P.I. 1T-MB326GB-1

FLIGHT MANUAL

AERMACCHI MB-326GB

AIRCRAFT

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AERONAUTICA MACCHI - VARESE (Italia)
Technical Publications Department

P.I. 1T-MB326GB-1

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AIRCRAFT

This change replaces supplement P.I. 1T-MB326GB-1A .
dated 15 May 1971.

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CHANGE 1 - 20 NOVEMBER 1971

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Section I, II and III are closely interrelated and contain complete information relative to the physical act of flying the aircraft under normal or emergency conditions.

Section II NORMAL PROCEDURES 2-1

Section III EMERGENCY PROCEDURES 3-1

Section IV AUXILIARY EQUIPMENT 4-1

Section IV contains a description and operation of such auxiliary equipment as: cabin conditioning, navigation, radio, oxygen, armament.

Section V OPERATING LIMITATIONS 5-1

Contains all operating limitations and restrictions except those which are characteristic of only one phase of operation.

Section VI FLIGHT CHARACTERISTICS 6-1

Cover flight characteristics of the aircraft.

Section VII SYSTEMS OPERATION 7-1

Not applicable, all information formerly contained in this section is now contained in Section I.

Section VIII CREW DUTIES 8-1

Not applicable.

Section IX ALL WEATHER OPERATION 9-1

Instructions for instrument flight, cold weather operation, ecc.

Appendix I PERFORMANCE DATA A-1

Contains all performance data required for preflight and inflight mission planning.

Foreword

SCOPE. This manual contains the necessary information for safe and efficient operation of the MB-326GB 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.

PERMISSIBLE OPERATIONS. The Flight Manual takes a positive approach, and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein.

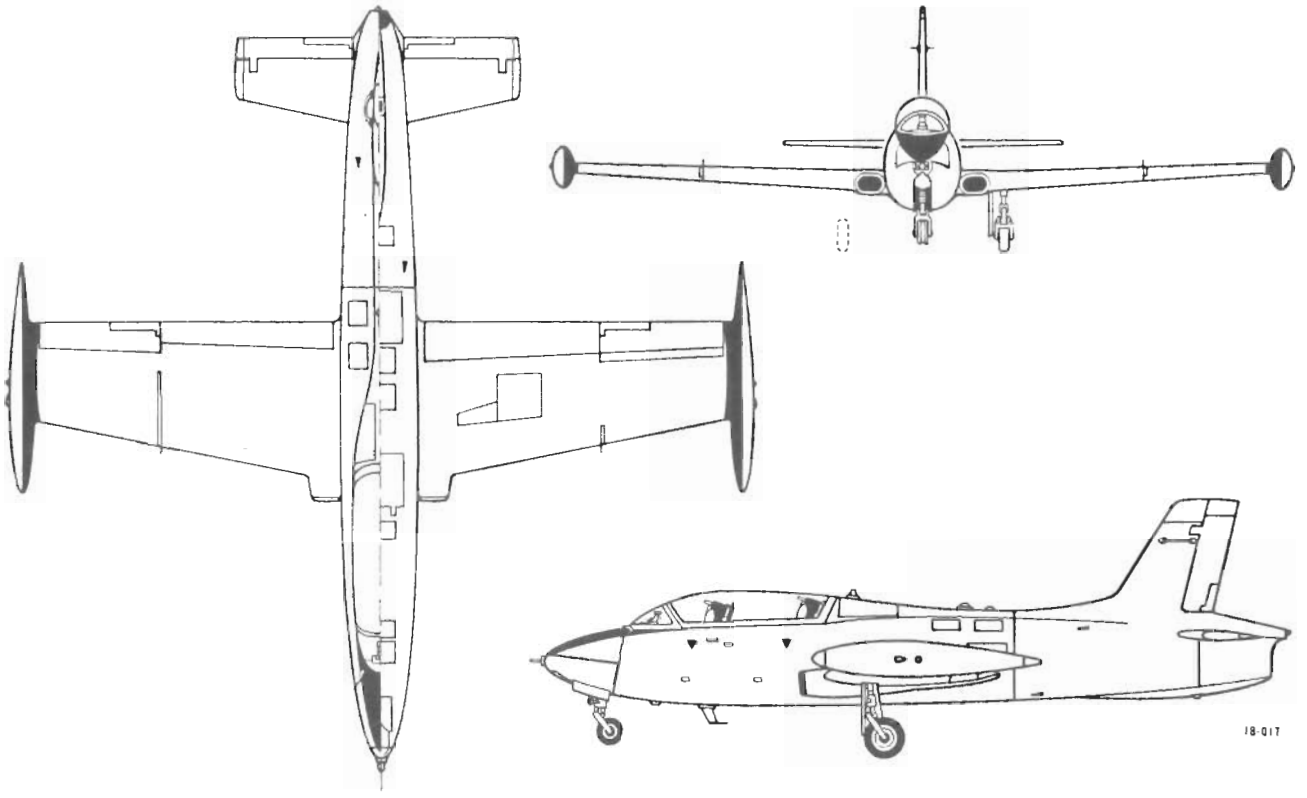
CHECKLISTS. The Flight Manual contains the amplified checklists. Abbreviated checklists will be issued in a separate publication. Whenever a Safety Supplement affects the abbreviated checklist, write-in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement, will be issued.

WARNINGS, CAUTIONS AND NOTES. The following definitions apply to "Warnings", "Cautions" 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.



MB-326GB



SECTION I
DESCRIPTION

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AIRCRAFT

The Aermacchi MB-326GB is a single-engine, tandem two-seat aircraft with semi-low wing and retractable tricycle landing gear. The aircraft can be used as a trainer or in its armed version, six strong points being provided under the wing for the attachment of ordnance loads. The aircraft is powered by an axial flow turbojet engine.

AIRCRAFT DIMENSIONS

The main dimensions of the aircraft are as follows:

— Wing span	35.03 ft
— Fuselage length	35.02 ft
— Height	12.20 ft

AIRCRAFT GROSS WEIGHT

The approximate take-off gross weight of the aircraft is as follows:

— Training configuration	8800 lb
— Weapons training configuration	11500 lb

ENGINE

The Rolls-Royce Viper 20 MK540 turbojet engine (fig. 1-2) has a rated sea-level static thrust of approximately 3400 lb at maximum power.

During engine operation, air enters the intake ducts, one on either side of the fuselage on the wing leading edge, and is routed to an axial-flow compressor, where it is compressed progressively in 8 stages. The compressed air then flows to the annular combustion chamber, where atomized fuel is injected and combustion occurs. From the combustion chamber, the hot exhaust gases pass through the turbine and tail pipe to provide the high-velocity jet and reaction thrust. The turbine, which is rotated by the exhaust gases, is directly connected to the compressor.

ENGINE FUEL CONTROL SYSTEM

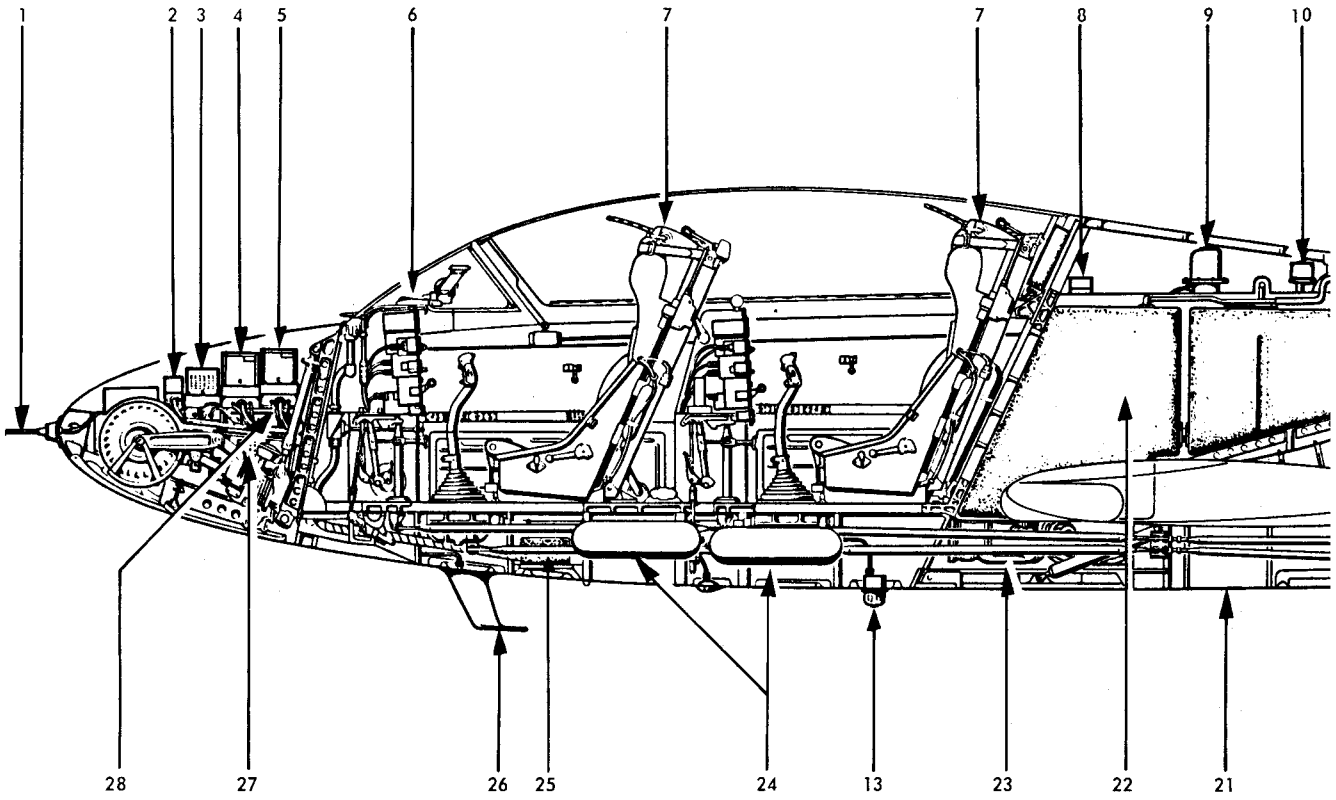
Fuel from the aircraft tanks is pumped (fig. 1-4) by the booster pump through a shut-off valve (L.P. cock) to the low pressure filter. After passing through the L.P. filter the fuel is piped to the engine-driven high pressure pump. The pump is designed to supply fuel in excess of engine requirements. The flow from the pump is controlled by the following components:

- A hydro-mechanical maximum rpm governor
- A barometric flow control unit (B.F.C.U.)
- An air/fuel ratio control (A/F.R.C.)
- An electro pressure control (E.P.C.)

A rate reset valve is fitted to correct the pressure of the fuel flowing into the fuel pump governor rotor chamber, thus ensuring that changes in the fuel pump delivery pressure due to altitude do not affect maximum governed rpm. The pump supplies fuel under pressure to the B.F.C.U. The flow control houses a throttle assembly by means of which any engine speed may be selected, and a barometric capsule stack, sensitive to air intake pressure, which maintains the selected rpm under varying conditions of altitude and forward speed. Also incorporated in the control is a high pressure shut-off cock which provides a means of stopping the engine by interrupting the fuel supply to the combustion chamber. The electro pressure control (EPC) serves to limit JPT down to 725°C when the "JPT LIM" switch is on.

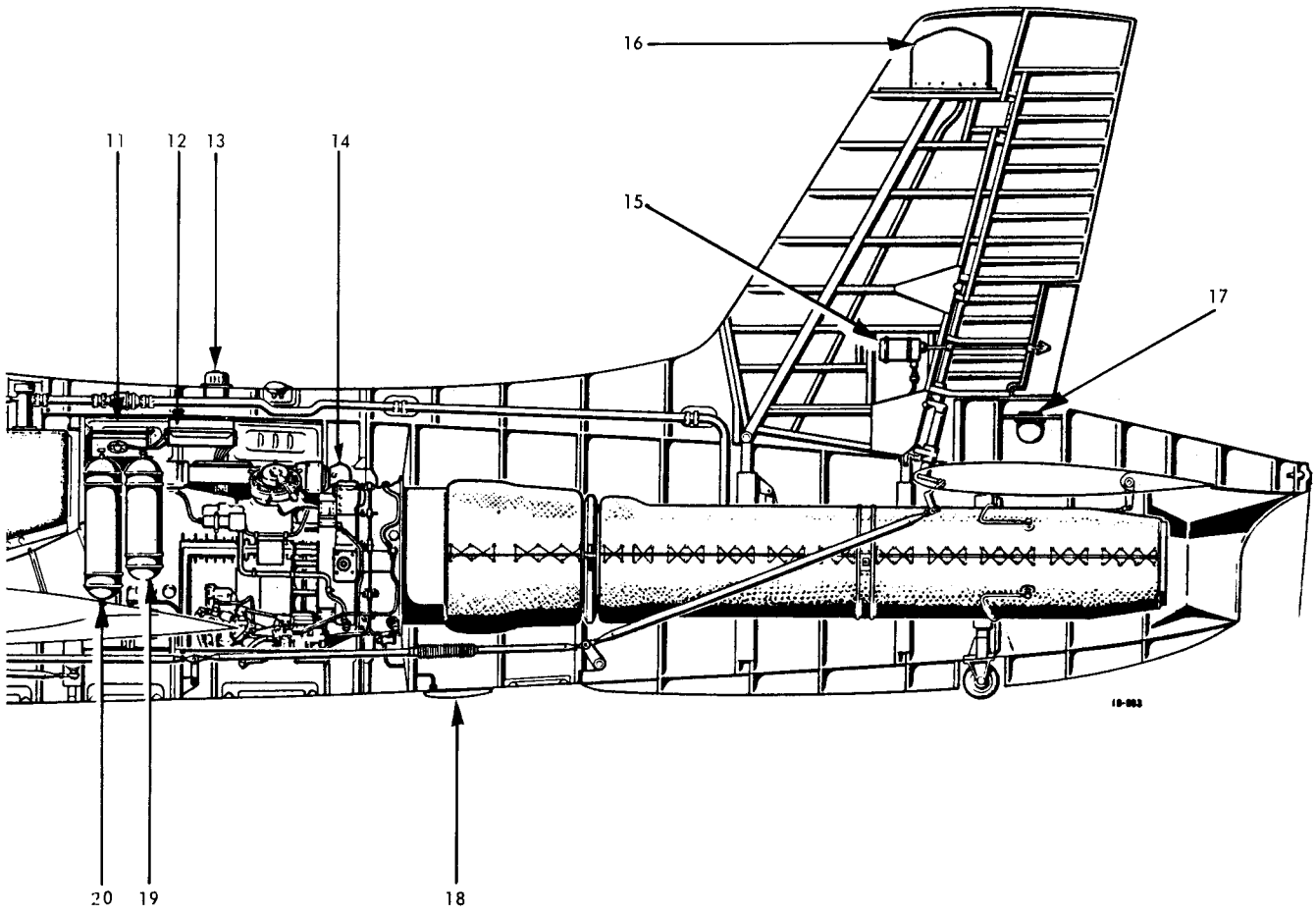
The EPC is electrically controlled by the thermocouples and reduces the amount of fuel to the

GENERAL ARRANGEMENT



1. GLIDE SLOPE ANTENNA
2. MARKER BEACON RECEIVER
3. VOR/ILS RECEIVER
4. VHF2 TRANSCEIVER
5. VHF1 TRANSCEIVER
6. GUNSIGHT
7. EJECTION SEAT
8. PHASE ADAPTER
9. DIRECTIONAL GYRO
10. COMPASS AMPLIFIER
11. BATTERIES
12. POWER RELAY BOX
13. ROTATING BEACON
14. VIPER 540 ENGINE

Figure 1-1 (Sheet 1 of 2)



15. RUDDER TRIM TAB ACTUATOR
16. VHF1 ANTENNA
17. GYRO COMPASS TRANSMITTER
18. MARKER BEACON ANTENNA
19. EMERGENCY HYDRAULIC ACCUMULATOR
20. MAIN HYDRAULIC ACCUMULATOR
21. ADF LOOP ANTENNA
22. FUSELAGE FUEL TANKS
23. TURBOREFRIGERATOR
24. OXYGEN CYLINDERS
25. EMERGENCY BATTERY
26. VHF2 ANTENNA
27. INVERTERS
28. ADF RECEIVER

Figure 1-1 (Sheet 2 of 2)

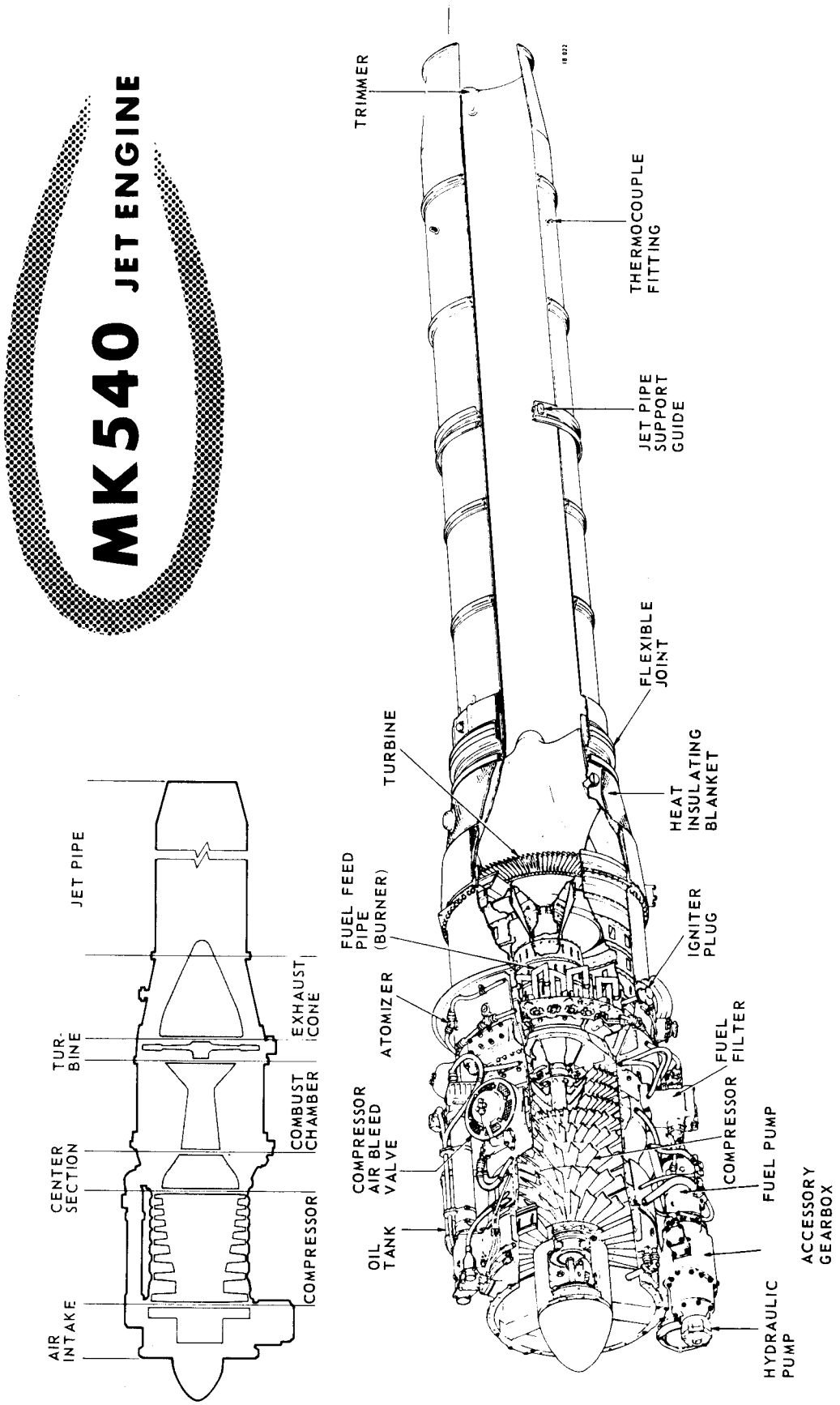

MK540 JET ENGINE
JET PIPE
EXHAUST CONE
TUR-BINE
COMBUST CHAMBER
CENTER SECTION
COMPRESSOR
AIR INTAKE
TRIMMER
THERMOCOUPLE FITTING
JET PIPE SUPPORT GUIDE
FLEXIBLE JOINT
TURBINE
HEAT INSULATING BLANKET
FUEL FEED PIPE (BURNER)
IGNITER PLUG
ATOMIZER
FUEL FILTER
COMPRESSOR AIR BLEED VALVE
COMPRESSOR
OIL TANK
FUEL PUMP
ACCESSORY GEARBOX
HYDRAULIC PUMP

Figure 1-2

ENGINE THROTTLE LEVER

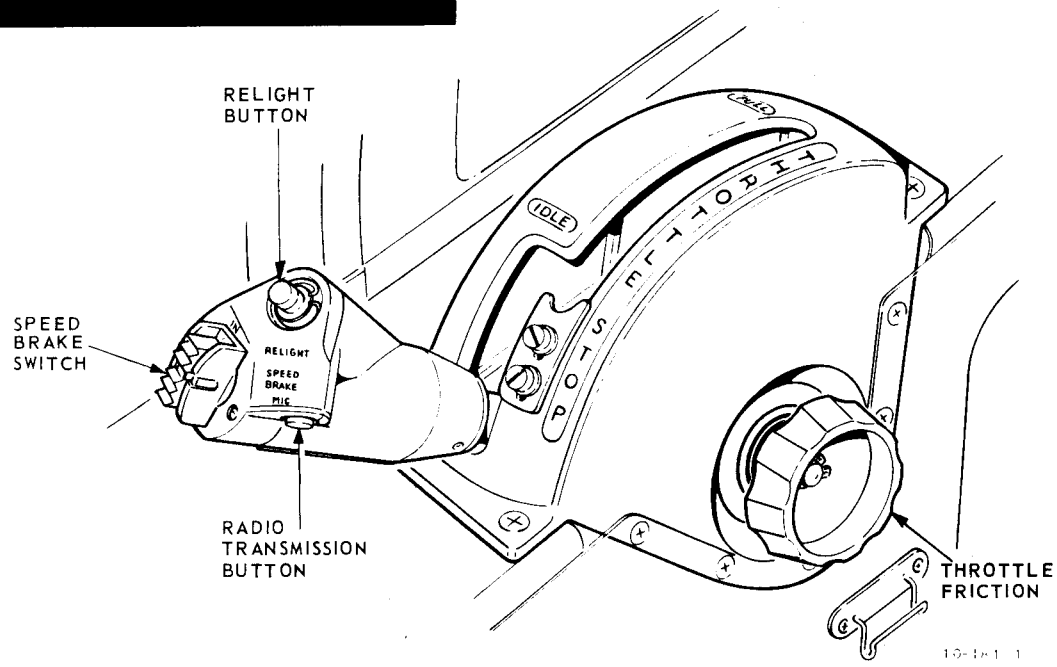


Figure 1-3

engine when the pre-set temperature is attained.
Fuel metered by the B.F.C.U. passes to the air/fuel ratio control, the function of which is to limit the amount of fuel supplied to the engine when the throttle is opened rapidly. This obviates the possibility of compressor stall due to over-fuelling of the combustion chamber.
The spring-loaded pressure increasing valve provides a resistance to the fuel flowing out of the A/F.R.C. and thus ensures firstly, that the fuel pressure at the atomizers will be sufficiently high to ensure the atomized spray necessary to light up the engine, and secondly, that the fuel pressure within the fuel system components will be sufficient to overcome any lag in response due to fluid inertia.
A tapping upstream of the pressure increasing valve leads fuel to the starting solenoid valve which is opened during the starting cycle to allow fuel to flow to the starting atomizers. A flowmeter is also provided in the supply line to the burners.

