEARANCE

STANDARD ATMOSPHERIC CONDITIONS WEIGHT 6600 lbs.
FLAPS 15°



Note
6600 lbs = no weapons,
1 pilot, all tanks full.

Figure A2-3



Sample 1

With normal acceleration and two engines operative, V_i = 60 KIAS must be reached after 650 feet ground run distance.

Sample 2

On a runway length of 2950 feet, the refusal distance is 1500 feet. That means, under normal conditions the aircraft has traveled a ground distance of 1500 feet and accelerated up to 85 KIAS. With a ground speed of 85 KIAS, a runway length of 1450 feet is required to bring the aircraft to a complete stop. Consequently, the aircraft will come to a stop at the end of the runway.

Sample 3

Assuming one engine becomes inoperative at a speed of 70 KIAS (up to reaching 70 KIAS both engines have normally accelerated and the aircraft, at this speed, has reached a ground run distance of 920 feet - the aircraft may still become airborne, provided that the actual runway length is 2620 feet. If the runway length is less, the takeoff run must be aborted. The aircraft will be stopped at a traveled ground run distance of 1625 feet.

Sample 4

If the aircraft becomes airborne at 95 KIAS, the total distance to clear a 35-foot obstacle is 3940 feet.

Part 3—Climb

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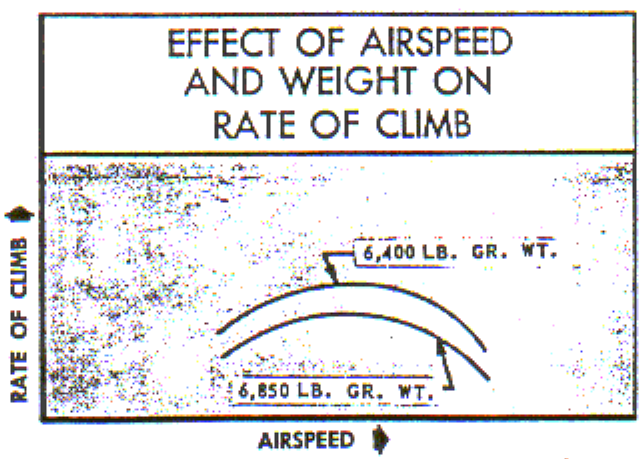
CLIMB PERFORMANCE.

Performance data presented in terms of distance and time-to-climb for altitudes ranging from sea level to 30,000 feet is shown in figure A3-1. This chart displays the relationship of time, fuel, distance, and altitude, obtainable at the recommended climb speed of 200 knots (then Mach 0.42).

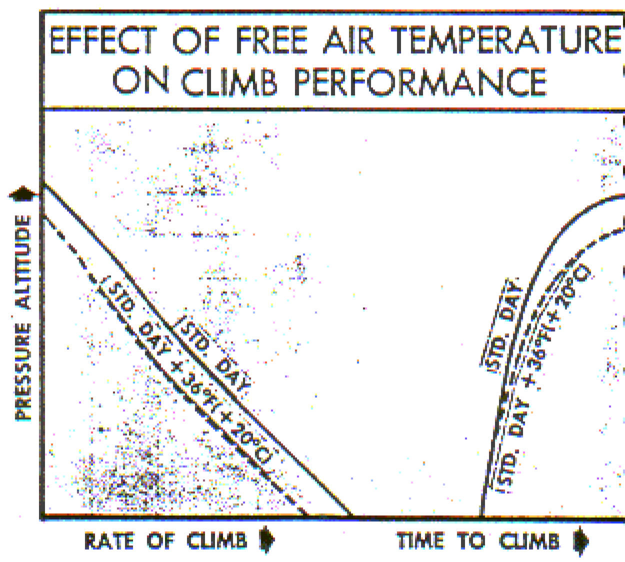
EFFECT OF AIRSPEED AND WEIGHT ON RATE OF CLIMB

A typical variation of rate of climb with airspeed and gross weight is shown on the following sample curve:



EFFECT OF FREE AIR TEMPERATURE ON CLIMB PERFORMANCE

The climb speed decreases with the air temperature rising. Therefore, the time to climb will increase correspondingly. The effect of air temperature on the climb performance is demonstrated on the following sample curve:



MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

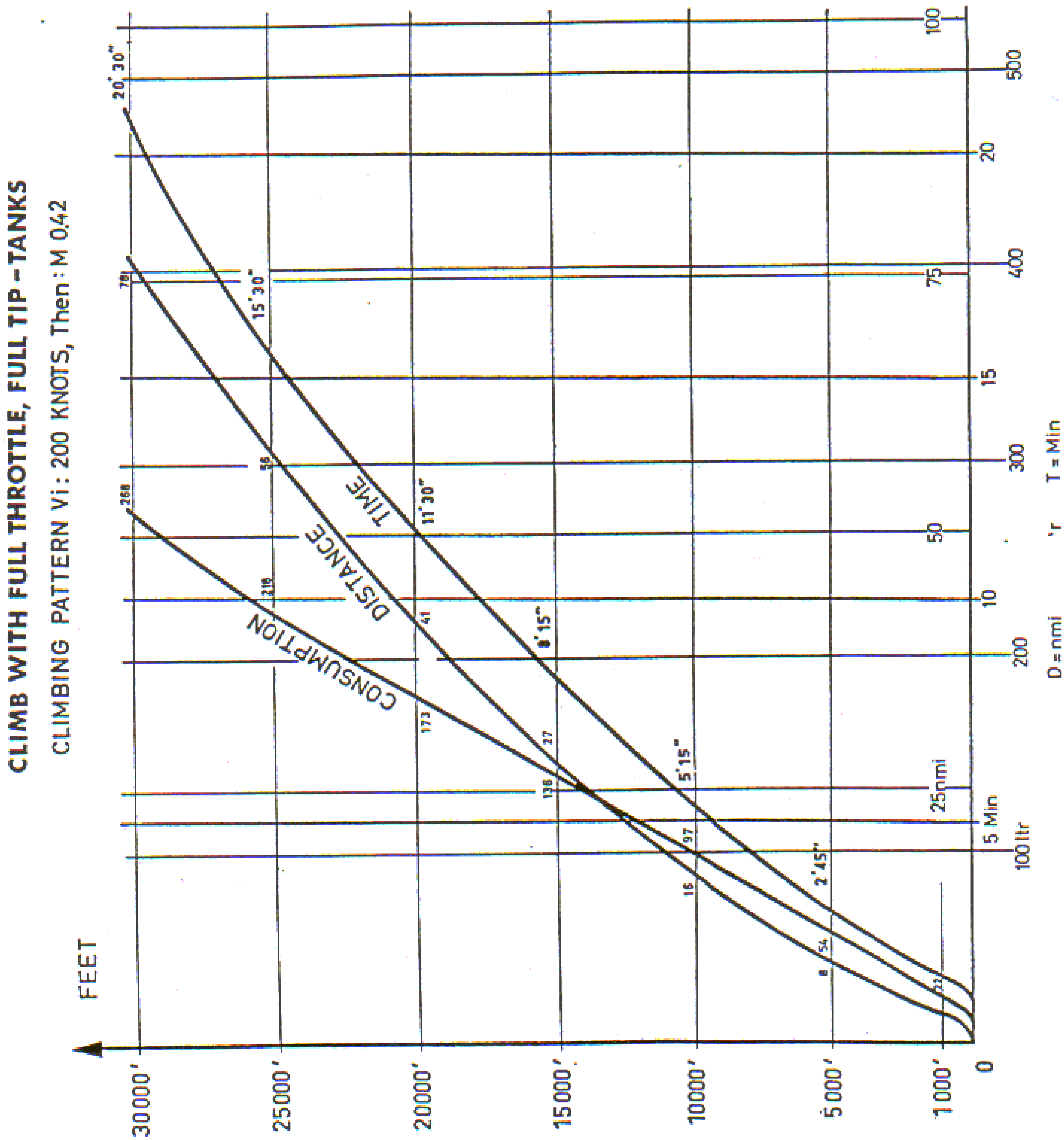


Figure A3-1

Part 4 — Range

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RANGE PERFORMANCE.

The Mission Profile charts present the range characteristics of the aircraft in a convenient pictorial form and allow accurate flight planning for the majority of missions where cruise control must be considered. Using these charts eliminates much of the computation required in adapting data from the graphical nautical-miles-per-gallon and climb charts to obtain correct estimates of the fuel and time to fly a particular mission. This is done by pictorially presenting the relationship of time, fuel, and distance, obtainable at optimum cruise settings, for all altitudes at which the aircraft is capable of flying. The Mission Profile charts are presented for RPM values from 18.000 to 21.000.

Miles-per-liter charts, which can be used for planning operations, are included in Part 6.

MISSION PROFILE CHARTS.

The Mission Profile charts (A4-1 to A4-4) present both the level flight cruise and the variable altitude (cruise-climb) maximum range characteristcs of the aircraft. The charts give the time and fuel required to fly a given distance under a no-wind condition at any cruising altitude from sea level to the optimum cruise-climb altitude.

CHART ARRANGEMENT.

In general, the Mission Profile chart is read from left to right in a flight sequence of initial climb followed by cruising flight. The initial climb path is indicated by a solid line; it shows the distance traveled in climbing from the point where the initial climb speed is reached, to the point any desired cruising altitude is reached. At the point any desired distance is reached, the fuel remaining in the aircraft fuel system is indicated in squares (21 etc.).

The time elapsed after takeoff is given in hours and minutes (2 H 26).

At last, the charts shown also the increased ranges for visual flight rules descent with idle power setting.

LEVEL FLIGHT SPEED.