Throttle

The engine throttle lever (fig. 1-3) is mounted on the left console in each cockpit and is normally used to control the engine speed. Three positions are provided in the operating range, labelled "STOP", "IDLE" and "FULL". At the "STOP" position, the throttle closes the H.P. fuel cock. The "IDLE" position corresponds to the minimum engine rpm either on the ground or in flight, and the "FULL" position (throttle fully forward) corresponds to the engine maximum rating. The throttle accommodates in its grip the "SPEED BRAKE" switch for speed brake operation, the "RELIGHT" button for engine relighting in flight and the microphone "MIC" button.
The "stiffness" of the throttle is friction-controlled and may be adjusted by a wheel located on the fulcrum.

"JPT LIM" switch

The "JPT LIM" switch (fig. 1-5), mounted on the engine control panel on the left console in the forward cockpit, is safetied in the ON position. With the switch in this position, the jet pipe temperature is prevented from exceeding 725°C. Taking the "JPT LIM" switch to OFF cuts out the electro pressure control from operation and JPT can rise above 725°C.

IGNITION SYSTEM

The ignition system, providing ignition through two igniters, functions only during normal ground starts and windmilling air starts.
For normal ground starts, with the "ENG MASTER" switch and the "BATT" switch turned ON, the primary 28 V dc bus current passes, at a certain stage of the starting cycle (3 to 24 seconds after the beginning of the cycle), from the starter controller to two high energy ignition units.
This dc power is converted by the ignition units into

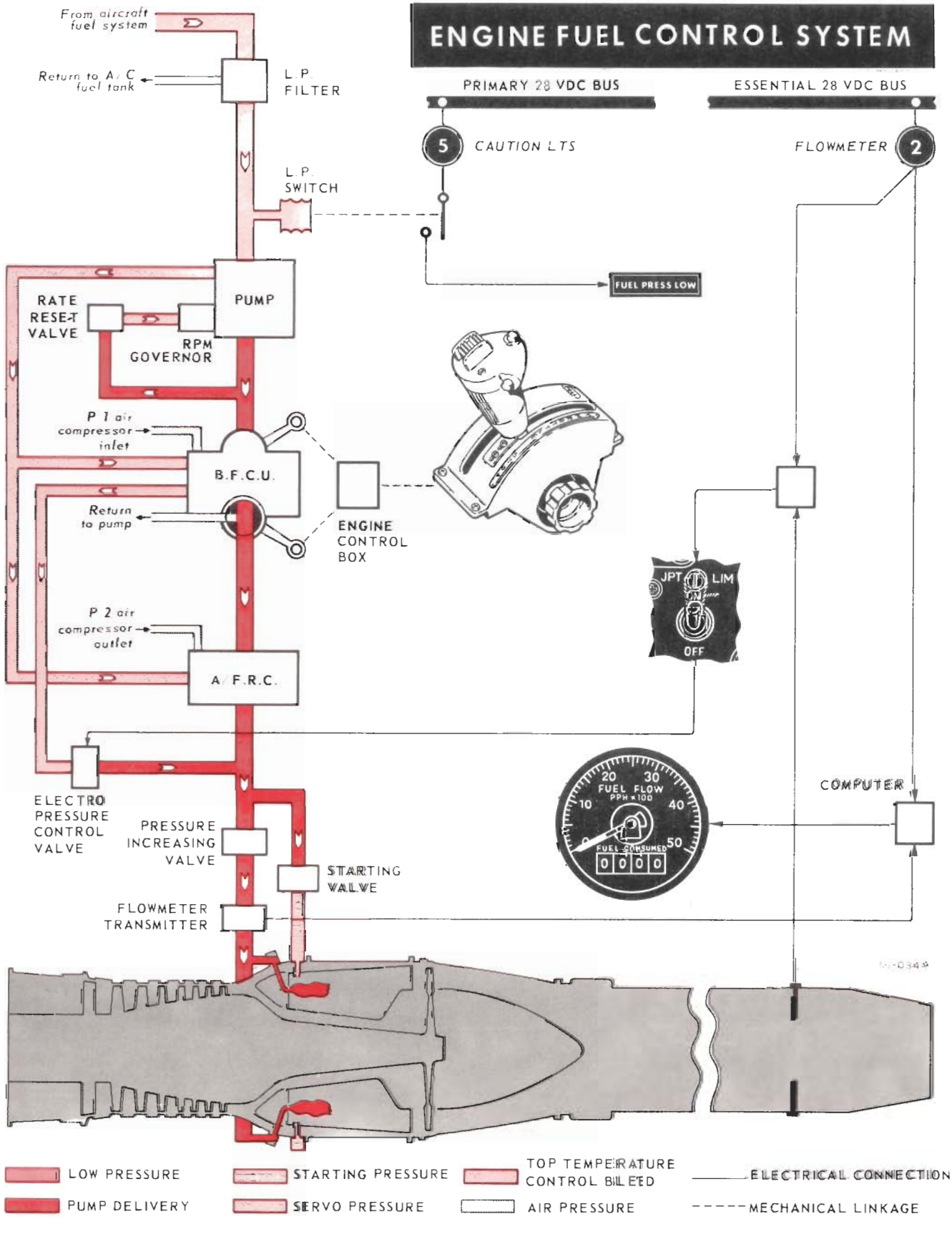

ENGINE FUEL CONTROL SYSTEM
From aircraft fuel system
Return to A/C fuel tank
L.P. FILTER
L.P. SWITCH
PRIMARY 28 VDC BUS
ESSENTIAL 28 VDC BUS
5
CAUTION LTS
FLOWMETER
2
FUEL PRESS LOW
PUMP
RATE RESET VALVE
RPM GOVERNOR
P1 air compressor inlet
B.F.C.U.
Return to pump
ENGINE CONTROL BOX
JPT
LIM
OFF
P2 air compressor outlet
A/F.R.C.
COMPUTER
ELECTRO PRESSURE CONTROL VALVE
PRESSURE INCREASING VALVE
STARTING VALVE
FLOWMETER TRANSMITTER
FUEL FLOW PPH x 100
FUEL CONSUMED
LOW PRESSURE
PUMP DELIVERY
STARTING PRESSURE
SERVO PRESSURE
TOP TEMPERATURE CONTROL BLEED
AIR PRESSURE
ELECTRICAL CONNECTION
MECHANICAL LINKAGE

Figure 1-4

high-voltage alternating current and is fed to the igniters.
During windmilling air starts, the ignition system is energized by pushing in the "RELIGHT" button mounted on the engine throttle grip.

"Eng Master" Switch

Refer to paragraph "Starting System" in this section.

"Relight" Switch

To provide ignition for restarting the engine in flight, a "RELIGHT" push-button switch is installed on the grip of each engine throttle lever. The "RELIGHT" switch is powered from the primary 28 V dc bus.

"Ignition" Switch

The guard-protected "IGNITION" switch, located on the left console in the forward cockpit (fig. 1-5), allows isolation of the high energy units and the starting fuel solenoid valve during the starting cycle.

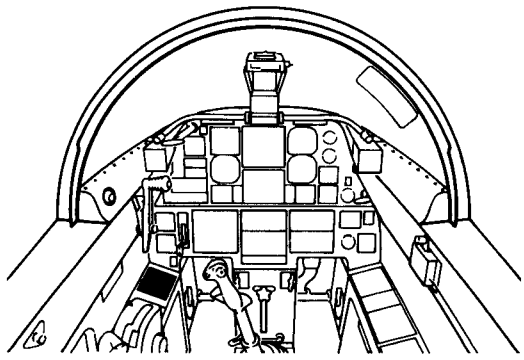
STARTING SYSTEM

The engine is started by a starter-generator which acts as a starter until engine speed increases to 23% rpm. When this value of rpm is attained, the unit is automatically disconnected from the power source and, with the increase of rpm, acts as a generator. To start the engine, the starter-generator may be energized either from an external power source or from the aircraft batteries. When starting is carried out using an external power source, the starter is directly energized from the external power source whereas the starter control circuit receives power from the aircraft batteries. Starting the engine by means of the aircraft batteries causes the batteries, that are normally connected in parallel, to be connected in series. Thip type of connection lasts as long as power is supplied to the starter.
The starting system is operated by the "ENG MASTER" switch and the "STARTER" button. When the "STARTER" button is pressed, the starting cycle is initiated and will continue automatically until, at approximately 23% rpm, the starting controller cuts in to halt the cycle after the engine has reached the self-sustaining speed.
The starting cycle may be halted at any stage by turning the "ENG MASTER" switch OFF.

"Eng Master" Switch

The "ENG MASTER" switch (fig. 1-5) is installed on the engine control panel located on the left console in the forward cockpit.
The switch has two positions: ON and OFF. When the switch is moved to the ON position, provided the

ENGINE CONTROL PANEL



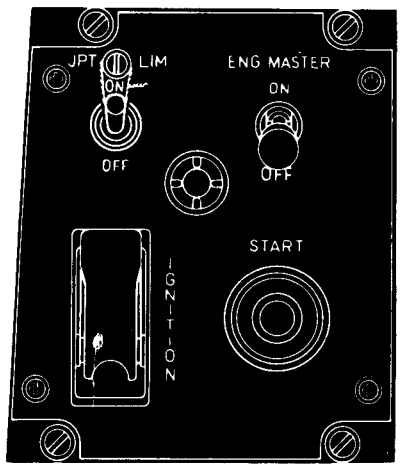


Figure 1-5

"BATT" switch is ON, both the ignition and the starting circuits are energized. When the switch is turned OFF, the starting cycle is interrupted.

"Start" Button

The "START" push-button switch (fig. 1-5) is installed on the engine control panel located on the left console in the forward cockpit. This switch is energized by the "ENG MASTER" switch.
Pressing the "START" button introduces the engine starting cycle.

ENGINE INDICATORS

Jet Pipe Temperature Indicator

A Jet Pipe Temperature indicator, calibrated in 20-degree increments from 0°C to 800°C (fig. 1-6 and

FRONT COCKPIT-INSTRUMENT PANEL

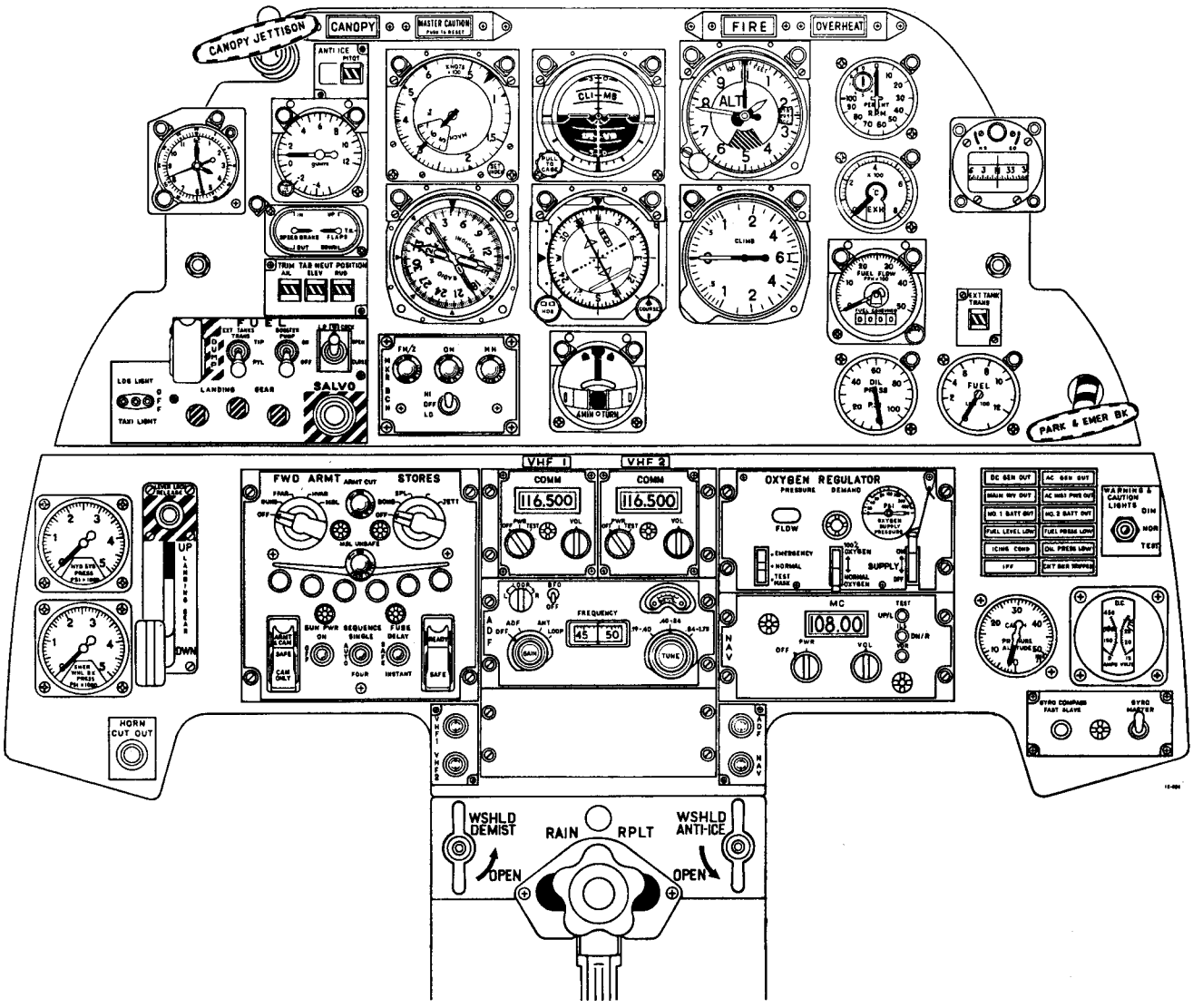


Figure 1-6

1-9), is mounted on the instrument panel in each cockpit to provide a visual indication of the engine operating condition, so that accurate power setting can be obtained. The indicator, being a self-generated electrical unit, does not require power from the electrical system of the aircraft for its operation. For the Jet Pipe Temperature indicator markings, see figure 5-1.

Tachometer

A tachometer provided with two pointers moving on two separate dials is mounted on the instrument panel in each cockpit. The larger dial is calibrated from 0 to 100% in 10% increments while the smaller dial is calibrated from 0 to 10% in 1% increments.
The tachometer (fig. 1-6 and 1-9) indicates engine speed in percentage of the maximum rated rpm (13800). This indicator, which is used in conjunction with the jet pipe temperature indicator, enables engine power to be accurately set without exceeding engine limitations. The tachometer is not powered from the electrical system of the aircraft. It is supplied by the tachometer generator, which generates a frequence proportional to engine speed. For the tachometer markings, see figure 5-1.

Fuel Flowmeter

A fuel flowmeter, calibrated from 0 to 5,000 pounds per hour fuel flow (fig. 1-6 and 1-9), is provided on both instrument panels and gives the rate of fuel flow in pounds per hour.
A window on the instrument dial also provides a direct reading of the fuel consumed.
The flowmeter is powered from the primary 28 V dc bus.

"Fuel Press Low" Caution Light

The "FUEL PRESS LOW" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows to indicate that the fuel pressure at the engine pump inlet has dropped below the minimum permissible value (3.5 ± 0.5 psi)

Oil Pressure Indicator

The oil pressure indicator, on each instrument panel, is calibrated from 0 to 100 psi (fig. 1-6 and 1-9) and indicates the pressure of oil within the engine. The indicator is an electrical instrument powered from the primary 26 V ac bus. For the oil pressure indicator limitation markings, see figure 5-1.

"Oil Press Low" Caution Light

The "OIL PRESS LOW" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows to indicate that the oil pressure at the oil pump outlet has dropped below 6 ± 0.5 psi..

OIL SYSTEM

Entirely self-contained within the engine, the system is supplied from an oil tank mounted on the engine. The combined oil pump unit builds up a metered and unmetered pressure oil system and a scavenge oil system. The oil system operates automatically; no action is required from the pilot except checking the oil pressure reading on the indicator.
The oil system contains 9.5 pints of oil in a 15-pint tank.
Inverted flight operation is limited to 30 second.

FUEL SYSTEM

Fuel is contained in two fuselage interconnected tanks and in two centerline tip tanks. The fuselage tanks are accommodated within the fuselage walls behind the cabin and above the air intakes. They are shock-proof rubber cells. A fuel collector box, containing the booster pump, is located at the bottom of the forward cell; its function is to retain a certain quantity of fuel when the aircraft is inverted, so as to allow inverted flight for not longer than approximately 12 seconds.
The tip tanks are not jettisonable, but they can be easily installed or removed on the ground.
The fuel system includes a pressure refuelling system allowing simultaneous filling of all tanks in about 8 minutes. The nozzle receptacle is on the right side of the fuselage.
Two underwing tanks may be installed under the central pylons. These tanks can be refuelled manually only.
The fuel transfer system from the tip tanks (fig. 1-10) operates automatically when the engine is started and continues until all fuel has been consumed. No action is required from the pilot except when underwing pylon tanks are installed. When this installation is present in the aircraft, the procedure to be followed is as described in Section II.
Fuel flows from the fuel collector box of the main tank to the booster pump chamber through an annular filter and is directed by the pump into the engine supply line. The supply line leading to the engine-driven fuel pump, includes an electrically operated shut-off valve and a filter.

TIP TANKS

The aircraft standard configuration comprises two 70 imp gal tip tanks. Replacement of the tanks is accomplished on the field by maintenance personnel. The tanks are non-jettisonable and they are provided with a quick-dumping cock electrically operated from the cabin.

FRONT COCKPIT-LEFT SIDE CONSOLE

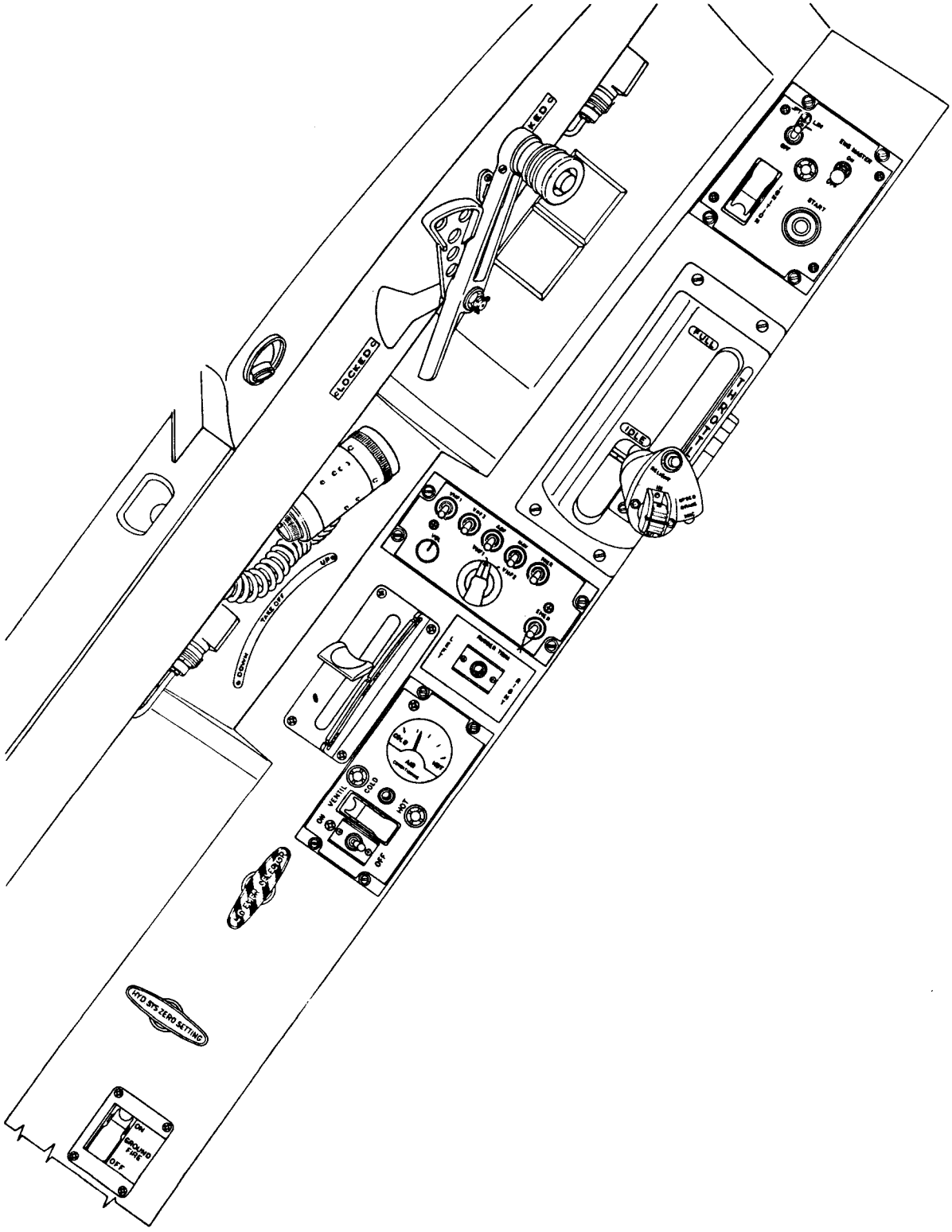


Figure 1-7

FRONT COCKPIT - RIGHT SIDE CONSOLE

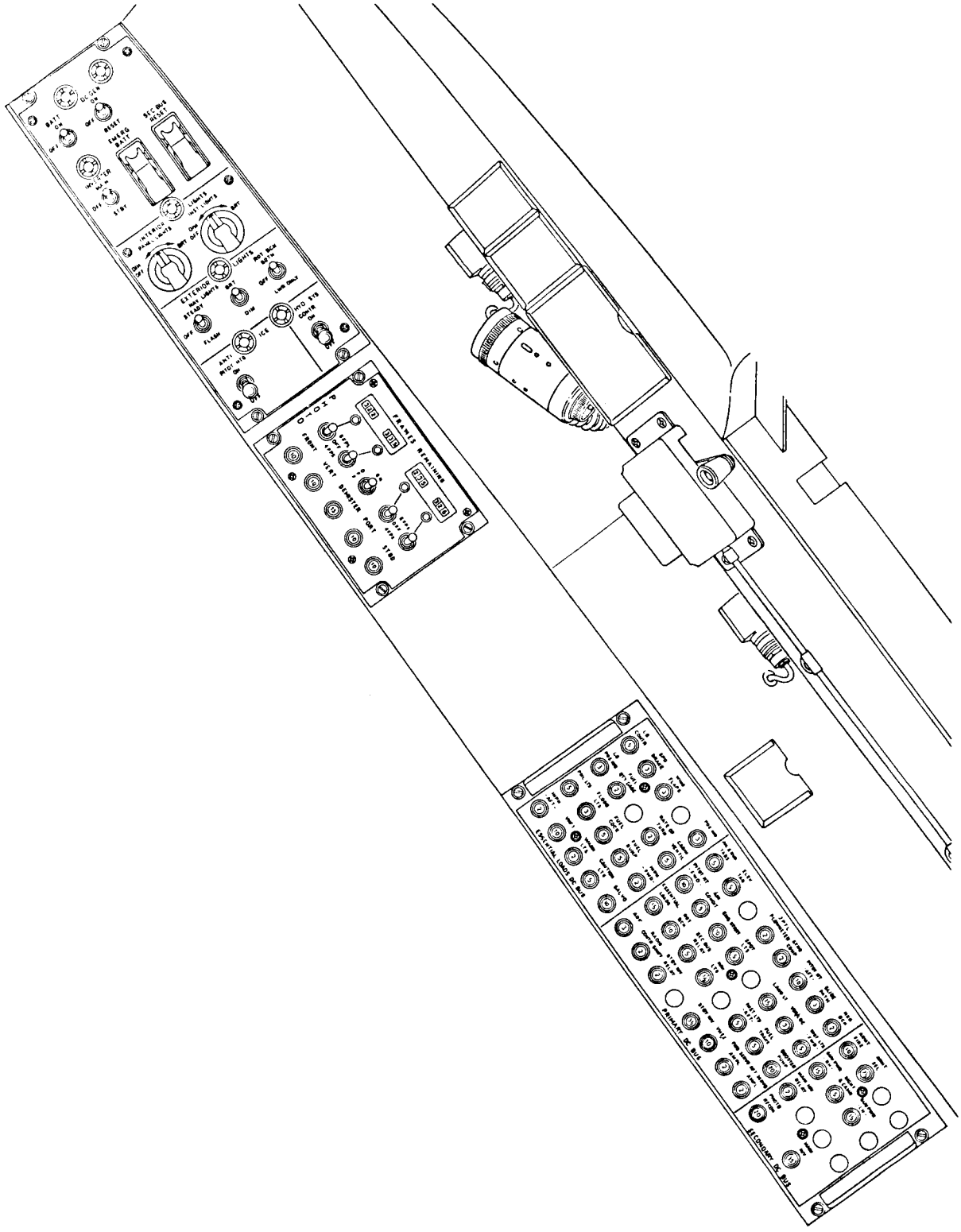
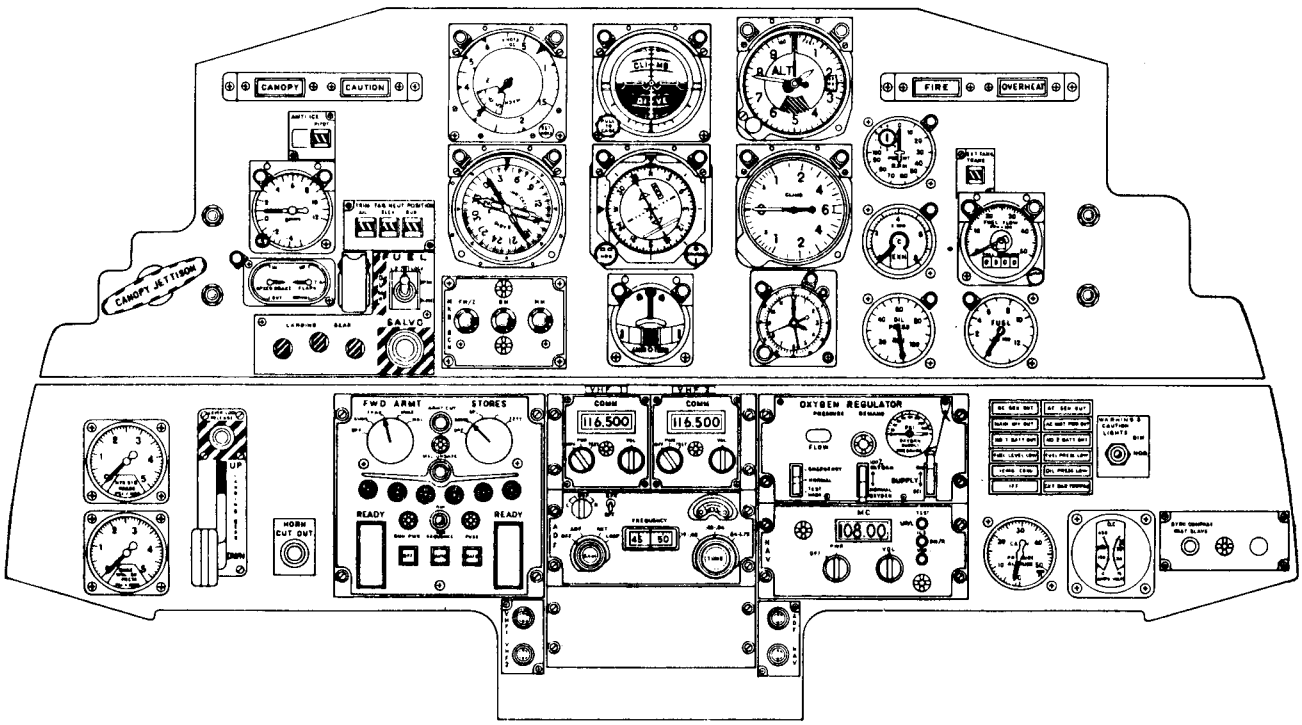


Figure 1-8

REAR COCKPIT - INSTRUMENT PANEL AND CONSOLES



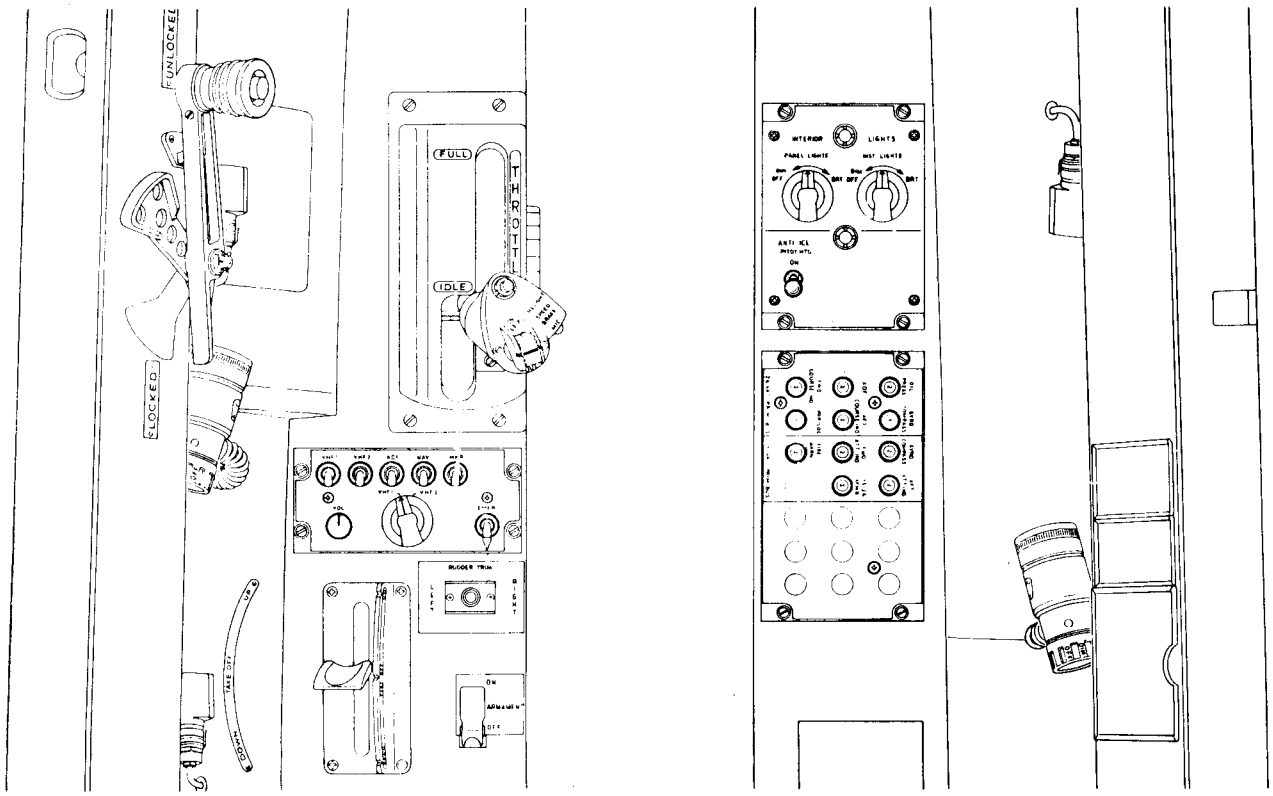


Figure 1-9

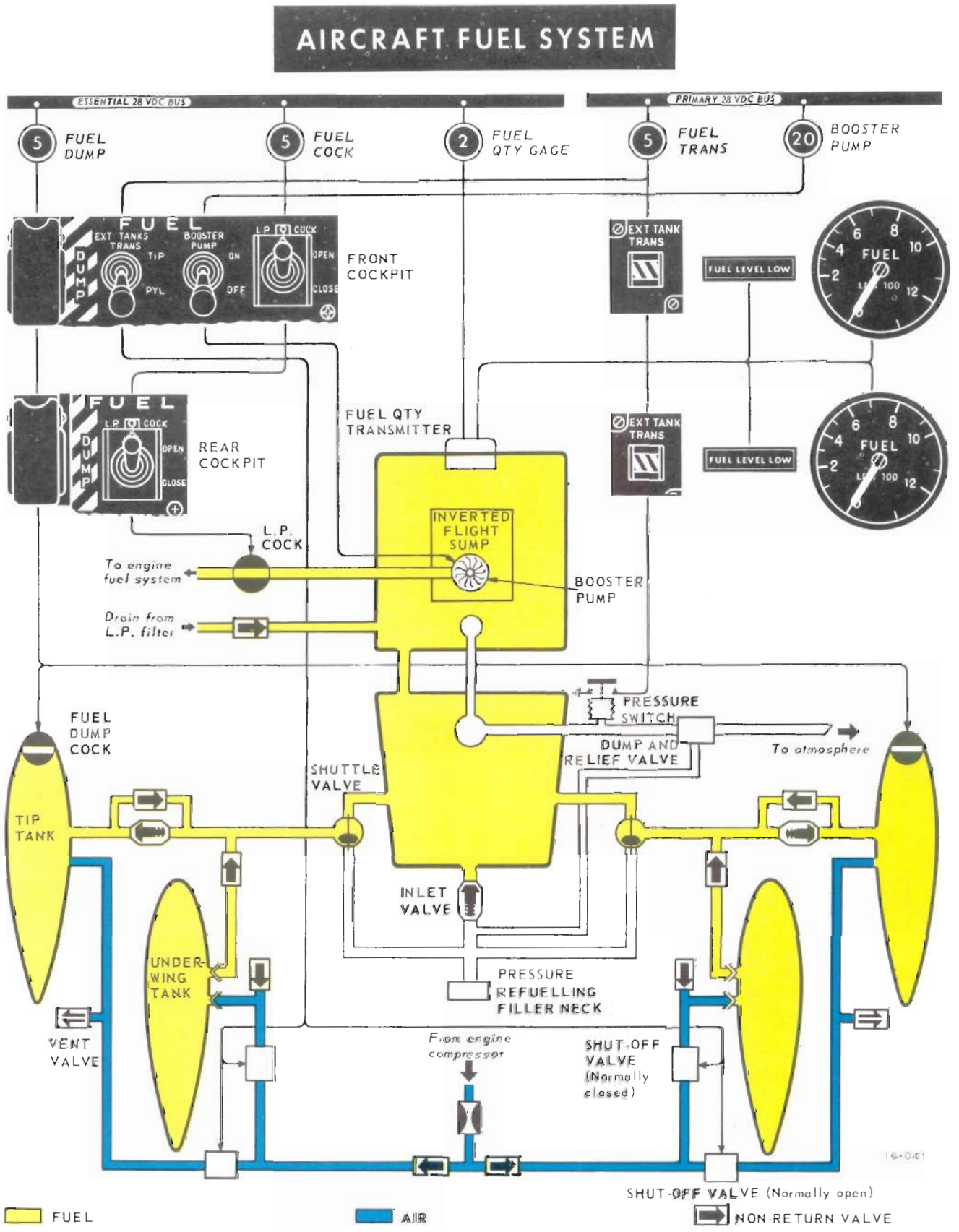
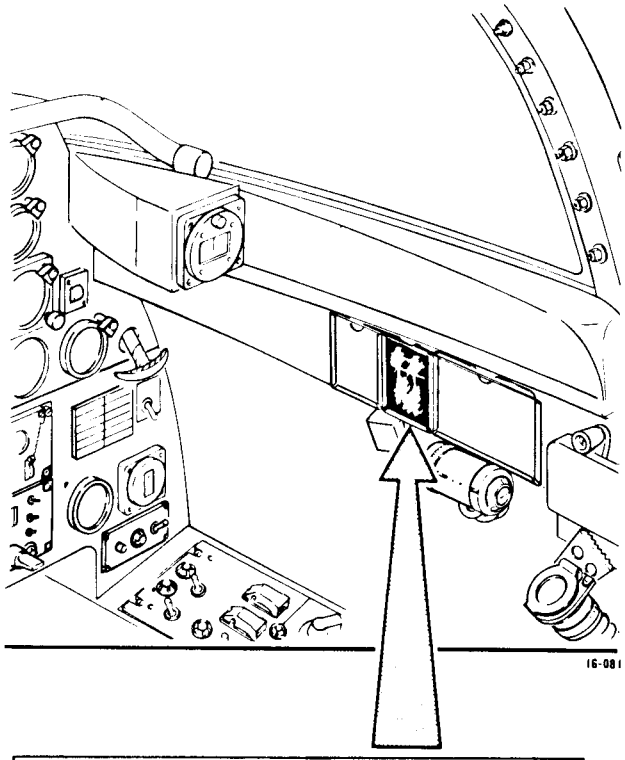

AIRCRAFT FUEL SYSTEM
ESSENTIAL 28 VDC BUS
PRIMARY 28 VDC BUS
5 FUEL DUMP
5 FUEL COCK
2 FUEL QTY GAGE
5 FUEL TRANS
20 BOOSTER PUMP
FUEL
EXT TANKS TRANS
TIP
PYL
BOOSTER PUMP
ON
OFF
L.P. COCK
OPEN
CLOSE
DUMP
FRONT COCKPIT
EXT TANK TRANS
FUEL LEVEL LOW
FUEL
REAR COCKPIT
FUEL QTY TRANSMITTER
INVERTED FLIGHT SUMP
L.P. COCK
To engine fuel system
Drain from L.P. filter
BOOSTER PUMP
PRESSURE SWITCH
DUMP AND RELIEF VALVE
To atmosphere
FUEL DUMP COCK
SHUTTLE VALVE
TIP TANK
INLET VALVE
UNDER-WING TANK
PRESSURE REFUELLING FILLER NECK
VENT VALVE
From engine compressor
SHUT-OFF VALVE (Normally closed)
SHUT-OFF VALVE (Normally open)
FUEL
AIR
NON-RETURN VALVE

Figure 1-10



CORRECTION TABLE
FUEL QUANTITY READINGS

* INDICATED QUANTITY	ACTUAL QUANTITY	
	5° NOSE UP (CLIMB)	13° NOSE DOWN (STEEP DESCENT)
LB	LB	LB
100	155	80
200	255	180
300	350	310
400	460	440
500	565	515
600	670	570
700	780	635
800	875	710
900	975	775
1000	1090	845
1100	1175	910
1200	1260	980
1300	1300	1100

* INDICATED QUANTITY = ACTUAL QUANTITY IN LEVEL FLIGHT

Part No. 839.12.02A

Figure 1-11

FUEL SYSTEM CONTROLS AND INDICATORS

Throttle

Refer to paragraph "Engine Fuel Control System" in this section.

"Fuel Dump" Switch

The guard-protected "FUEL DUMP" switch is mounted on the left side of the instrument panel in each of the cockpits (fig. 1-6 and 1-9). This switch can be used to rapidly discharge the fuel contained in the tip tanks. Operation of the switch opens a cock mounted inside the tanks. The "FUEL DUMP" switch is powered from the essential 28 V dc bus.

"Ext Tanks Trans" Switch

The "EXT TANKS TRANS" switch is mounted on the left side of the front instrument panel (fig. 1-6). When the switch is in the PYL position, the fuel transfers from the underwing tanks to the fuselage tank. When the switch is turned to the TIP position, the fuel transfers from the tip tanks to the fuselage tank.

"Fuel Booster Pump" Switch

This switch, located on the left side of the forward instrument panel (fig. 1-6), actuates the submerged booster pump installed in the fuselage forward cell. The "FUEL BOOSTER PUMP" switch is powered from the primary 28 V dc bus.

"Fuel L.P. Cock" Switch

The "FUEL L.P. COCK" switch is mounted on the left side of the instrument panel in each of the cockpits (fig. 1-6 and 1-9). This switch is normally lockwired in the OPEN position. Should an emergency arise, moving either of the two switches to the CLOSE position closes the shut-off valve in the engine supply line at the fuselage tank outlet. The switch is powered from the essential 28 V dc bus.