In figure A4-5, The relationship of engine speed(RPM), airspeed (CAS), and the Mach number based on different altitudes is presented.

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

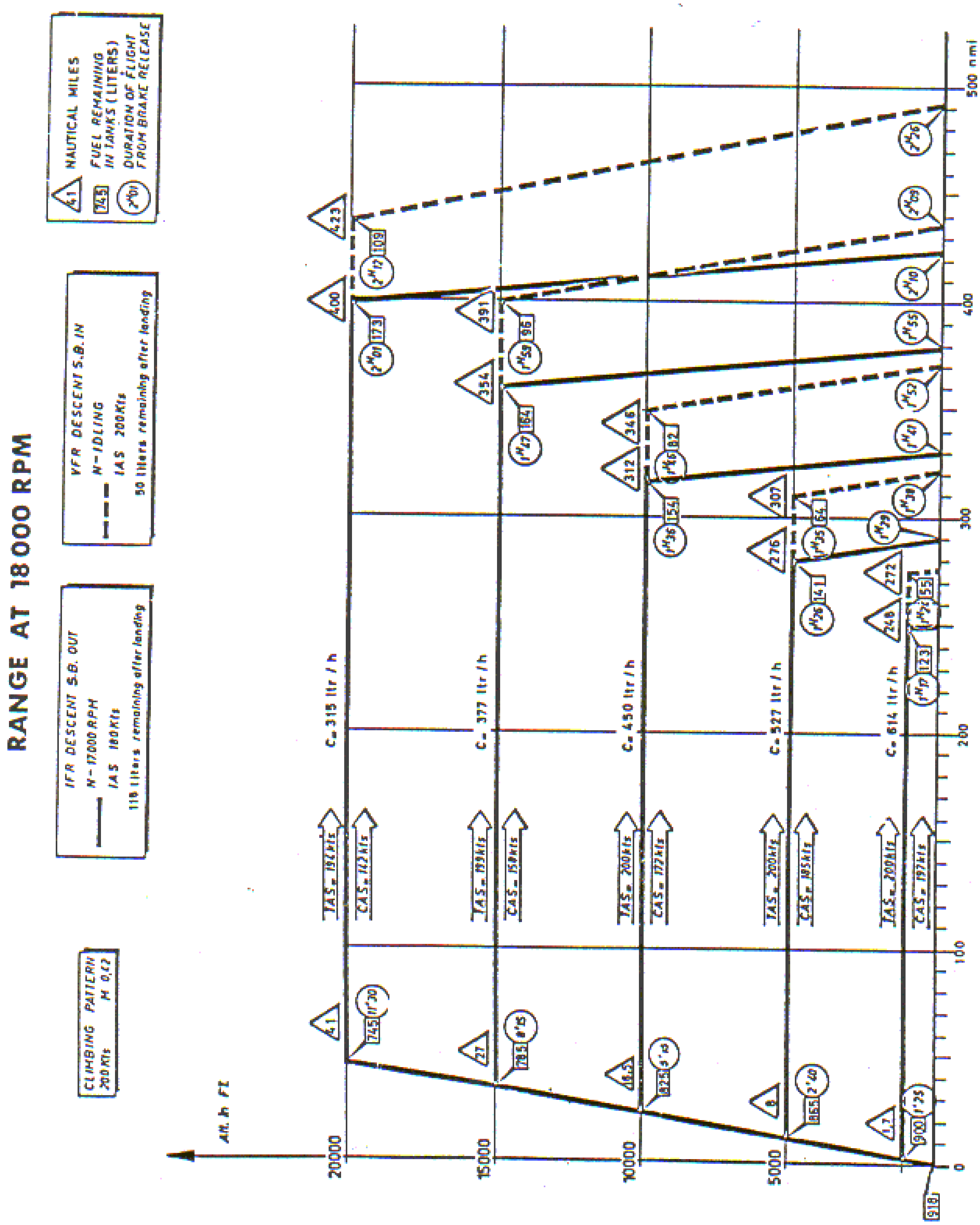

Figure A4-1

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

RANGE AT 19000 RPM

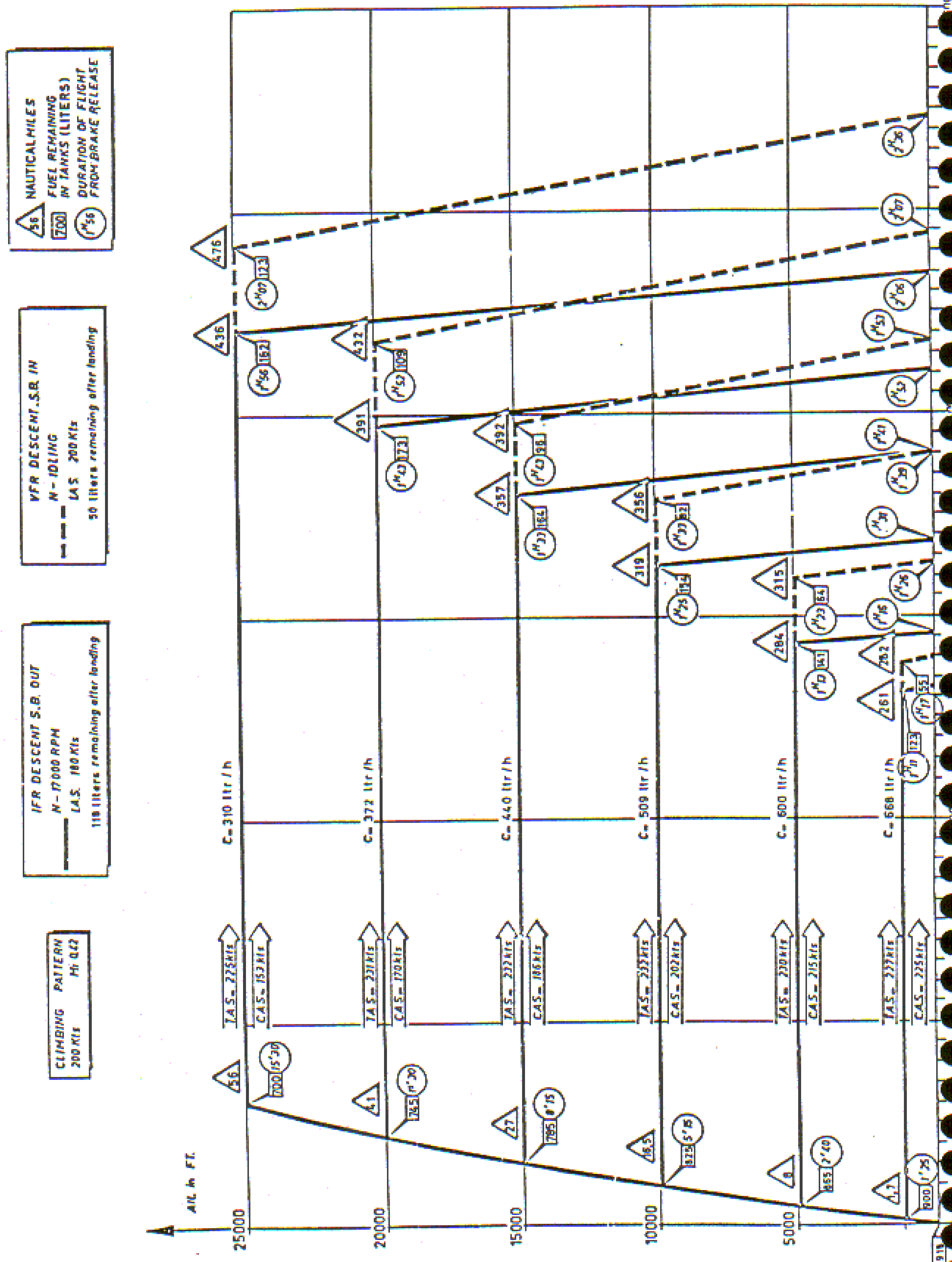

Figure A4-2