Fuel Quantity Indicator

A fuel quantity indicator (fig. 1-6 and 1-9) is provided on the right side of each instrument panel to indicate the total pounds of internal fuel. The fuel quantity indicator is powered from the essential 28 V dc bus. No fuel quantity indicator is provided for the tip tanks. When the aircraft is fully serviced, the indicator will read 1300 lb. The engine fuel consumption will initially take down the instrument reading as this consumption is normally larger than the fuel level restoration due to transfer. After the fuel in the tip tanks has been consumed, the level of fuel in the fuselage tank will decrease at a larger rate and, with the aircraft in horizontal trim, the instrument reading will coincide with the actual quantity of fuel in the tank. For pitch attitudes of the aircraft, refer to the table in fig. 1-11 which shows the reading errors involved by these attitudes of the aircraft.

TANKS	USABLE FUEL		
	Imp gal	lb	
		NATO F-40	NATO F-35
FUSELAGE TANK	172 0	1342	1359
LEFT TIP TANK	67.0	523	529
RIGHT TIP TANK	67 0	523	529
TOTAL	308 0	2388	2417
LEFT UNDERWING TANK	72 8	568	575
RIGHT UNDERWING TANK	72.8	568	575
TOTAL	453.6	3524	3567

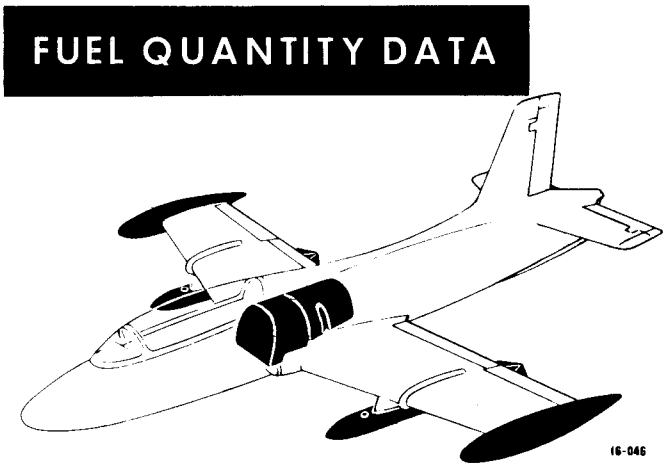


Figure 1-12

"Fuel Level Low" Caution Light

The "FUEL LEVEL LOW" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows when the fuel quantity in the fuselage tank drops to 350 lb.

"Ext Tanks Trans" Magnetic Indicator

The "EXT TANKS TRANS" magnetic indicator is located on the right side of each instrument panel. The indicator reads ON when fuel transfer from the tip tanks or the pylon tanks to the fuselage tank is in progress. It turns striped when transfer is complete.

Note

- Alternate ON and striped indication of the magnetic indicator as may sometimes occur, is not a reliable evidence of fuel transfer completion. Fuel transfer is completed when the indicator gives a steady striped indication.
- When fuel transfer from the pylon tank is completed and the "EXT TANKS TRANS" switch is turned to TIP the magnetic indicator remains striped for about one minute before returning to ON to indicate a new condition of transfer in progress.

ELECTRICAL POWER SUPPLY SYSTEM

Electrical energy in this aircraft is supplied through a 28-volt, direct current system powered by an engine-drigen generator (fig. 1-13). The generator is a combination starter-generator unit, acting as a starter up to about 23% rpm, and thereafter acting as a generator.
When the generator is inoperative (during flight in case of failure; on the ground with the engine shut down), power is supplied by two 24 volt, 22 ampere-hour main batteries. Should failure of both normal power sources (generator and main batteries) occur during flight, a 27 volt, 7 ampere-hour emergency battery can be connected to that equipment necessary to sustain flight. Alternating current at 115 volts for operation of the gyro instruments and the fire warning system is supplied by a main inverter and, when required, by a standby inverter. A transformer provides 26 VAC power to the navigation instruments.

ELECTRICALLY-OPERATED EQUIPMENT

In fig. 1-13 is listed the electrically-operated equipment, opposite the different bus bars.

D.C. ELECTRICAL POWER DISTRIBUTION

The dc electrical power (fig. 1-13) necessary for operation of the electrical units in the aircraft is distributed by a group of three busses: a primary bus, a secondary bus and an essential load bus.
Besides the main batteries, a dc external power source may be used to energize the aircraft dc busses when the aircraft is on the ground. The dc external power source should be plugged into the external power receptacle on the right side of the aircraft. During engine start from external power, the main battery system energizes the starting control network, but is not connected to the starting bus. During an internal start, No. 1 battery remains connected to the battery bus and No. 2 battery connects in series with No. 1 battery. When the 800 ampere starting load is applied at the beginning of the engine starting sequence, the voltage on the starting bus will be about 20 volts. The starting control network will be energized by the starting bus, in order to keep its supply voltage high enough. When the engine reaches about 23% rpm, the

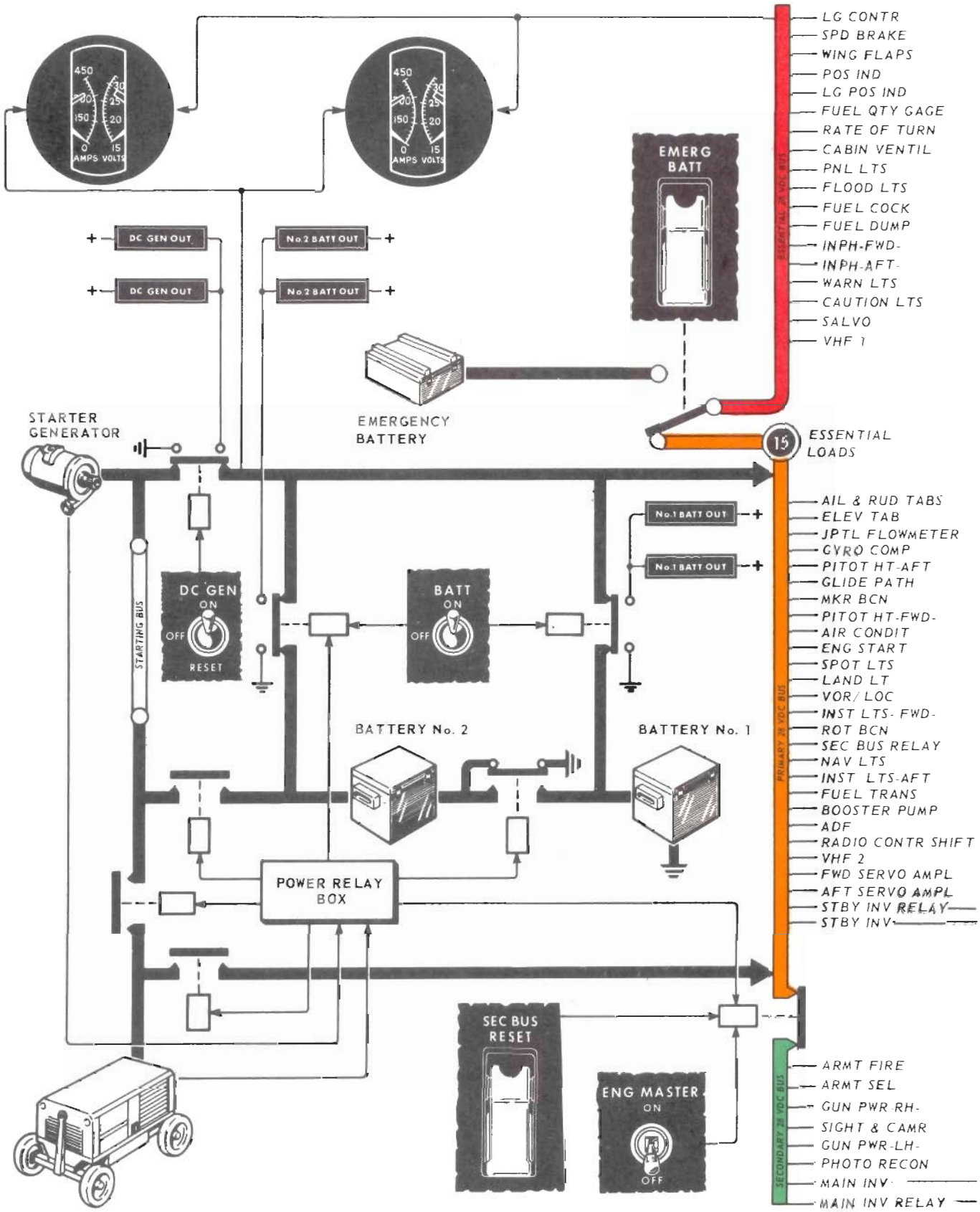


Figure 1-13 (Sheet 1 of 2)

ELETRICAL POWER DISTRIBUTION

ENGINE STOPPED			ENGINE START	ENGINE RUNNING				
EXT PWR IN	EXT PWR IN	EXT PWR OUT	EXT PWR IN & OUT	GENERATOR INOPERATIVE	GENERATOR INOPERATIVE	GEN & BATT INOPERATIVE	MAIN INVERTER INOPERATIVE	BOTH INVERTERS INOPERATIVE
ENGINE MASTER OFF	ENGINE MASTER ON	ENGINE MASTER OFF & ON	ENGINE MASTER ON		INVERTER SWITCH STBY	EMERG BATT ON	INVERTER SWITCH STBY	
ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS	ESSENTIAL 28 VDC BUS
PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS		PRIMARY 28 VDC BUS	PRIMARY 28 VDC BUS
SECONDARY 28 VDC BUS	•	•	•	SECONDARY 28 VDC BUS	•		SECONDARY 28 VDC BUS	SECONDARY 28 VDC BUS
PRIMARY 115 VAC BUS	PRIMARY 115 VAC BUS	PRIMARY 115 VAC BUS	PRIMARY 115 VAC BUS	PRIMARY 115 VAC BUS	PRIMARY 115 VAC BUS		PRIMARY 115 VAC BUS	
SECONDARY 115 VAC BUS	•	•	•	SECONDARY 115 VAC BUS	•			
PRIMARY 26 VAC BUS	PRIMARY 26 VAC BUS	PRIMARY 26 VAC BUS	PRIMARY 26 VAC BUS	PRIMARY 26 VAC BUS	PRIMARY 26 VAC BUS		PRIMARY 26 VAC BUS	
SECONDARY 26 VAC BUS	•	•	•	SECONDARY 26 VAC BUS	•			
CAUTION LIGHTS								
DC GEN OUT	DC GEN OUT	DC GEN OUT			DC GEN OUT	DC GEN OUT		
	MAIN INV OUT	MAIN INV OUT	MAIN INV OUT		MAIN INV OUT	MAIN INV OUT	MAIN INV OUT	MAIN INV OUT
						AC INSTR PWR OUT		AC INSTR PWR OUT
No. 1 BATT OUT						No. 1 BATT OUT		
No. 2 BATT OUT						No. 2 BATT OUT		

• Secondary 28 Vdc Bus, Secondary 115 Vac Bus & Secondary 26 Vac Bus can be reinserted using "Sec Bus Reset" Switch

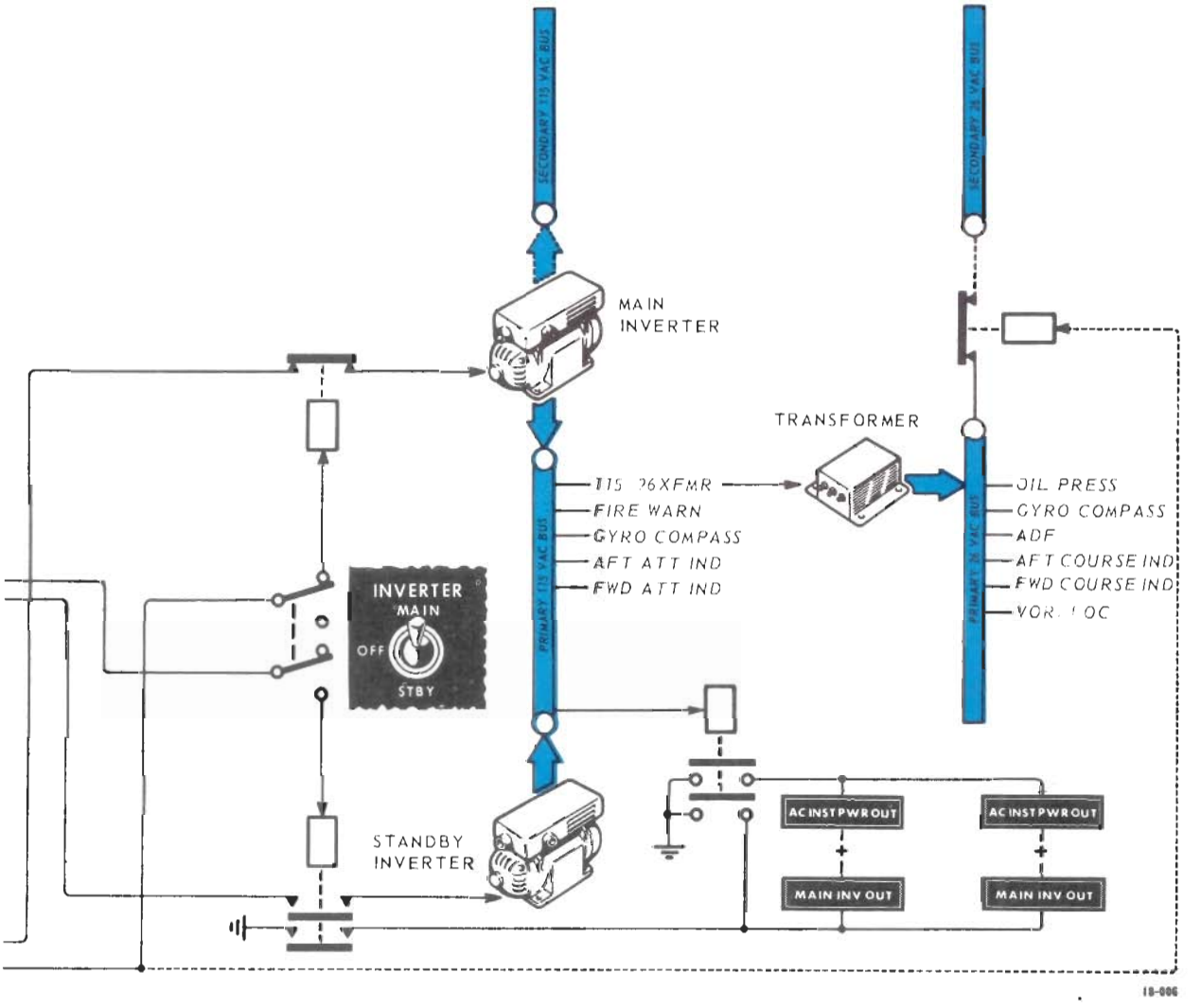


Figure 1-13 (Sheet 2 of 2)

starting controller automatically disconnects the main batteries from the starting bus and reconnects them in parallel to the battery bus. The starter-generator then acts as a generator and through the reverse current relay is connected to the primary bus feeder.

External Power Receptacle

The dc external power receptacle is on the right side of the fuselage at the wing trailing edge. When external power is connected to the receptacle, all equipment is operable.

Circuit Breakers

Most of the dc electrical circuits are protected by push-pull circuit breakers mounted on a panel (fig. 1-8) on the right side of the forward cockpit.

CAUTION

Circuit breakers should not be pulled or reset without a thorough understanding of all the effects and results. Use of the circuit breakers can eliminate from the system some related warning system, interlocking circuit or signal, which could result in an undesirable reaction.

"Batt" Switch

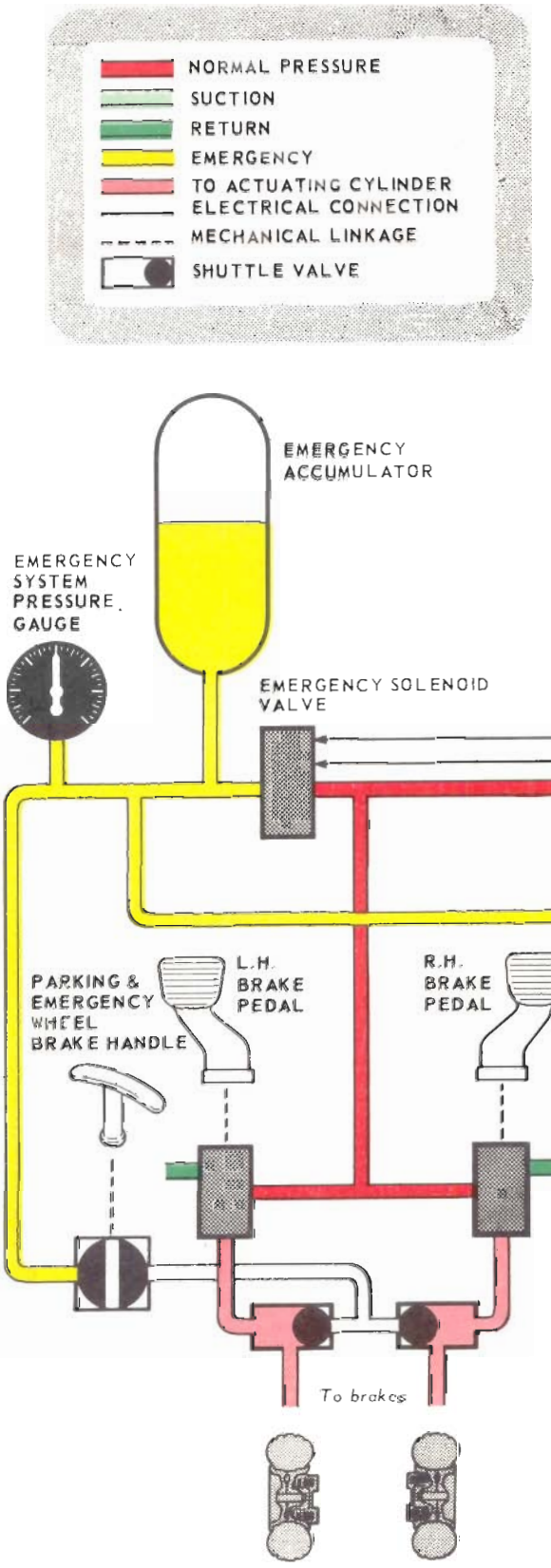
The "BATT" switch is located on the right console in the forward cockpit. When in the ON position, this switch permits power to be supplied from the main batteries in parallel, to the primary 28 V dc bus.

"DC Gen" Switch

The "DC GEN" switch is located on the right console in the forward cockpit. When in the ON position, this switch permits power to be supplied from the generator to all 28 V dc busses. When in the RESET position, the switch resets the original position of the field relay incorporated in the dc generator control unit.

"Emerg Batt" Switch

The "EMERG BATT" switch is located on the right console in the forward cockpit and is protected by a red guard. In case normal power supply to the busses is interrupted because of a failure in the system, actuation of this switch connects the essential 28 V dc bus to the emergency battery and permits flight to be continued under the minimum safety conditions. When the switch is turned on, the voltmeter will show the emergency battery voltage.