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

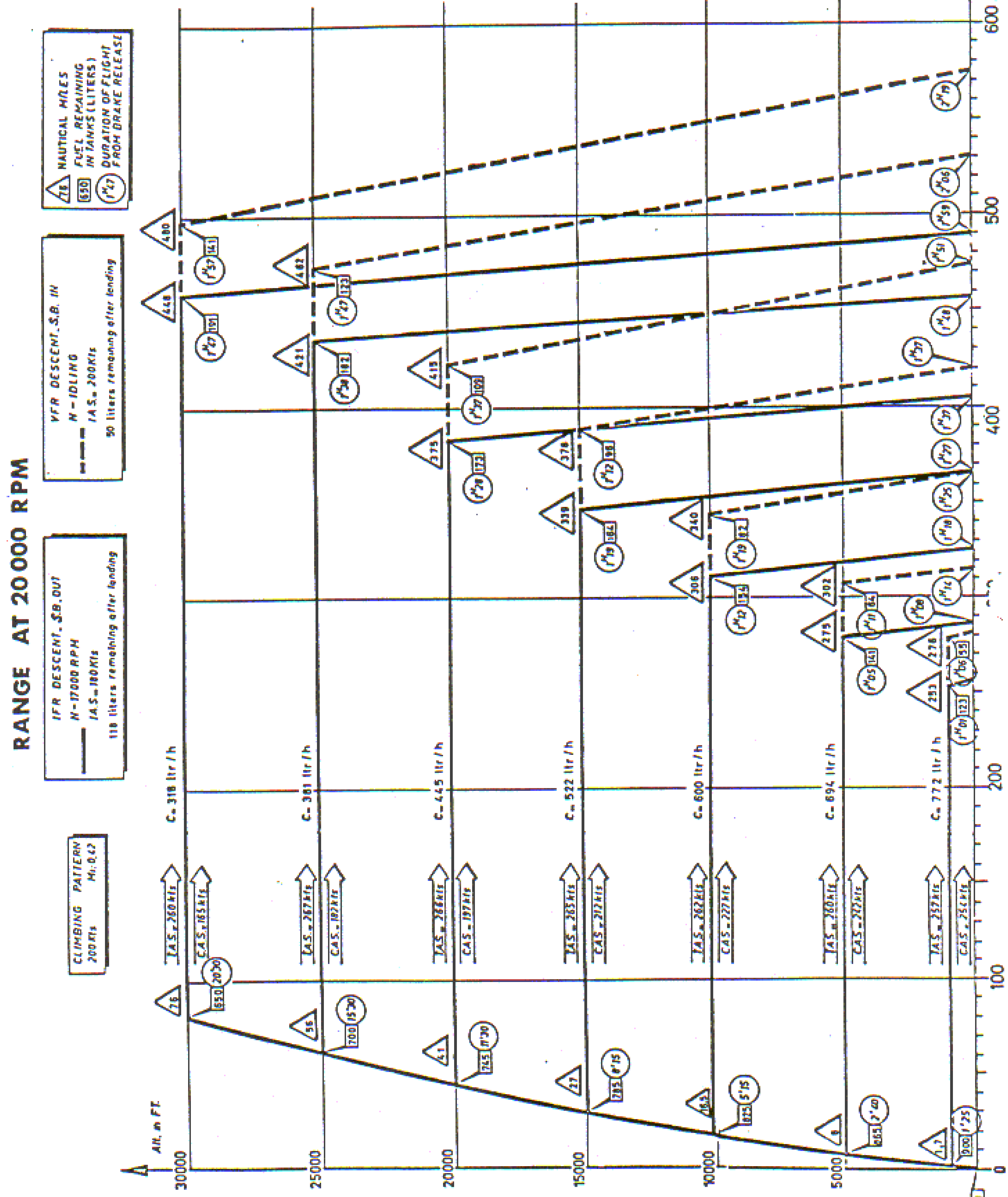

Figure A4-3

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

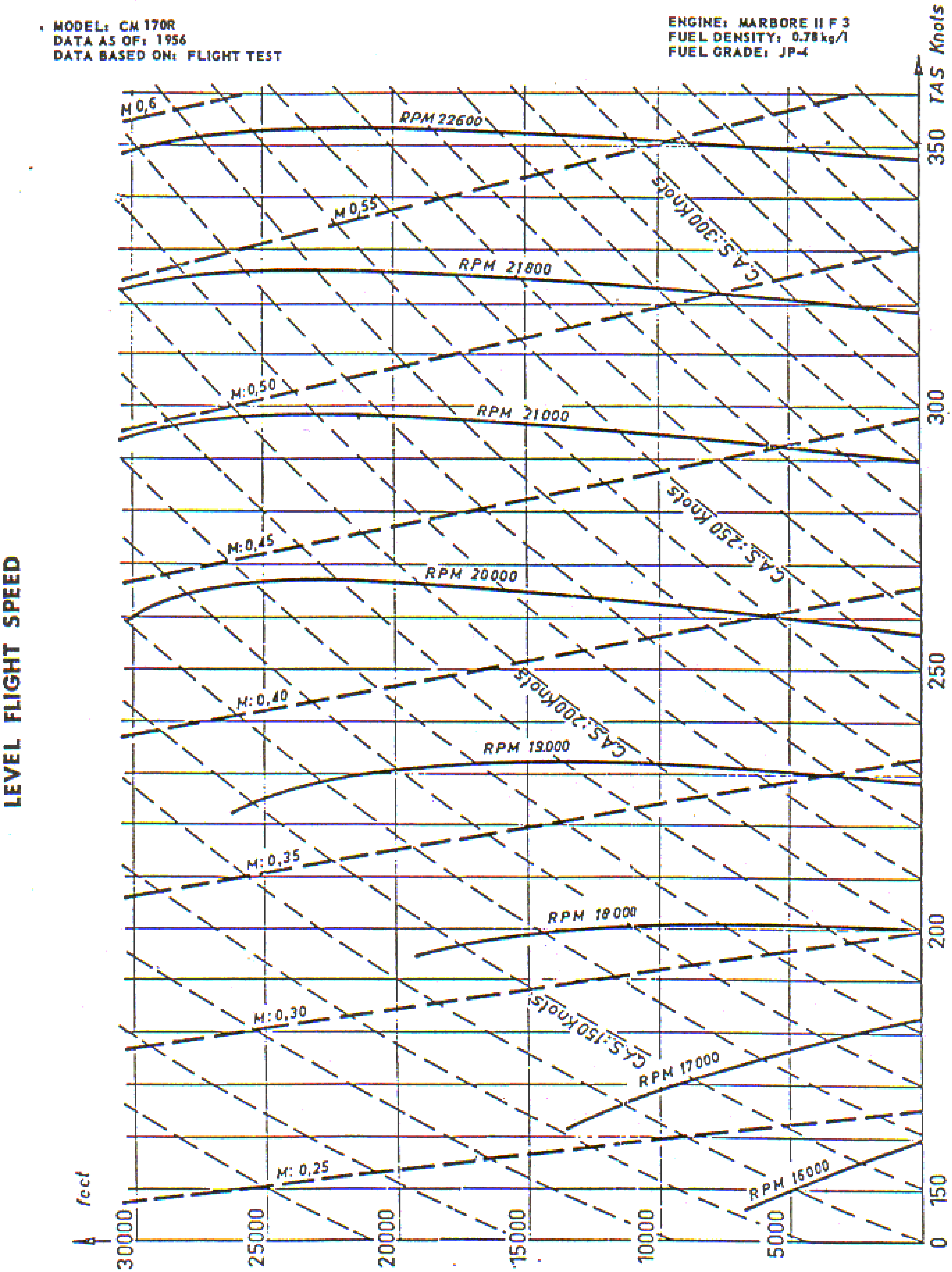

Figure A4-5

Note

Flight test performed with no weapons, with empty tip tanks and 1 pilot.

Part 5 — Descent

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DESCENT PERFORMANCE.

Descent performance data presented in terms of distance and time-to-descend for altitude ranging from 30,000 feet to sea level for different power settings and descent flight rules is shown in figure A5-1. This chart displays the relationship of time, fuel, distance, and altitude, obtainable at the different descent speeds and power settings.