HYDRAULIC SYSTEM

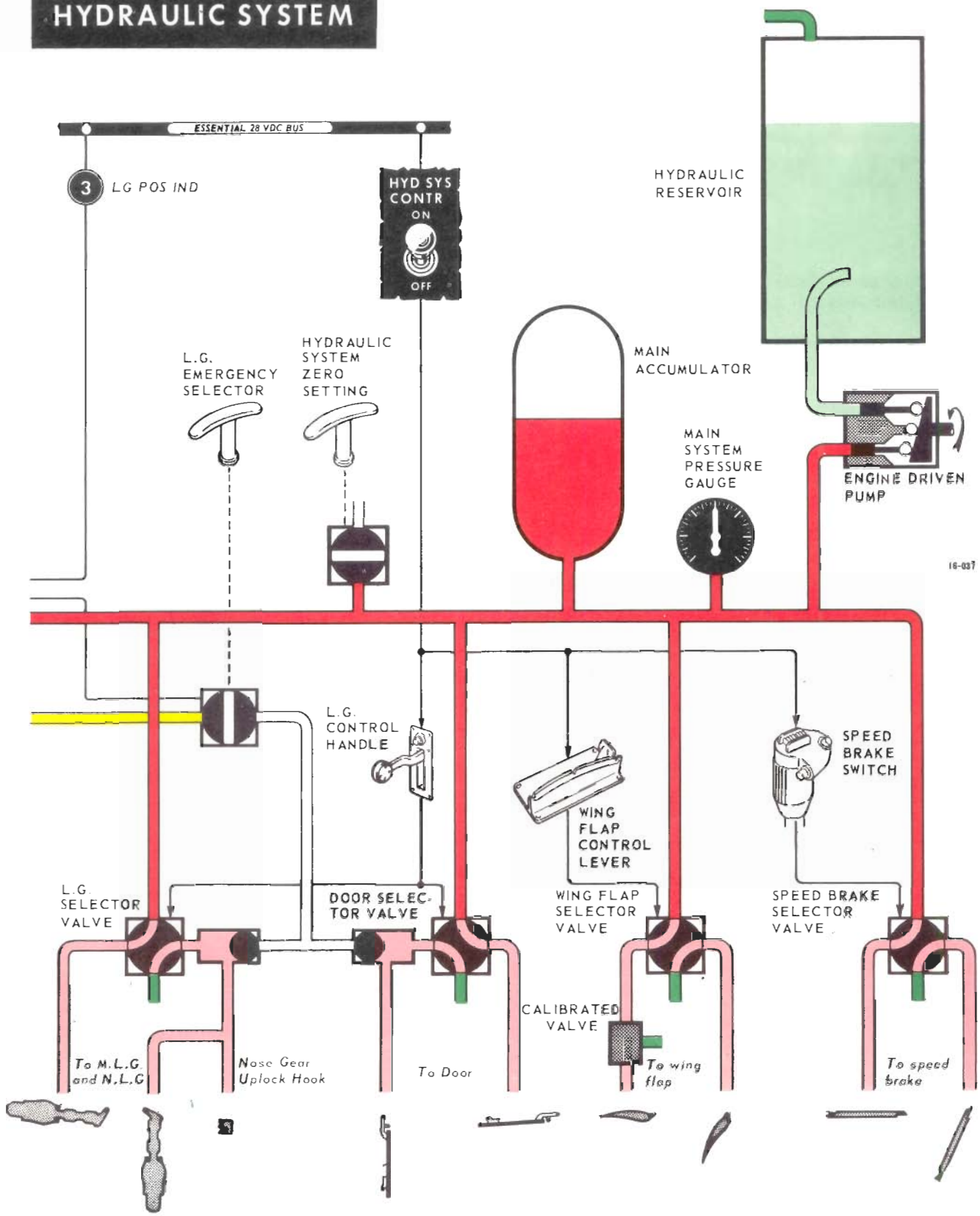


Figure 1-14

"Sec Bus Reset" Switch

The "SEC BUS RESET" switch is located on the right console in the forward cockpit and is protected by a red guard. When, because of generator failure, the secondary bus is disconnected and the batteries feed the primary bus and the essential load bus only, the pilot can manually reconnect the secondary bus for the desired period of time (compatible with the available battery life) by actuating the "SEC BUS RESET" switch.

Voltammeter

The voltammeter (fig. 1-6 and 1-9) is mounted on the lower right side of the instrument panel in each cockpit. The instrument incorporates two scales: an "AMPS" scale providing indication of the electrical load absorbed by the electrically operated equipment and a "VOLTS" scale providing a visual indication of the electrical potential produced by the generator or available at the essential 28 V dc bus.

"Dc Gen Out" Caution Light

The "DC GEN OUT" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows to indicate that the generator has failed or has been disconnected from the primary 28 V dc bus. The light is powered by the essential 28 V dc bus.

"No. 1 Batt Out" and "No. 2 Batt Out" Caution Lights

The "No. 1 BATT OUT" and "No. 2 BATT OUT" caution lights are on the caution light panel located on the lower right side of each instrument panel. These lights glow to indicate that battery No. 1 or battery No. 2 has failed or has been disconnected.

AC ELECTRICAL POWER DISTRIBUTION

AC electrical power (fig. 1-13)is distributed to the ac electrical equipment throughout the aircraft by two 115 V ac busses (primary and secondary) and two 26 V ac busses (primary and secondary). These busses are normally supplied by the main inverter, which in turn receives power from the secondary 28 V dc bus. In an emergency, the pilot can turn the "INVERTER" switch from MAIN to STBY and obtain ac electrical power from the primary 28 V dc bus through the standby inverter. In this case, however, the secondary 115 V ac and the secondary 26 V ac busses are not energized and the TACAN, the IFF and the UHF/DF remain inoperative. The two 26 V ac busses (primary and secondary) are powered by the primary 115 V ac bus through a transformer.

Note

The two 115 V ac and 26 V ac secondary busses do not power any system but are intended as a power source for optional equipment.

"Inverter" Selector Switch

The "INVERTER" selector switch located on the right console in the forward cockpit (fig. 1-6), is used to manually select the main or the standby inverter as a power source for the ac-operated equipment. The switch (powered by both the primary and secondary 28 V dc busses) has three fixed positions: OFF, both inverters are inoperative; MAIN, for all normal operations; STBY, for a standby inverter power source in case of main inverter failure.

"Main Inv Out" Caution Light

The "MAIN INV OUT" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows, together with the "AC INST PWR OUT" caution light, to indicate that the ac busses are inoperative and the "INVERTER" selector switch must be turned to STBY. Under this condition the "AC INST PWR OUT" caution light goes out while the "MAIN INV OUT" caution light stays on to indicate that the main inverter is disconnected and therefore the secondary 115 V ac and the secondary 26 V ac busses are not energized.

"Ac Inst Pwr Out" Caution Light

The "AC INST PWR OUT" caution light is on the caution light panel located on the lower right side of each instrument panel. This light glows when the ac busses are inoperative and therefore all ac-operated instruments are disconnected.

HYDRAULIC POWER SUPPLY SYSTEM

The hydraulic power supply system is a closed-center, constant-pressure (2600 psi) type system incorporating an engine-driven, hydraulic pump of the constant delivery type (fig. 1-14). A pressure accumulator in the system provides the energy required to extend the landing gear, wing flaps, speed brake and for operation of the wheel brakes in case of failure of the hydraulic pump. An emergency system is also provided to extend the landing gear and for emergency braking when the main system is inoperative. Landing gear, doors, flaps and speed brake are operated by hydraulic actuating cylinders supplied through electrically actuated selector valves. The emergency system is connected to the main system through an emergency solenoid valve and includes a pressure accumulator.

"Hyd. Sys Zero Setting" Handle

A zero setting handle is provided on the left console in the forward cockpit to relieve pressure in the whole

hydraulic system, except for the emergency system which is set to zero on the ground by means of a separate selector valve located on the wheel brakes power plant.

"Hyd Sys Contr" Switch

The "HYD SYS CONTR" switch is located on the right console in the forward cockpit. When turned ON, this switch allows the flap, speed brake and landing gear circuits to be energized by the essential 28 V dc bus.

Hydraulic Pressure Gauges

Two pressure gauges (fig. 1-6 and 1-9) are provided on the lower left side of each instrument panel to indicate the pressure existing in the main system and in the emergency system.

FLIGHT CONTROL SYSTEM

The flight controls comprise push rod systems, mechanical and electro-hydraulic systems, electrical trim systems. The primary flight control surfaces include the ailerons, the elevator and the rudder. The secondary flight control surfaces include the wing flaps and the speed brake. The primary flight control surfaces are mechanically controlled by push rods and bellcranks. The secondary flight control surfaces are hydraulically operated. The trim tabs on the left aileron, on the elevator and on the rudder, are electrically operated. The ailerons are balanced by Irving type balancing. The right aileron incorporates a balance tab. All trim tabs (on the left aileron, on the elevator and on the rudder) are hinged so as to act also as balance tabs. The primary flight controls may be locked on the ground by means of a device accommodated under the forward instrument panel.

PRIMARY FLIGHT CONTROLS

Control Stick

Mounted on the control stick grip (fig. 1-15) are the aileron and elevator trim switch, the armament trigger (forward cockpit only), the droppable store release push-button (forward cockpit only), the interphone push-button and the photo-reconnaissance push button (forward cockpit only).

Rudder Pedals

The rudder control pedals (fig. 1-16) are of the pendulum type and incorporate the controls for operation of the wheel brakes. The pedals are adjustable fore-and-aft by a knob located at the center under the instrument panel. This knob may also be operated in flight.

Flight Control Lock

The flight controls may be locked on the ground by

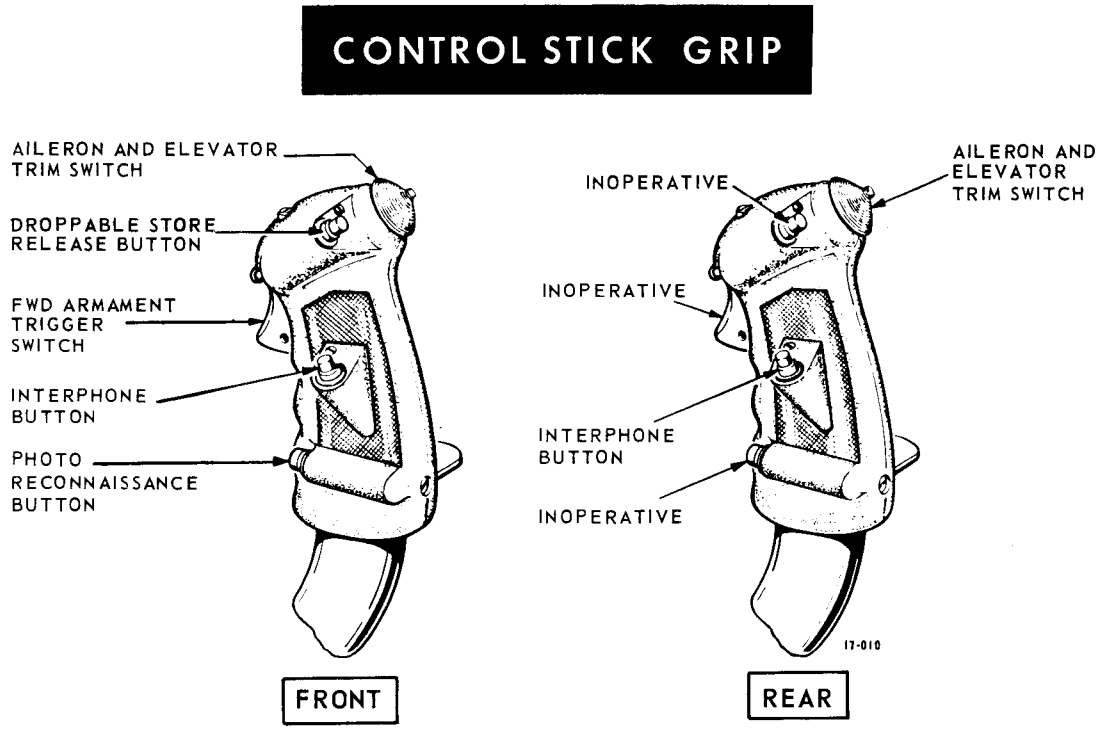


Figure 1-15

RUDDER PEDALS AND CONTROL LOCK

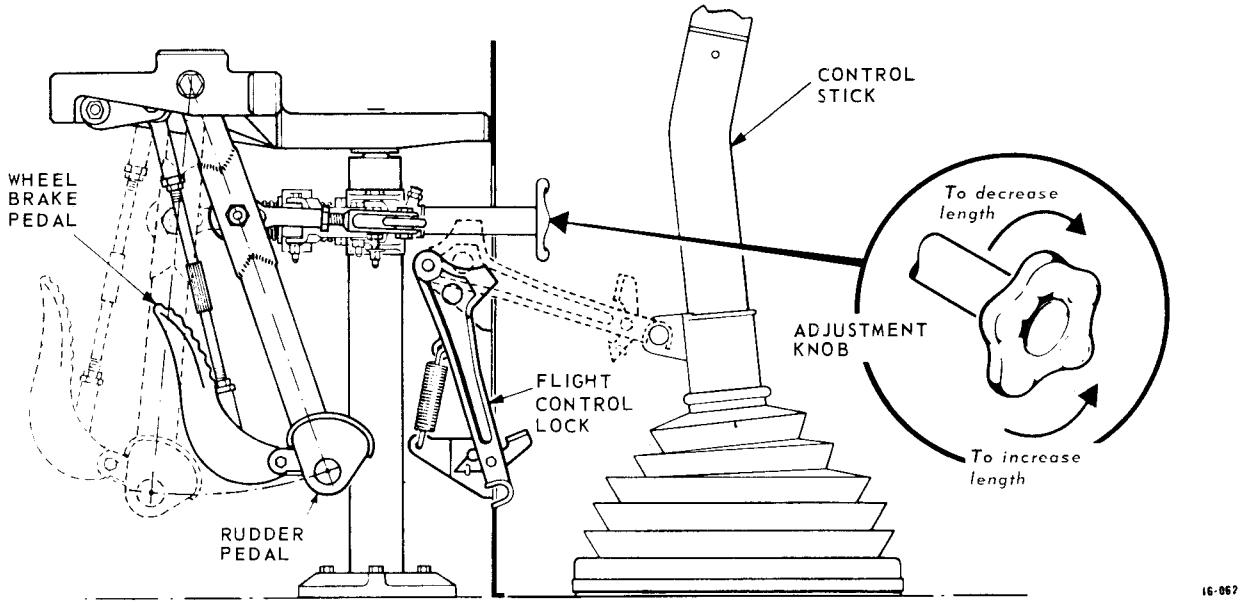


Figure 1-16

means of a device (fig. 1-16) accommodated under the forward instrument panel. This device consists of a lever, hinged at the top, which is normally held in the vertical position by a spring and a spring-loaded latch which locks it in the unlocked position. When locking of flight controls is required, the latch is disengaged and the lever moved out of its position and engaged with the locking pin on the control stick base. By this operation the rudder pedals are also locked simultaneously since a fork embodied in the lever engages with the mount of the rudder adjustment knob, which is integral with the rudder pedals fulcrum.

TRIM CONTROL SYSTEM

Aileron and Elevator Trim Switch.

The trim tab on the left aileron and the trim tabs on the elevator are controlled by a five-position switch on the top of the control stick (fig. 1-15). The switch is powered by the primary 28 V dc bus and is spring-loaded to the center position. Trimming is effected by positioning the stick for the desired flight attitude and then operating the trim switch to remove the stick loads. Holding the trim switch to either side causes the corresponding wing to be trimmed down. Holding the trim switch forward trims the nose down, while holding it aft trims the nose up. When the switch is released, it automatically returns to the center (off) position and the trim action stops. The rear cockpit aileron and elevator trim switch overrides the front one.

"Rudder Trim" Switch

The rudder trim tab is electrically controlled by a spring-loaded switch (fig. 1-7 and 1-9) located on the left console in each cockpit. The switch is held to LEFT or RIGHT for corresponding rudder trim and is spring-loaded to the OFF position. The rudder trim switch receives its power from the primary 28 V dc bus. The rear cockpit rudder trim switch overrides the front one.

"Trim Tab Neutral Position" Magnetic Indicators

Three magnetic indicators grouped on the instrument panel in each of the two cockpits indicate, by reading NEUT, when the trim tabs are at zero. When any of the trim switches is actuated and the corresponding tab is displaced from neutral, the associated indicator will turn striped.

Note

In the event of the two elevator tabs being misaligned in their travel, the indicator will not show neutral. If this occurs it is necessary to move the two tabs to bottom in either

direction so that they may subsequently align at neutral.

WING FLAP SYSTEM

The hydraulically operated, slotted-type wing flaps extend from the aileron to the fuselage on each wing panel. The flaps are attached to gear-type control boxes installed at the wing trailing edge. A linkage connected to the control boxes permits a considerable amount of rearward movement of the flaps during lowering. The two wing flaps are interconnected and are actuated by a single actuating cylinder installed in the fuselage. A valve incorporated in the hydraulic system permits partial retraction of the flaps when they are lowered at speed exceeding the limit value.

Flap Control Lever

The flap control lever (fig. 1-7 and 1-9) is mounted on the left console in each cockpit and operates the flap control microswitch unit. The two levers are interconnected by a rigid transmission and can be set to three positions, namely: "UP", "TAKEOFF" and "DOWN".

Wing Flap Position Indicator

The flap position indicator is mounted with the speed brake position indicator in a single instrument located on the upper left side of each instrument panel. The position of the flaps is indicated by a rotating pointer. The instrument dial is marked UP, T/O and DOWN.

SPEED BRAKE SYSTEM

The hydraulically operated speed brake is mounted on the lower side of the fuselage and consists of a hinged panel which, when open, extends down and forward into the air stream. The speed brake opens or closes in about 2 seconds and can be positioned as desired. When extending the landing gear, the speed brake, if down, closes to 28° to ensure a safe ground clearance on landing.

WARNING

Before operating the speed brake on the ground, be sure that the fuselage area around the brake is clear, as the brake operates rapidly and forcefully and could injure any personnel near the brake.

Speed Brake Switch

A toggle switch, mounted on the top of each throttle grip (fig. 1-3), controls the speed brake hydraulic control valve. The switch is powered by the essential 28 V dc bus. It has three positions and is spring-loaded to the center position. The switch is held to IN or OUT for corresponding speed brake movement. The speed brake can be stopped in any position by releasing the toggle switch which thus springs back to the center position. The rear cockpit control overrides the front one. When the speed brake is extended while the landing gear is down, it does not extend through its full travel but stops at 28° to ensure a safe ground clearance on landing.

Note

The restriction in speed brake extention is not effective when the landing gear has been extended through the emergency system.

Speed Brake Position Indicator

The speed brake position indicator is mounted with the flap position indicator in a single instrument located on the upper left side of each instrument panel. The position of the speed brake is indicated by a rotating pointer. The instrument dial is marked IN and OUT.

LANDING GEAR SYSTEM

The landing gear and wheel fairing doors are hydraulically actuated and electrically (dc power) controlled and sequenced (fig. 1-14).
The hydraulic system comprises an independent circuit for landing gear emergency extension. The nose landing gear retracts forward into the fuselage. The main landing gear retracts outward into the wing panels. Hydraulic brakes are provided on the main wheels.

Landing Gear Control Lever

A control lever on the landing gear control panel (fig. 1-7) located on the instrument panel in each cockpit, electrically controls the landing gear and door selector valves. The lever has two positions, UP and DOWN, and is energized by the essential 28 V dc bus. When the aircraft is on the ground with its weight on the wheels, a ground safety switch prevents inadvertent retraction of the landing gear through an automatic lock device which locks the lever in the DOWN position.

"Lever Lock Release" Button

The "LEVER LOCK RELEASE" button is located on the instrument panel in each cockpit, immediately above the landing gear control lever (fig. 1-17).

LANDING GEAR CONTROL

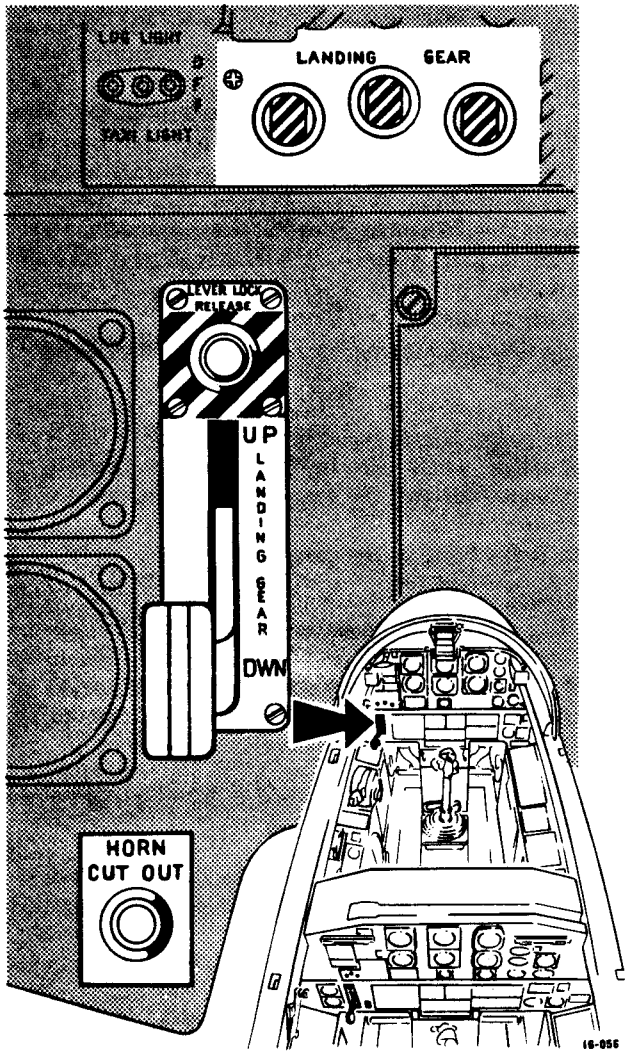


Figure 1-17

Pressing this button under emergency conditions disconnects the safety switch and permits emergency ground retraction of the landing gear.

"L.G. Emerg Selector" Handle

Should failure of the hydraulic system or of the electrical system occur, the landing gear may be lowered by use of the "L.G. EMERG SELECTOR" handle located on the left console in the forward cockpit. When this handle is pulled to full extension, the independent L.G. emergency extension circuit is connected to the actuating cylinders.

Note

The fairing doors will remain open when the landing gear is extended by means of the emergency system.

CAUTION

Automatic retraction of the speed brake from DOWN to 28° does not occur when the landing gear is lowered through the emergency system.

LANDING GEAR SYSTEM INDICATORS

Three landing gear position indicators (fig. 1-17) on the landing gear control panel in each cockpit provide a visual indication of the condition of the landing gear and fairing doors. A caution light is in the landing gear control lever. Each indicator shows white stripes if the related gear is in an unlocked condition, the word "UP" if the gear is up and locked, or a miniature wheel if the gear is down and locked. White stripes also appear if the electrical system is inoperative. The caution light (inside the lever) glows whenever the landing gear or the door position does not correspond to the position of the landing gear lever, or when the throttle is retarded to IDLE position and the landing gear is not down and locked.