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

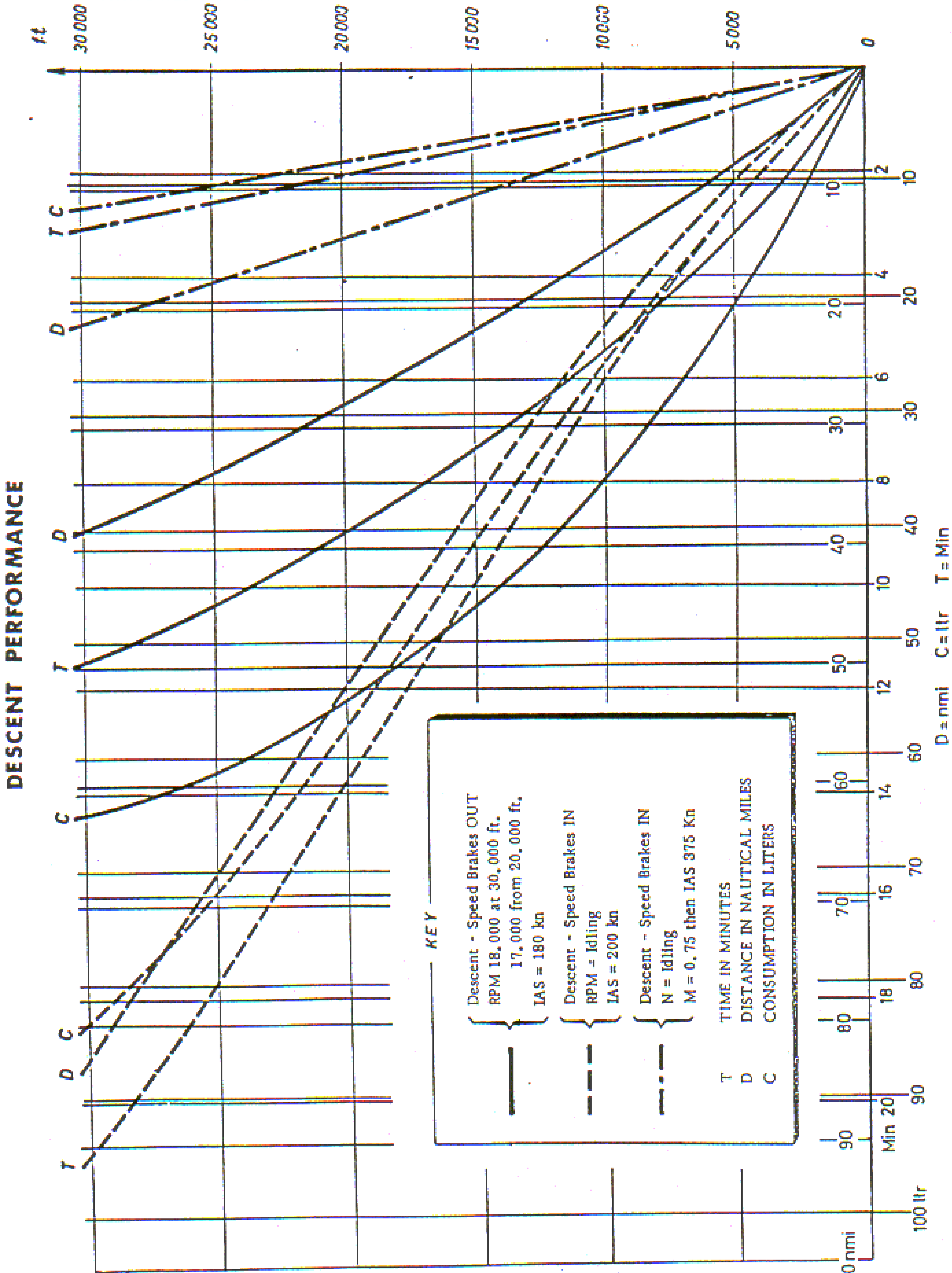

Figure A5-1

Part 6 – Nautical Miles Per Liter of Fuel

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NAUTICAL MILES PER LITER OF FUEL PERFORMANCE.

The Nautical Miles Per Liter of Fuel chart (figure A6-1) furnishes standard day aircraft performance in terms of nautical miles per liter of fuel for level flight operation in zero wind under any condition from 15.000 to 22.000 RPM. The chart is given for altitudes from sea level to 30.000 feet, in increments of 5.000 feet, for the aircraft configuration with tip tanks (gross weight 6.000 lbs).

The Hourly Consumption Vs. Speed chart (figure A6-2) displays the hourly fuel consumption in relationship of speed (TAS) and altitudes.

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4

DISTANCE COVERED PER US GALLON AND LITER

Note
Test flight performed with empty tip tanks, no weapons, one pilot.