A warning horn in the cockpit sounds when the gear is in any position other than down and locked and the throttle is retarded to IDLE position. A "HORN CUT OUT" button (fig. 1-17), adjacent to the gear control lever, is provided to silence the horn. Advancing the throttle silences the horn and resets the horn circuit. Both the caution light and the warning horn operate either in the air or on the ground whenever power is available. Power for the landing gear position indicators, caution light in the control lever and warning horn is supplied from the essential 28 V dc bus. The landing gear caution light is automatically dimmed when the "WARNING & CAUTION LIGHTS" switch is moved to DIM.

WHEEL BRAKE SYSTEM

The wheel brake circuit is connected to and supplied by the main hydraulic system (fig. 1-14). It consists essentially of two pairs of sensitive selector valves connected to the rudder pedals and two braking units of the disc-type on the wheels of the main gear. In case of failure of the hydraulic pump, application of the brakes is possible by use of the hydraulic pressure stored in the main accumulator.

If no pressure is available in the main accumulator, the brakes can still be operated using the pressure stored in the emergency accumulator. In this case, however, the brakes are not applied by means of the pedals but by

operation of the "PARK & EMER BK" handle. The brake units, on each main wheel, consist of rotor and stator plate assemblies. The braking effect is obtained by metered hydraulic pressure pushing the stationary stator plates against the rotor plates. Multiple plates are used to increase braking efficiency, aid in heat dissipation, and prevent brake seizure due to disc warpage resulting from high temperatures.

"Park & Emer Bk" Handle

Should failure of the hydraulic system occur, brakes can still be applied using the pressure stored in the emergency accumulator, by means of the "PARK & EMER BK" handle located on the upper right side of the forward instrument panel. When this handle is pulled out, pressure is delivered to the braking units, the braking action being proportional to the extent the handle is out and equal on both wheels. The "PARK & EMER BK" handle can also be used to set the brakes for parking; for this purpose the handle is pulled out and rotated 90° clockwise to retain it out and maintain the brakes applied on the wheels.

INSTRUMENTS

Most of the instruments are electrically operated by power from the electrical system (See figure 1-13). The tachometer and jet pipe temperature indicators are self-generated electrical instruments and are not powered by the electrical system.

Note

For information regarding instruments that are an integral part of a particular system, refer to the applicable paragraphs in this section and in section IV.

PITOT PRESSURE AND STATIC SYSTEM

The pitot pressure and static system operates the mach-airspeed indicator, altimeter and vertical speed indicator. The pitot heads (one for each instrument panel) are mounted on the fuselage, just forward the windshield. The static ports are mounted on the L.H. and R.H. sides of the rear part of the fuselage. The Pitot heads are electrically heated. The heating element of each head is controlled by the "PITOT HTG" switch on the right console of each cockpit (fig. 1-8 and 1-9).

AIRSPEED AND MACH NUMBER INDICATOR

This instrument, located on the upper portion of each instrument panel, combines the indication of the indicated airspeed as given by a conventional airspeed indicator with the indication of the Mach number. It also gives the indication of the maximum allowable speed of the aircraft and provides the pilot with a visual adjustable reference for any speed he intends to fly. A pointer integral with a shade is used to indicate airspeed on a fixed dial through a range of 40 to 650 knots and the corresponding Mach number on a movable scale. This scale, which appears in a window of the airspeed pointer integral shade, rotates with altitude changes to show the Mach number (in a range from Mach .3 to Mach 1.2) that is equivalent to the indicated airspeed for the particular altitude. A movable red and black limiting pointer automatically indicates, in terms of IAS, the maximum allowable equivalent airspeed (EAS) of the aircraft in a clean configuration.

A knurled knob, at the lower right corner of the instrument ring, sets the indicated airspeed index marker to the recommended speed for the various configurations. (The speed index marker moves along the right perimeter of the dial).

ALTIMETER

The altimeter is located on the upper portion of each instrument panel. The range of the altimeter is 0 to 80,000 feet. In addition to the three pointers indicating the tens, hundreds and thousands of feet, this altimeter is provided with a window where a striped section appears at altitudes below 16,000 feet. A barometric scale is visible through a window on the right side of the dial, and is adjustable by a knob on the front of the instrument.

The knob allows the altimeter to be adjusted to any desired atmospheric pressure setting. Atmosphere pressure sensing for the altimeter is through the aircraft static pressure system.

ACCELEROMETER

An accelerometer, mounted on the upper left side of each instrument panel, indicates G (positive and negative). Reference to this instrument provides an indication of structural loads. In addition to the conventional indicating pointer, there are two recording pointers (one for positive and one for negative G loads) which follow the indicating pointer to its maximum attained travel. The recording pointers remain at the maximum travel positions reached by the indicating pointer, thus giving a record of the maximum G-loads encountered. To return the recording pointers to the normal (1 G) position, it is necessary to press the knob on the lower left corner of the instrument.

VERTICAL SPEED INDICATOR

The vertical speed indicator is mounted on the upper

portion of each instrument panel. The indicator registers the rate of climb or descent in feet per minute and is operated by the static air system.

TURN AND BANK INDICATOR

The turn and bank indicator is an electrically driven instrument located on the upper portion of each instrument panel. It indicates the extent of turn which the aircraft is carrying out in the unit of time. A ball-type bank indicator is incorporated in the instrument to indicate a possible incorrect turn.

RADIO MAGNETIC INDICATOR (RMI)

Refer to paragraph "Navigation Equipment" in Section IV of this manual.

COURSE INDICATOR (CI)

Refer to paragraph "Navigation Equipment" in Section IV of this manual.

ATTITUDE INDICATOR

The attitude indicator is mounted on the upper portion of each instrument panel. The instrument provides a visual indication of pitch and roll flight attitude with respect to the earth.
The display portion of the instrument consists of a sphere integral with a gyroscope. The sphere presents a horizon line (hypothetical) which in level flight is coincident with a symbol in form of a miniature aircraft attached to the instrument ring.
When the aircraft climbs or dives, the horizon line moves up (dive) or down (climb) with respect to the miniature aircraft. Beyond a certain amount of deviation, the word "CLIMB" at nose-up attitudes or "DIVE" at nose-down attitudes, becomes visible on the instrument. A graduated scale on the lower half of the presentation provides indication of the aircraft bank angles against a fixed index marker on the gyroscope axis.
The instrument also embodies an "OFF" alarm flag controlled by a relay in pair with an electronic device, which appears on the center of the dial face whenever a power failure or instrument malfunctioning is present.
A "PULL TO CAGE" knob on the lower left corner permits (when rotated) to align the miniature aircraft with the horizon line and (when pulled) to apply power to the gyro fast-erection system. Fast erection of the gyroscope is used, especially after a series of acrobatic maneuvers, to erect the gyro back to the vertical. The instrument comprises a mechanism which introduces a fast erection cycle during initial starting. To remove possible indication errors during prolonged turns, the erection system is fitted with an over-riding device which operates when acceleration along the line of flight is above 0.17 ÷ 0.19 g.

STANDBY COMPASS

A conventional magnetic compass is located on the upper right side of the forward instrument panel. Illumination of the standby compass is controlled by the "INST LIGHTS" rheostat on the right console of each cockpit, and power is supplied by the primary 28 V dc bus.

"GYRO MASTER" SWITCH

This switch is provided in the forward cockpit only. When turned ON the switch operates the gyro compass system, the turn and bank indicator and the attitude indicator.

CAUTION AND WARNING LIGHT SYSTEM

CAUTION LIGHT SYSTEM

The caution light system consists of a caution light panel, a master caution light and reset bar, and a switch for light test and dimming.

"Master Caution" Light

The "MASTER CAUTION" light, located on the upper edge of each instrument panel, illuminates when a caution light placard is energized. A reset bar on which the front master caution light is mounted permits the pilot to extinguish the master caution light, although a malfunction continues to exist. The individual caution light placard will then remain illuminated and the master caution light will indicate a second malfunction, should one occur.

Caution Light Panel

The caution light panel consists of individually illuminated placards that provide visual indication of failure in the power eauipment or unsafe condition in the aircraft system. In the event of a condition requiring the pilot's attention, the caution light placard for the particular system remains on until the failure is corrected. The caution light panel contains the following placards:

DC GEN OUT	*AC GEN OUT
MAIN INV OUT	AC INST PWR OUT
NO. 1 BATT OUT	NO. 2 BATT OUT
FUEL LEVEL LOW	FUEL PRESS LOW
*ICING COND	OIL PRESS LOW
*IFF	CKT BKR TRIPPED

* The caution lights are inoperative.

The "CKT BKR TRIPPED" caution light, on the caution light panel, glows to indicate that one of the electrical system circuit breakers has tripped disconnecting the related circuit. The following circuit breakers are not connected to the "CKT BKR TRIPPED" caution light:

- LAND LT.
- GUN PWR – RH.
- GUN PWR – LH.
- ESSENTIAL LOADS
- PHOTO RECON
- STBY INV
- MAIN INV
- PHOTO RECON
- BOOSTER PUMP
- Emergency battery circuit breaker (in the oxygen filler access door).

"Warning & Caution Lights" Switch

A "WARNING & CAUTION LIGHTS" switch is located on the right side of the caution light panel on each instrument panel. The switch on the forward instrument panel has three positions, DIM, NOR and TEST. The switch on the aft instrument panel has only two positions, DIM and NOR. When the switch is in the NOR position, full bus voltage is directed to the caution lights to provide maximum brilliance when energized. When the switch is placed to the DIM position, the intensity of the caution lights is reduced to half. When the switch on the forward instrument panel is moved from NOR to the spring-loaded TEST position, the filaments of all warning and caution lights (Canopy, Fire, Overheat, Landing gear control levers, Master caution and Caution panels) and the horn are checked. When the switch is released, it automatically returns to the NOR position.

ENGINE FIRE DETECTOR WARNING SYSTEM

Two fire detector systems (fig. 1-18) detect and indicate fire in the forward section of the engine compartment and an overtemperature condition or fire in the aft section. A stainless-steel firewall divides the engine compartment immediately aft of the compressor. Therefore, the forward section includes the compressor and the accessory section; the aft section, the combustion chamber and the tail pipe. Each system consists of a fire-wire detector unit mounted throughout the engine compartment and of a warning light. The warning lights are on the upper right side of each instrument panel. Illumination of the red warning light, marked "FIRE", indicates fire in the forward section of the engine, compartment. Illumination of the amber warning light, marked "OVERHEAT", shows an excessive overtemperature condition or fire in the aft engine section. Operation of the warning system and lights can be checked by means of the "WARNING & CAUTION LIGHTS" switch (see the related paragraph).

CANOPY UNSAFE WARNING LIGHT

A canopy unsafe warning light (fig. 1-19) is mounted on the upper left side of each instrument panel. The light will come on and remain illuminated as long as the canopy latches are unlocked. The light goes out when the canopy is closed and the latches are locked.

CANOPY

The single-piece, transparent plastic canopy covers both cockpits and is attached to the aircraft by hinges at the right side of the cabin sill. The canopy is counterbalanced and manually operated. It is closed by the pilots (fig. 1-19) using either or both the internal handgrips provided and is locked by manually operated latches. The canopy can be jettisoned by means of one of the two cartridge-type canopy guns installed. The jettisoning of the canopy is fully automatic since the actuating system is connected to the same firing handles (main and alternative) which operate the ejection seat. The canopy may also be jettisoned independently of the seat ejection since each pilot has available a control handle which directly operates the canopy jettison gun connected with the rear seat. With the canopy closed, the spring balance mechanism in the canopy is set to engage with a fastening device which, when the canopy is jettisoned, releases the canopy from the spring mechanism and retains the latter to the fuselage. During taxiing, at normal speeds, the canopy can be held partially open by an appropriate locking linkage.

An inflatable canopy seal seals the canopy in the closed position. Pressure for inflation of the seal is provided by the engine compressor and is provided by the engine compressor and is automatically controlled by a pressure regulator when the engine is operating. The seal is automatically inflated whenever the canopy is fully latched and is deflated whenever the canopy is unlatched.

EXTERNAL CANOPY LOCKING HANDLE

The canopy is operated from the outside by means of an external handle (fig. 1-19) which is normally flush with the fuselage contour. The handle is pulled out by pressing a button, and is rotated upwards to lock and downwards to unlock the canopy. After operation the handle shall be folded and tripped into its housing. When the canopy is unlocked, canopy opening simply requires pushing upwards using the appropriate handgrip. The canopy is held locked in the open position by a device incorporated in the spring balance mechanism. To close the canopy, it is sufficient to press the unlock on the

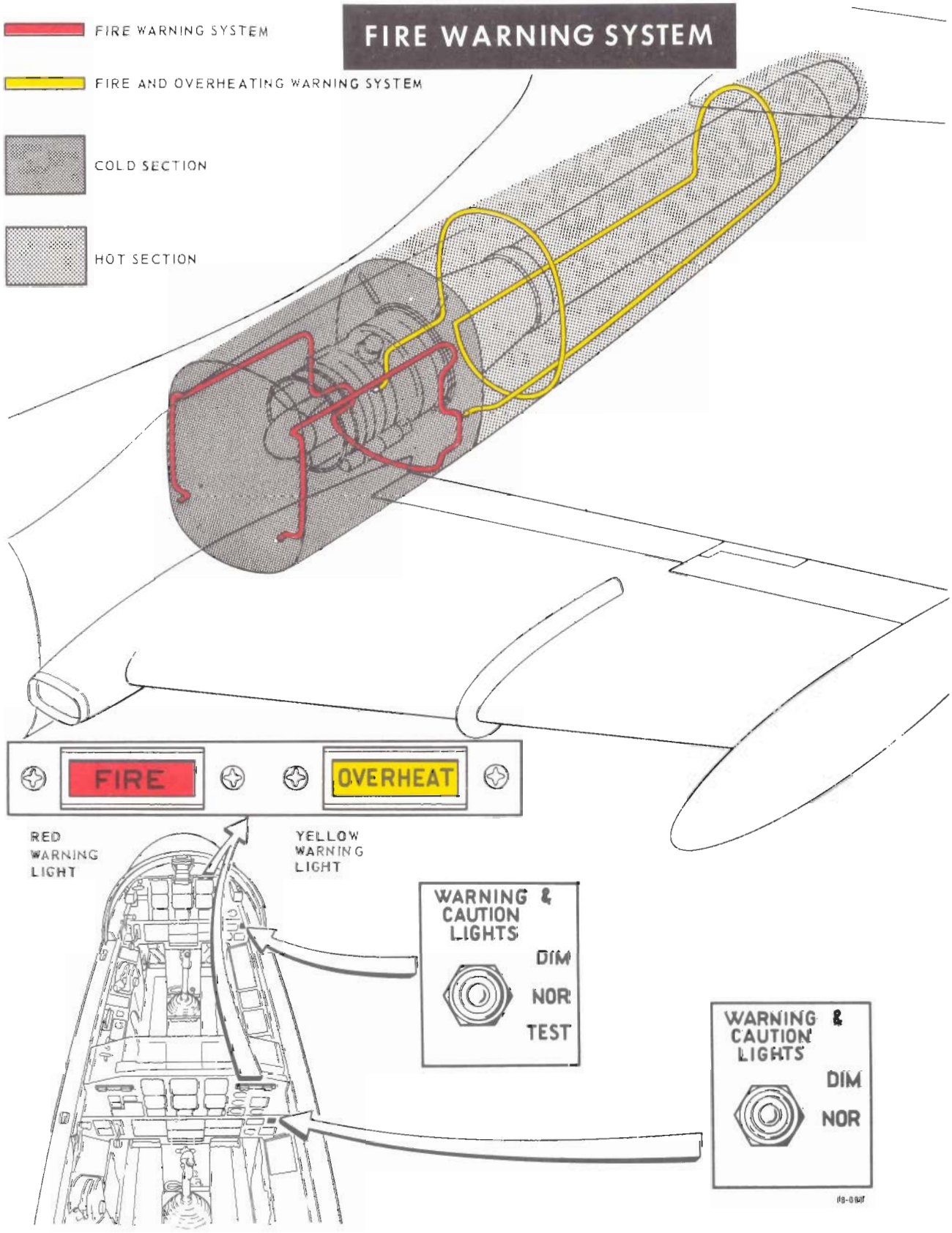

FIRE WARNING SYSTEM
FIRE WARNING SYSTEM
FIRE AND OVERHEATING WARNING SYSTEM
COLD SECTION
HOT SECTION
FIRE
OVERHEAT
RED WARNING LIGHT
YELLOW WARNING LIGHT
WARNING & CAUTION LIGHTS
DIM
NOR
TEST
WARNING & CAUTION LIGHTS
DIM
NOR

Figure 1-18

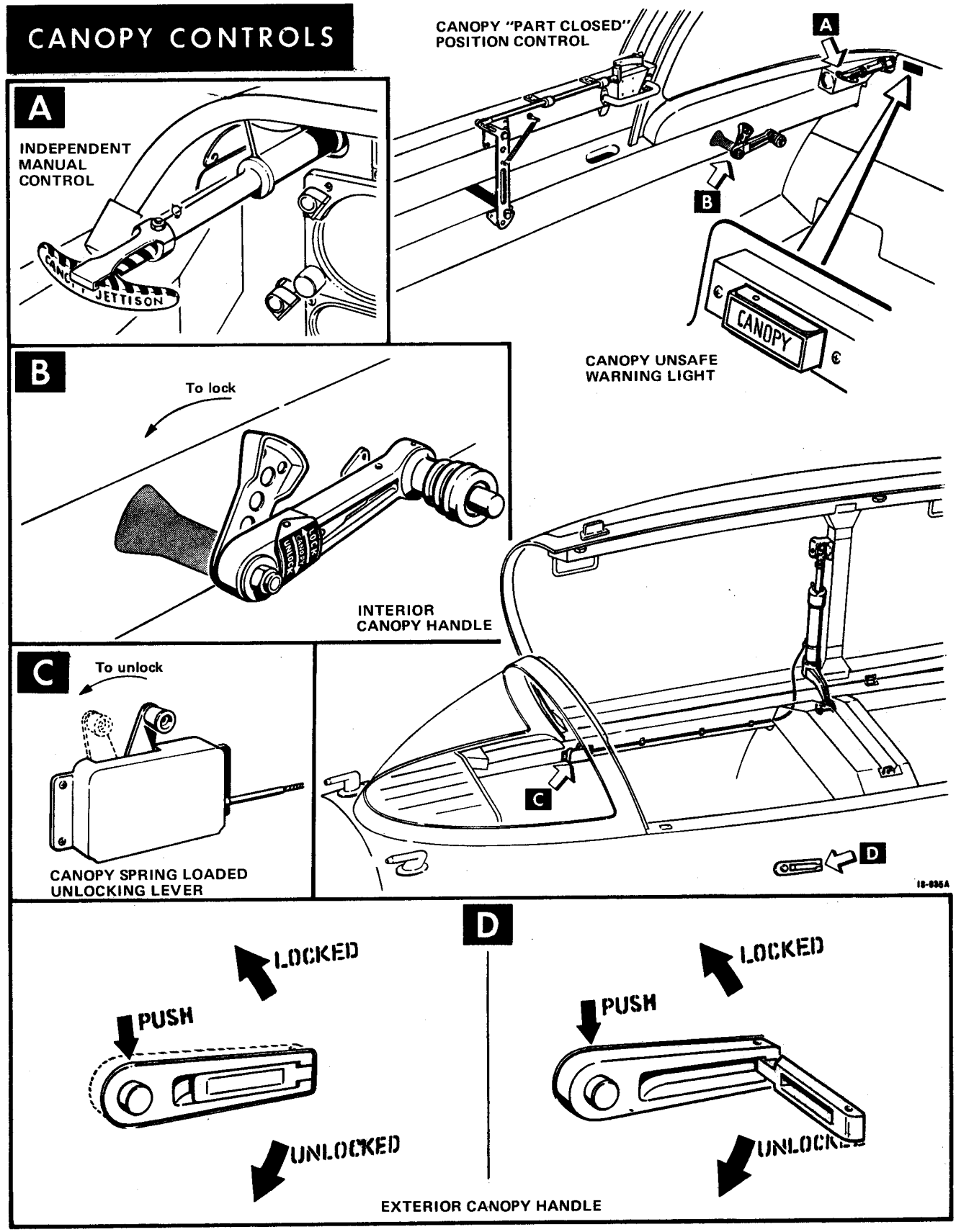

CANOPY CONTROLS
A
INDEPENDENT MANUAL CONTROL
CANOPY JETTISON
CANOPY "PART CLOSED" POSITION CONTROL
A
B
CANOPY
CANOPY UNSAFE WARNING LIGHT
B
To lock
LOCK
CANOPY
UNLOCK
INTERIOR CANOPY HANDLE
C
To unlock
CANOPY SPRING LOADED UNLOCKING LEVER
C
D
18-936A
D
LOCKED
PUSH
UNLOCKED
LOCKED
PUSH
UNLOCKED
EXTERIOR CANOPY HANDLE

Figure 1-19

spring mechanism and bring the canopy manually to the closed position.

INTERNAL CANOPY LOCKING HANDLE

The canopy, when closed, is locked or unlocked by means of either handle on the left side of the cockpits (fig. 1-19). A red-painted area at each canopy locking handle visually indicates to the pilot that, when locking of canopy is completed, the operating arm (rotating concentrically with the handle) is in the correct position. If the position is correct, the red area will be entirely cancealed by the operating arm. The handle is held at rest by a spring from which it is released by a button on the handle grip. When the handle is rotated all the way counterclockwise, the latches are engaged and the canopy is locked. When the canopy is closed and fully locked, the canopy switch circuit is opened and the canopy unsafe warning light goes out. Turning the handle clockwise unlocks the latches; the canopy switch circuit is then energized and the canopy unsafe warning light illuminates. When the canopy is unlocked, a direct manual action on the handgrip secured to the canopy is sufficient to open the canopy. The canopy is locked in the open position by a device incorporated in the spring balance mechanism. To close the canopy, it is sufficient to push the spring mechanism unlock lever forward and bring the canopy manually to the closed position.

INTERNAL "CANOPY JETTISON" HANDLE

A canopy jettison independent control handle (fig. 1-19) is mounted on the upper left side of each instrument panel. Both handles directly operate the canopy jettison gun connected with the rear seat. Should the gun fail to fire, it is possible to operate the canopy gun connected with the front seat by turning the "CANOPY JETTISON" handle 90° clockwise and pulling it for a further portion of its travel. The handles are provided with safety pins to be removed before operation.

EXTERNAL CANOPY EMERGENCY JETTISON CONTROL

A canopy emergency jettison handle connected to a cable, approximately 8 feet long, is located on the left side of the aircraft within a receptacle closed by a door. By pulling out this handle and stretching the cable tight, it is possible to jettison the canopy through the explosive charge of the canopy gun in the forward cockpit.

CANOPY SAFETY PINS

The canopy jettison system is safetied by inserting a ground safety pin (fig. 1-21) through the sear in both canopy jettison guns. This will prevent movement of the sear and inadvertent firing of the canopy. The ground safety pins are to be removed before flight and replaced immediately after flight.

WARNING

It is imperative that the safety pin be removed from canopy jettison gun in the aft cockpit (even in case of "solo" flight) or the pilot will be prevented from operating either the front or the aft canopy jettison independent control handle.

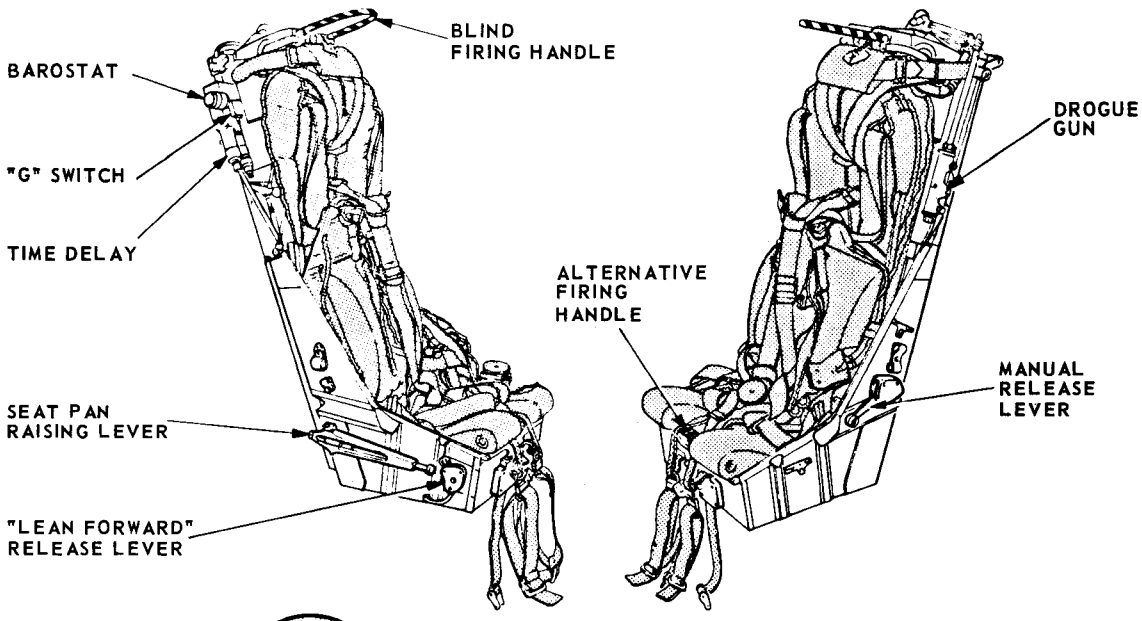
EJECTION SEAT

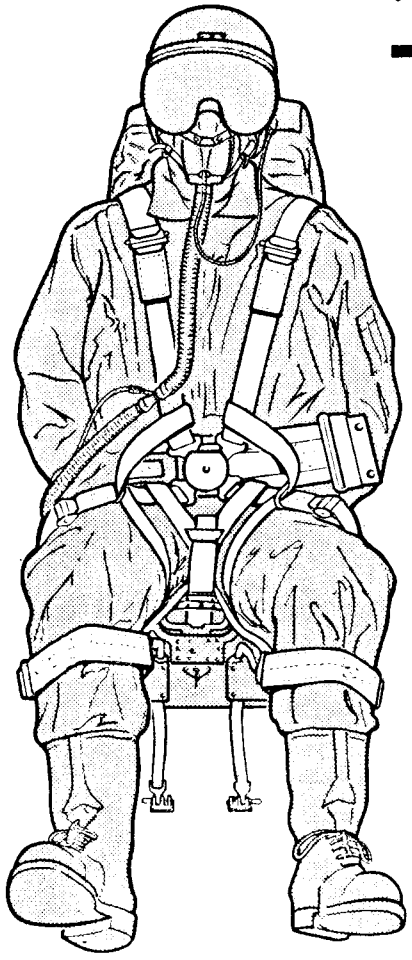
Both forward and aft cockpits are equipped with Martin-Baker Mk O4A ejection seats (fig. 1-20). This type of seat allows ejection from the aircraft at any speed and flight altitude including ejection at runway level provided that the aircraft speed is not less than 100 kts. The procedures to be followed for ejection of the seat are specified in paragraph "Ejection seat" in Section III.

After ejection has occurred, stabilization of the seat, opening of the parachute and separation of the occupant from the seat are fully automatic. When ejection is carried out at altitudes above 5000 m (16,400 ft), a barostatic time unit delays the deployment of the main parachute and the separation of the occupant from the seat. This allows the occupant to descend rapidly through the cold and rarefied atmosphere at high altitudes, secured to his seat stabilized by the drogue parachute and provided with oxygen from the emergency bottle attached to the seat, down to a more tolerable altitude, where he is automatically released from the seat by the automatic release mechanism. At high speed the parachute opening is delayed by an inertia switch, until a safe speed for deployment is reached. A cartridge device for canopy jettisoning is connected to the seat through a control rod, which makes unnecessary any further maneuver prior to seat ejection as both the canopy and the seat are operated by the seat firing handle. The seat main cartridge is fired one second after the canopy cartridge is fired.

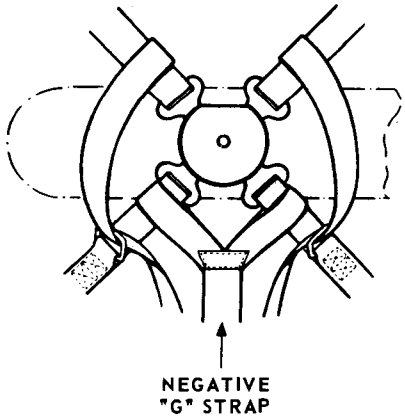
Besides the pilot's personal parachute, the seat incorporates a survival pack including a dinghy and a survival kit enclosed in a cushioned container which

MK04A EJECTION SEAT





ROUTING OF COMBINED HARNESS & LEG RESTRAINT



10-617

Figure 1-20

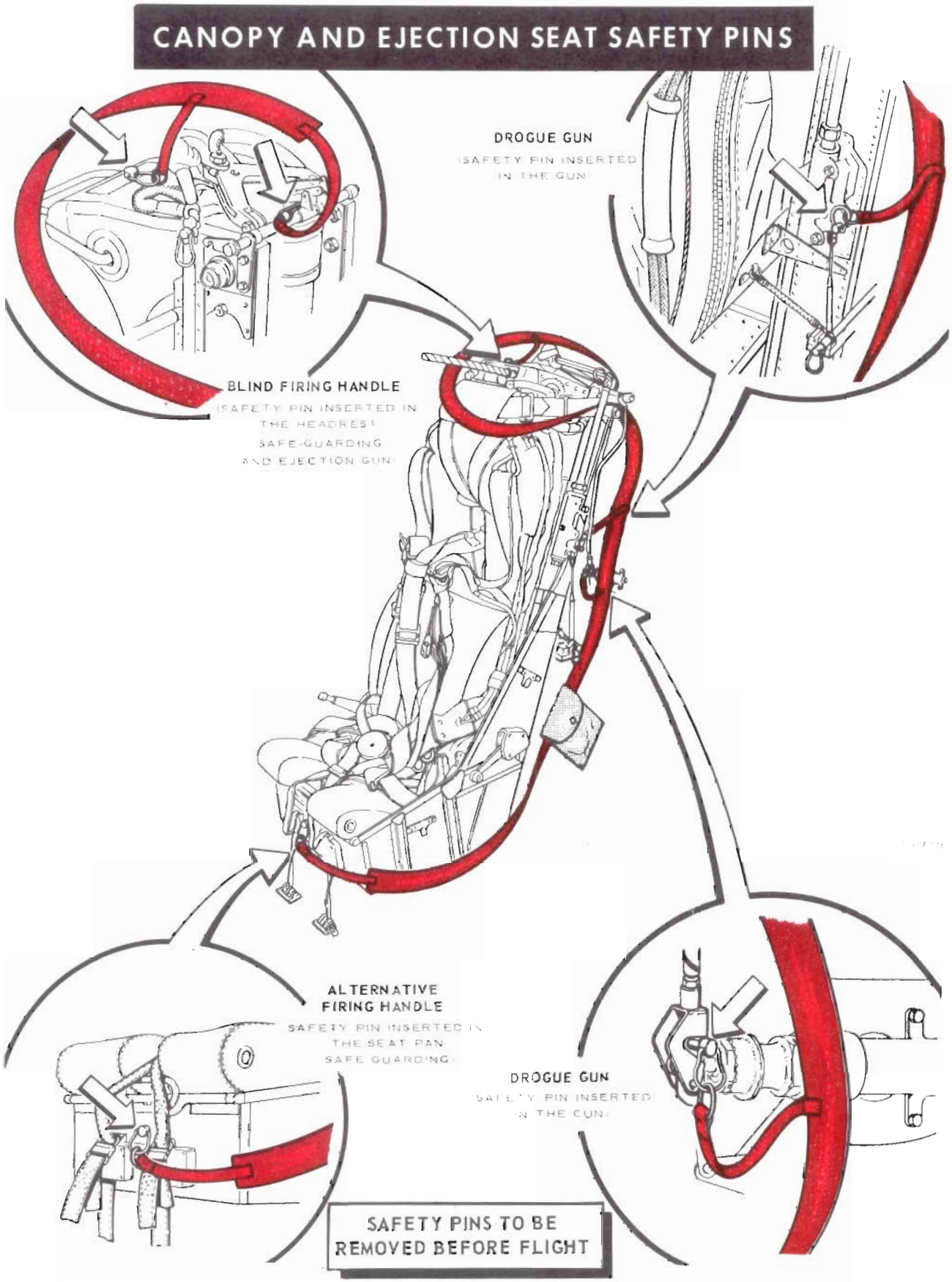

CANOPY AND EJECTION SEAT SAFETY PINS
DROGUE GUN
(SAFETY PIN INSERTED IN THE GUN)
BLIND FIRING HANDLE
(SAFETY PIN INSERTED IN THE HEADREST SAFE-GUARDING AND EJECTION GUN)
ALTERNATIVE FIRING HANDLE
(SAFETY PIN INSERTED IN THE SEAT PAN SAFE GUARDING)
DROGUE GUN
(SAFETY PIN INSERTED IN THE GUN)
SAFETY PINS TO BE REMOVED BEFORE FLIGHT

Figure 1-21

constitutes the seat cushion. The seat has provisions for height adjustment.

GROUND SAFETY PINS

The ejection seat is safetied by four safety pins (fig. 1-21), to be inserted one in the gun firing sear, one in the blind firing handle, one in the alternative firing handle and one in the drogue gun. These pins, as well as the canopy jettison gun safety pin, are connected one another by a band. The pin-carrying band will be removed from the seat before flying and will be stowed in the special holder provided in the cockpit.

BLIND FIRING HANDLE

The jettisoning of the canopy and the ejection of the seat are brought under the single control of the face blind located on the seat headrest, which, when pulled, extracts both the sear from the canopy gun firing unit and the sear from the ejection gun and causes the immediate jettisoning of the canopy followed one second later by the ejection of the seat (delayed through a time delay mechanism).

ALTERNATIVE FIRING HANDLE

An alternative firing handle is located on the forward portion of the seat pan and operates a cable which, at its far end, is connected to the canopy-seat firing linkage at the same point as the main control. The purpose of this handle is to permit the ejection of the seat when strong positive accelerations involved by particular flying conditions prevent the pilot from raising his hands to grasp the blind firing handle.

SEAT PAN RAISING LEVER

The position of the seat pan can be vertically adjusted and locked in one of seven positions over a distance of 6 inches by means of the seat raising lever located on the right side of the pan. This is effected by depressing a push rod knob which disengages the seat pan from its lock. The occupant adjusts the seat pan for optimum position and then releases the push rod knob which allows the seat pan to be locked in the new adjusted position. While the seat is unlocked, the weight of the pilot's body is balanced by two elastic cords that are part of the seat.

"LEAN FORWARD" RELEASE LEVER

The parachute and seat harnesses are combined and connected to a single box as one harness. The harness has a three point fixing to the seat, two locks on the seat pan securing the lap harness and a third lock on the mid cross member which secures the shoulder harness via a looped strap. The strap, under the control of the "Lean Forward" release lever on the right side of the pan, enables the pilot to lean well forward in the seat but on ejection or crash landing ensures that he is held well back in the seat.

MANUAL RELEASE LEVER

In the event of damage to the seat mechanism which prevents its operation, either by failure of the seat to eject or failure of the automatic gear to operate, a manual release lever located on the left side of the seat pan permits the pilot to make a free bail-out using the parachute or, after ejection, to separate himself from the seat by manually unlocking the seat harness.
See paragraph "Failure of seat to eject" in Section III for the correct use of this lever.

AUXILIARY EQUIPMENT

The following auxiliary equipment is described in Section IV:

- Cabin air conditioning and pressurization system
- Demisting and anti-icing system
- Anti-g suit system
- Communication equipment
- Navigation equipment
- Lighting equipment
- Oxygen system
- Armament system
- Photo-reconnaissance system
- Miscellaneous equipment

SERVICING

SERVICING THE FUEL TANKS

For servicing the fuel tanks, refer to figure 1-22 (sheet 1).

SERVICING THE ENGINE OIL TANK

For servicing the engine oil tank, refer to figure 1-22 (sheet 2).

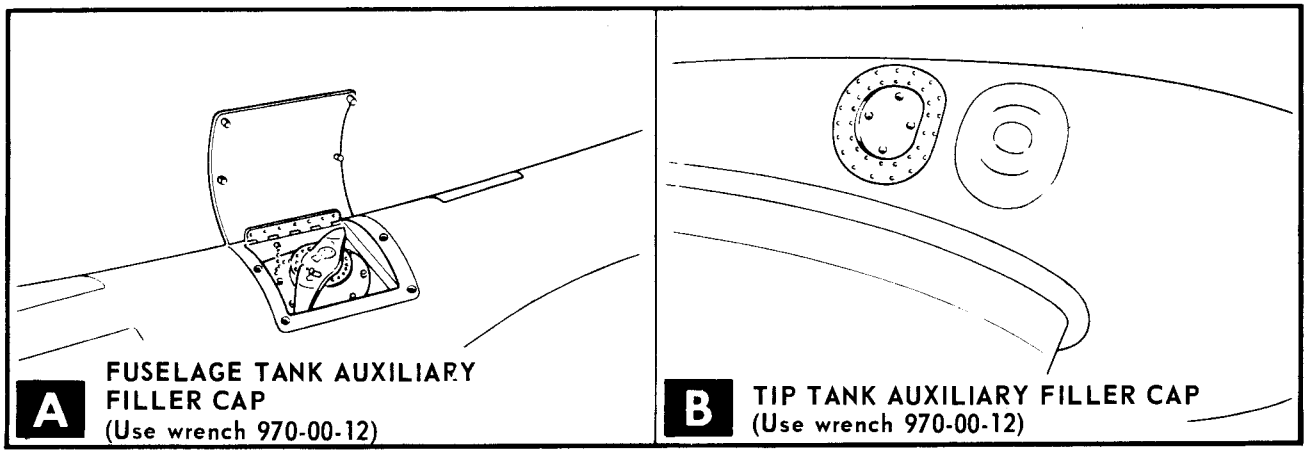
SERVICING THE HYDRAULIC FLUID RESERVOIR

For servicing the hydraulic fluid reservoir, refer to figure 1-22 (sheet 2).

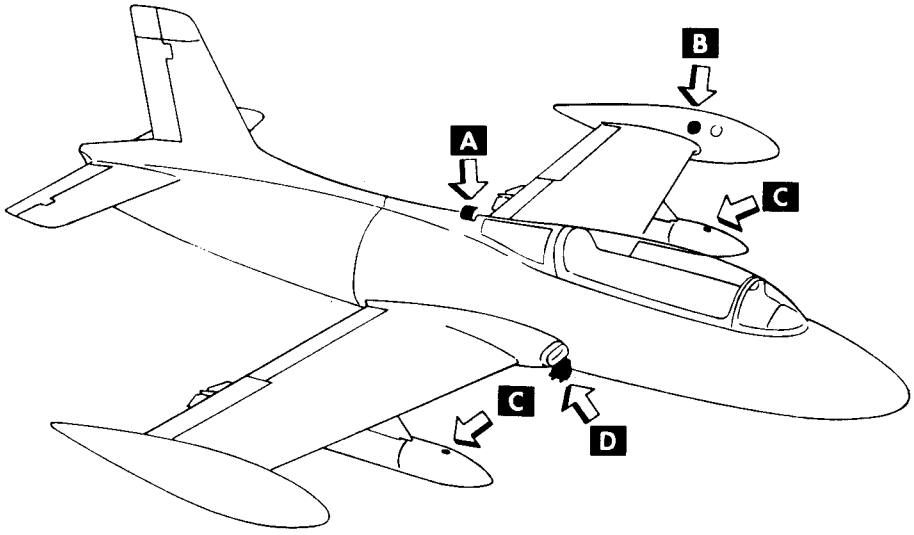
SERVICING THE OXYGEN CYLINDERS

For servicing the oxygen cylinders, refer to figure 1-22 (sheet 2).