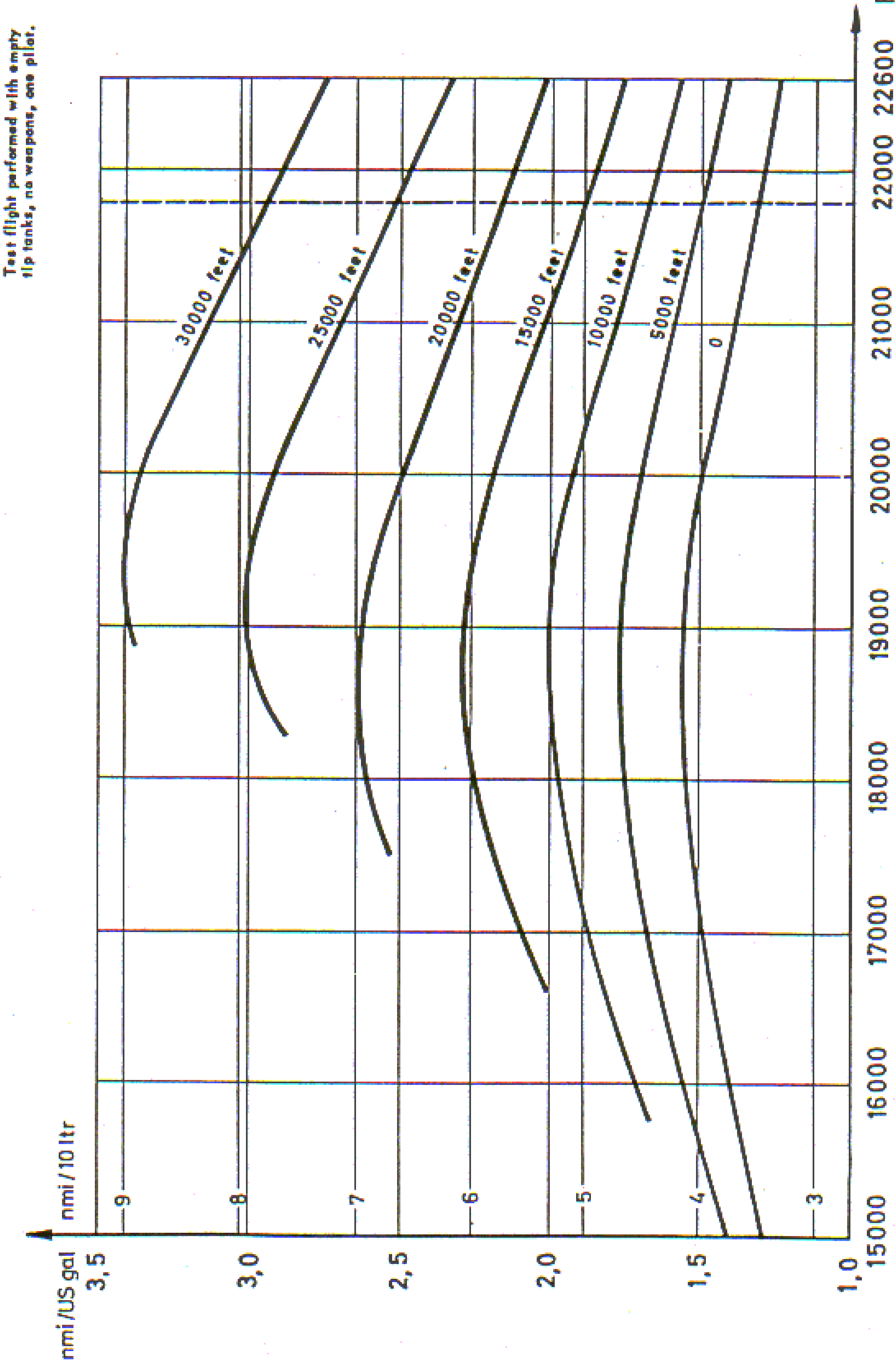
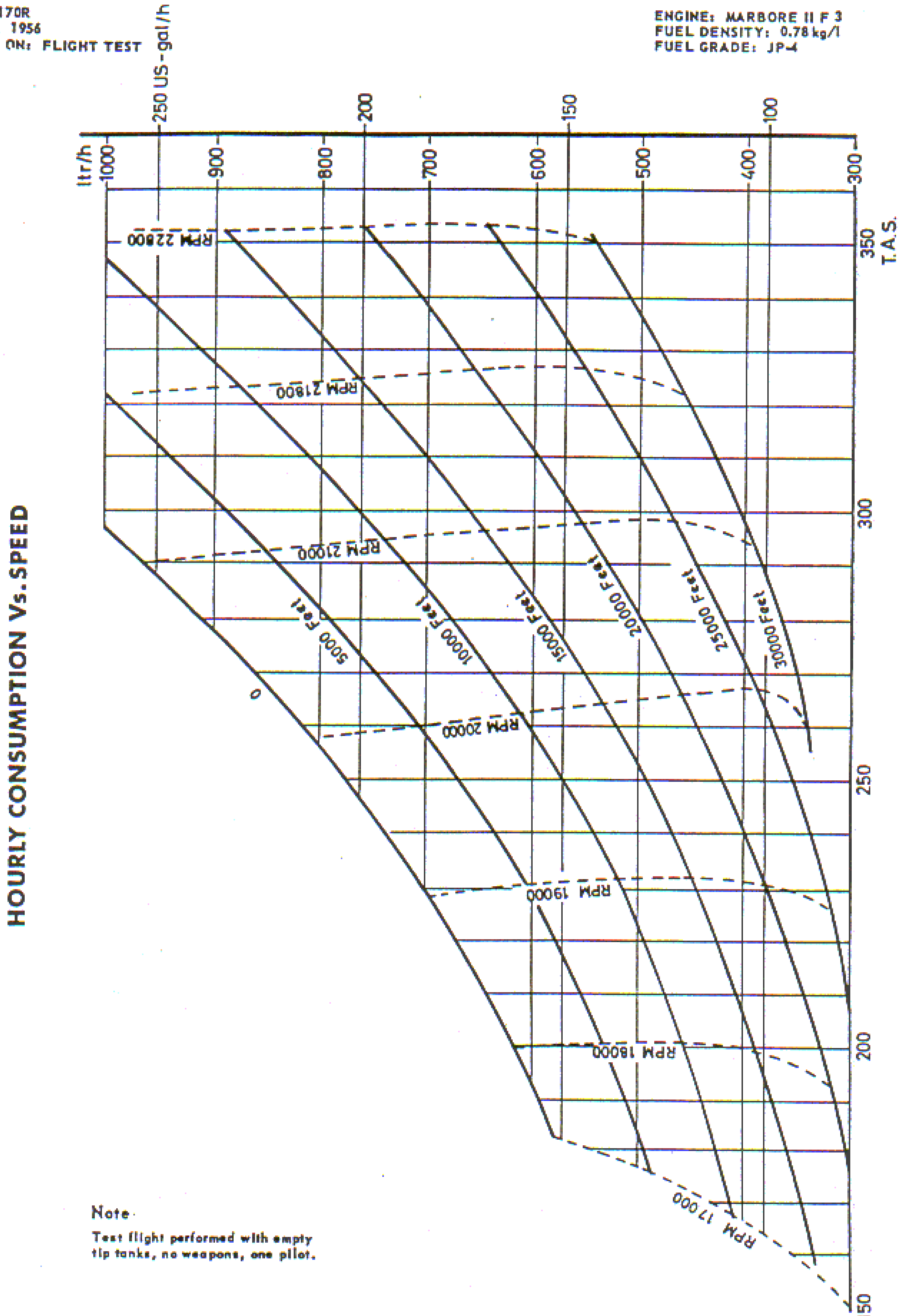


Figure A6-1

MODEL: CM 170R
DATA AS OF: 1956
DATA BASED ON: FLIGHT TEST

ENGINE: MARBORE II F 3
FUEL DENSITY: 0.78 kg/l
FUEL GRADE: JP-4



Note
Test flight performed with empty tip tanks, no weapons, one pilot.

Figure A6-2

ALPHABETICAL INDEX

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