SERVICING DIAGRAM



FUEL	
NATO CODE	BRITISH Specification
F-30	DERD.2482
F-34	DERD.2453
F-35	DERD.2494
F-40	DERD.2454
F-44	DERD.2498
F-45	DERD.2486



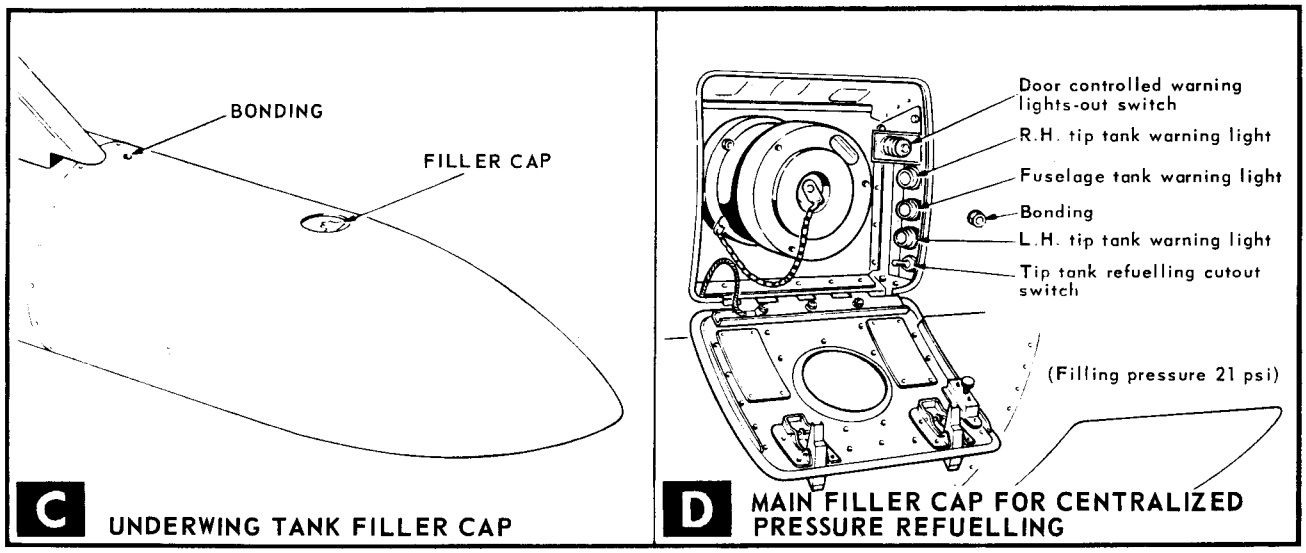
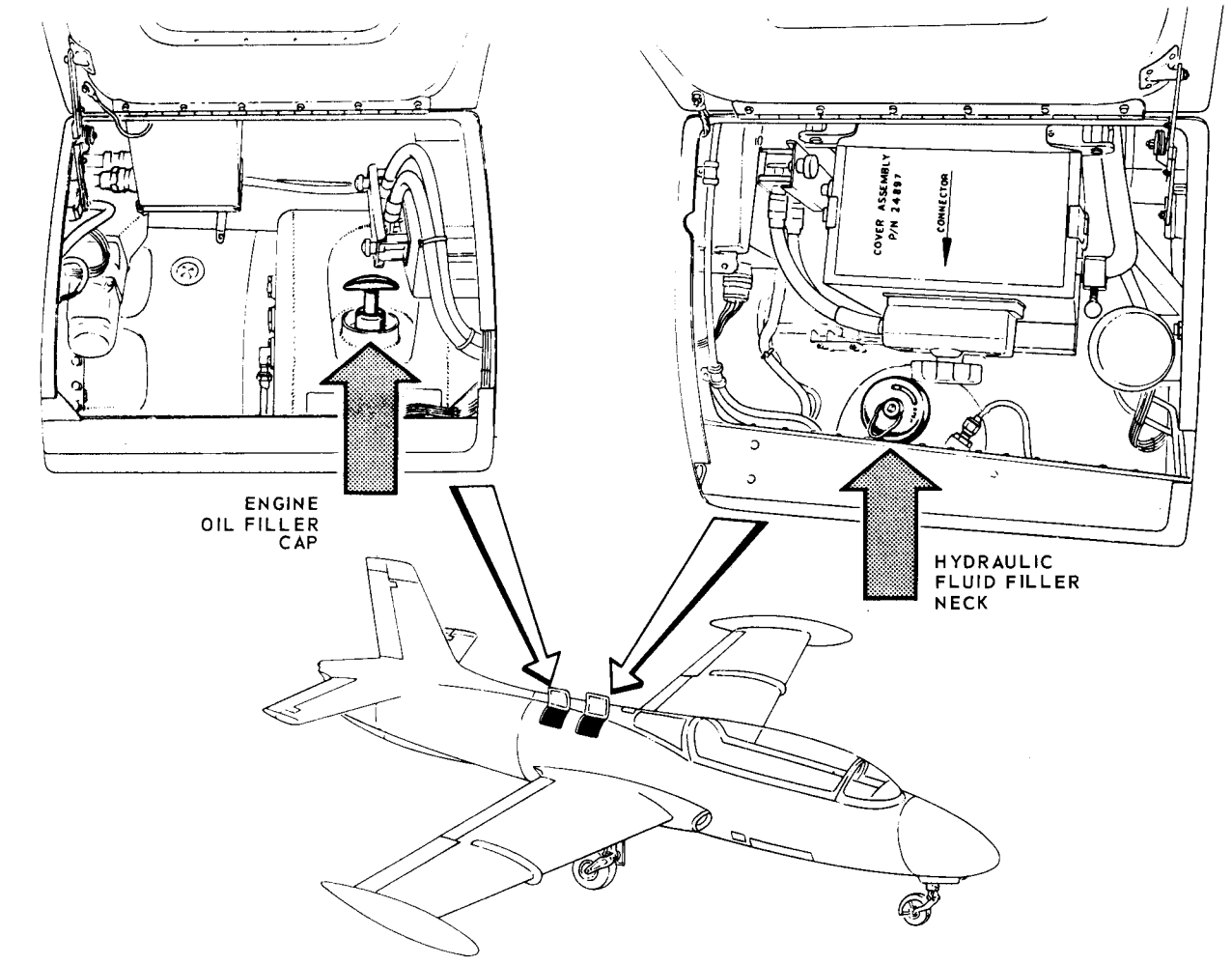
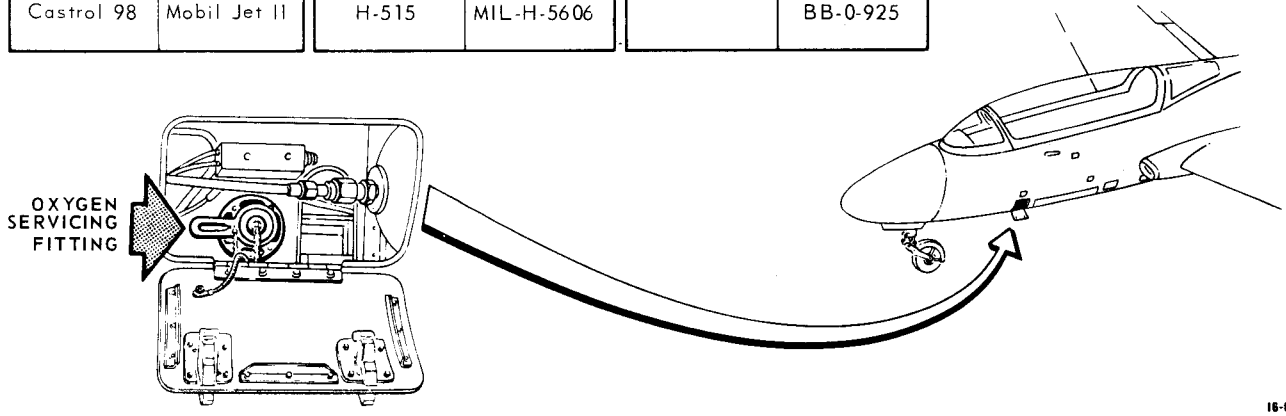


Figure 1-22 (Sheet 1 of 2)

SERVICING DIAGRAM



ENGINE OIL		HYDRAULIC FLUID		OXYGEN	
CASTROL	MOBIL	NATO CODE	U.S.A. Specification	NATO CODE	U.S.A. Specification
Castrol 98	Mobil Jet II	H-515	MIL-H-5606		BB-O-925



16-847

Figure 1-22 (Sheet 2 of 2)

SECTION II

NORMAL PROCEDURES

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PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

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

FLIGHT PLANNING

Appendix I contains the performance data of the aircraft allowing estimation of fuel consumption, corrected airspeed, rpm and altitude for the proposed flights and missions.

WEIGHT AND BALANCE

Refer to Section V for weight and balance limitations. For loading information, refer to publication P.I. 1T-MB326GB-5 "Basic Weight Check List and Loading Data".

ENTRANCE

Access to the cockpit is obtained from the left side of the aircraft after the canopy, which is hinged on the right side, has been manually opened (fig. 1-19). If a special ladder is not available, entrance is facilitated by footrests provided for each cockpit at a suitable distance from the ground (fig. 2-1).

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

1. Mod. 170 — Check

   Check Mod. 170 for engineering status and make sure that the aircraft has been serviced with the required amounts of fuel, oil, hydraulic fluid and oxygen for the mission. For servicing points, see figure 1-22.

2. Personal gear — Check

   Make sure that personal equipment, anti-G suit, oxygen mask, helmet is in good condition.

3. Controls — Unlocked and checked.

EXTERIOR INSPECTION

Perform exterior inspection as outlined in figure 2-2.

BEFORE ENTERING COCKPIT

1. Check windshield and canopy for cleanliness.
2. If required by the type of mission, check to ascertain that the instrument hood is properly installed.
3. Make sure that the seat and canopy safety pins are properly installed (fig. 1-21) in the:
   a. Ejection gun.
   b. Blind firing handle.
   c. Canopy jettison gun.
   d. Drogue gun.
   e. Alternative firing handle.
4. Ensure that the terminal eyelets on the cables of the main firing and alternative firing handles are properly engaged into the hook of the crossbeam that ope-

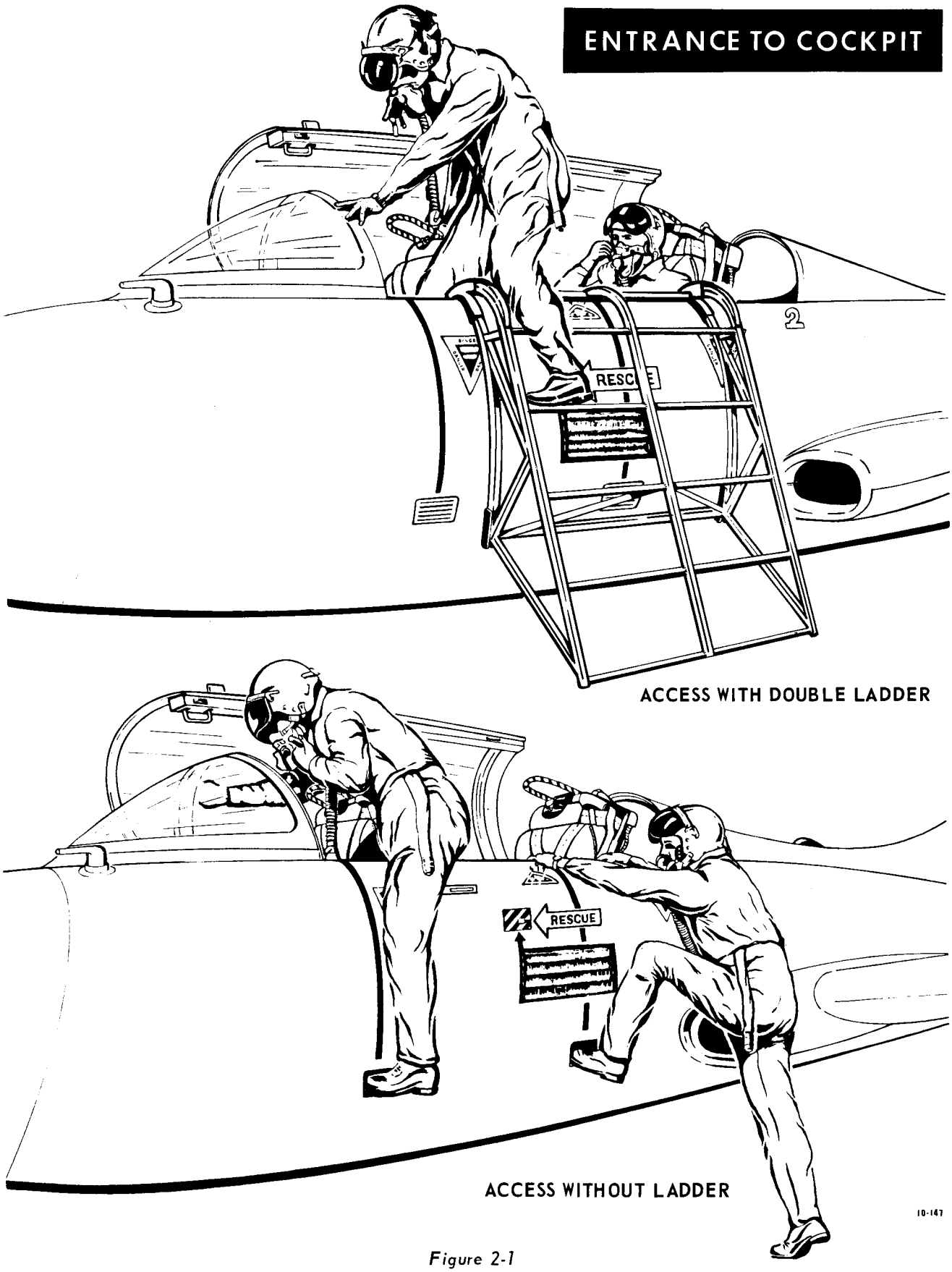

ENTRANCE TO COCKPIT
RESC
2
ACCESS WITH DOUBLE LADDER
RESCUE
ACCESS WITHOUT LADDER
10-147

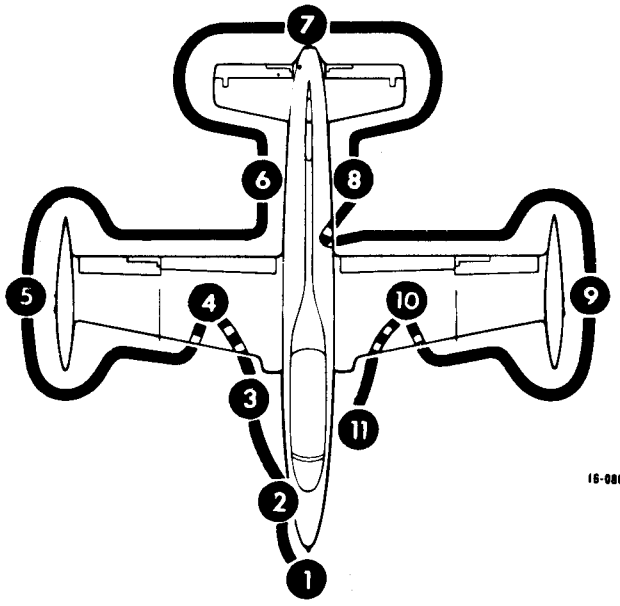
Figure 2-1

EXTERIOR INSPECTION

NOTE - Before exterior inspection unlock controls

GENERAL ITEMS

- Cracks, Distortion, Loose Fasteners, or Damage on all Surfaces.
- Leaks of Fuel, Oil, Hydraulic or other Fluids.
- Security of Access Doors, Panels, Covers and Filler Caps.
- Removal of Ground Safety Guards and Covers.
- Area clear of stones, equipment, etc.



1. FUSELAGE NOSE

- Pitot (2) - Condition.
- Nose cowling latches - Secured.
- Cabin air intake - Unobstructed.
- Glide slope antenna - Secured.

2. NOSE LANDING GEAR

- Doors - Condition and security.
- Inverters (2) - Condition and security.
- Distance tube, nose gear lock down (on the actuating cylinder) - Removed.
- Actuating cylinder - Leaks of fluid.
- Uplock hook - Leaks of fluid.
- Taxi light - Condition and security.
- Centering spring - Integrity.
- Shock absorber - 4.8 in extension.
- Tire - Condition, inflation.
- Mudguard - Condition and security.

3. RIGHT FORWARD FUSELAGE

- Fuselage skin - Condition.
- VHF2 antenna - Condition and security.
- Air intake - Cover removed, condition.
- Navigation light - Condition.
- Rotating beacon - Security.
- Turborefrigerator outlet - Unobstructed.
- Turborefrigerator - Security.
- Speed brake actuating cylinder - Leaks of fluid.
- Panels - Closed.

4. RIGHT MAIN LANDING GEAR

- Inner door - Security.
- Tire - Condition, inflation.
- Wheel brake - Condition and freedom of movement.
- Shock absorber - 2.6 in extension.
- L.G. actuating cylinder - Leaks of fluid.
- Brace, main gear lock down - Removed.
- Door - Properly latched.
- Wheel chock in place.

5. RIGHT WING

- Wing skin - Condition.
- "Fence" - For security.
- Tip tank - Security of mounting.
- Navigation light - General condition.
- Tip tank securing nut - Check for split pin in place.
- Aileron and tab - Condition and freedom of movement.
- Wing flap - Condition.

6. RIGHT AFT FUSELAGE

- Fuselage skin - Condition.
- Battery compartment - Panel closed.
- Engine compartment - Engine oil cap for security - Leave panel open.
- Hydraulic compartment - Leaks of fluid - Leave panel open.
- "Marker Beacon" antenna - Condition and security.
- Static pressure fitting - Blanking plate removed and condition.
- Cooling air intakes - Unobstructed.
- Fuel vent - Security of mounting.

7. EMPENNAGES

- Fin - Condition
- VOR/LOC antenna - Condition and security.
- Rudder - Condition and freedom of movement.
- Rudder trim tab - Condition.
- Stabilizer - Condition.
- Elevator - Condition and freedom of movement.
- Elevator trim tabs - Condition.
- Navigation light - Condition.
- Jet duct - Cover removed, cracks, presence of residual fuel.
- Turbine - Condition.
- Tail wheel - Freedom of movement.

8. LEFT AFT FUSELAGE

- Cooling air intakes - Unobstructed.
- Static pressure fitting - Blanking plate removed and condition.
- Engine compartment - { B.O.V. blanking plate removed; B.O.V.: Unobstructed; Circuit breakers (8) - Pushed in; Panel closed.
- Battery compartment - { Emerg. accumulator gauge: 860 psi; Panel closed.
- Navigation light - Condition.
- Rotating beacon - Condition.
- Fuselage skin - Condition.

9. LEFT WING

- Wing flap - Condition.
- Aileron and tab - Condition and freedom of movement.
- Tip tank securing nut - Check for split pin in place.
- Navigation light - General condition.
- "Fence" - Security.
- Wing skin - Condition.
- Landing light - Condition.

10. LEFT MAIN LANDING GEAR

- Door - Properly latched.
- Brace, main gear lock down - Removed.
- L.G. actuating cylinder - Leaks of fluid.
- Microswitch nut on L.G. leg - Alignment with red reference mark.
- Shock absorber - 2.6 in extension.
- Wheel brake - Condition and freedom of movement.
- Tire - Condition, inflation.
- Inner door - Security.
- Wheel chock in place.

11. LEFT FORWARD FUSELAGE

- Air intake - Cover removed, condition.
- Fuselage skin - Condition.
- Circuit breaker in oxygen receptacle - Pushed in.
- Oxygen recharging point - Check - Panel closed.

Figure 2-2

rates the firing sears.

5. Make sure that the manual release lever is down and the parachute and seat combined harness is properly attached to the fixing points. Check harness security by giving a few energetic pulls in turn to each concerned strap.
6. Make sure that the shoulder harness is stowed above the seat and the leg restraint garters are locked on the two consoles in the cockpit.
7. Make sure that the release cable of the emergency oxygen bottle is connected to the floor and the safety pin has been removed from the bottle head. Check that the "tell-tale" wire is unbroken.
8. Check that the quick-release pins on the ejection gun crossbeam lock the drogue gun and time release unit trip rods.
9. Ensure that the seat is correctly locked to the ejection gun by observing that the locking latch inner plunger is flush with or slightly protruding from the face of the locking plunger, and that the locking plunger itself does not protrude beyond its housing.
10. Check that the static line from the pilot's parachute to the stabilizer drogue is connected and routed under the parachute retaining straps.
11. Check that the controller drogue withdrawal line (white) is routed above the static line (black) from the parachute to the stabilizer drogue and that the line end is properly locked by safety pin to the drogue gun plunger.
12. Check that the scissor shackle is flat on the headrest.

AFT COCKPIT CHECKS FOR "SOLO" FLIGHTS

1. Check to ascertain that the parachute, survival pack, seat belt and harness, helmet radio cable connector, normal and emergency oxygen hoses, are fastened by means of the appropriate fastening gusset.

CAUTION

If a fastening gusset is not available, it is permitted, for ferry flights only, to fasten the parachute and survival pack by means of the seat belts or other fastening devices. The pilot shall be responsible of ascertaining that fastening is secure.

WARNING

Aerobatic maneuvers are forbidden when the fastening gusset is not installed in the rear seat.

2. Make sure that the "ARMAMENT" switch is ON (guard down)
3. Check all switches off.
4. Engine throttle friction loosened.
5. "FUEL L.P. COCK" lockwired OPEN.
6. Canopy gun safety pin removed and stowed into the special holding plate.

WARNING

It is imperative that the safety pin be removed from the canopy jettison gun, or the pilot will be prevented from operating either the forward or aft jettison device and will thus be unable to jettison the canopy by means of the independent control located on the instrument panel.

7. Canopy jettison handle — In and safetied.
8. Ensure seat is in full down position.

INTERIOR INSPECTION

1. Adjust the seat height and the rudder pedal length as required.
2. Secure the dinghy quick-disconnect fittings to the parachute harness and "Mae West".
3. Connect the anti-G suit hose to the anti-G suit valve line.
4. Adjust the foot ventilators as required.
5. Strap on the leg restraint garters below the knees.
6. Strap on combined parachute/safety harness.
7. Install the safety fork in the quick-release box of the parachute.
8. Put on helmet and connect the normal and emergency oxygen supply lines to the mask hose and plug the radio cable connector into the helmet.
9. External electrical power source (if available) — Plugged in.
   Make sure that the power source is capable of 28 Volts, 800 amperes.
10. "FUEL DUMP" switch — off (guard down).
11. "BATT" switch — ON.

    After "BATT" switch is moved to ON position check that the reading on the voltmeter is 28 V. (Or 24 V if external source is not connected).

Left to Right and Pre-start Checks.

1. "GROUND FIRE" — OFF (Guard down).
2. "HYD SYS ZERO SETTING" handle — Fully down.
3. "L.G. EMERG. SELECTOR" handle — Lockwired in down position.
4. Pressurization panel:
   a. Pressurization switch — ON.
   b. "VENTIL" switch — off (guard down).
   c. Indicator — COLD.
5. Wing flap control lever — Selected in DOWN position.
6. "RUDDER TRIM" switch — Check left to right then set to neutral observing that the indicator turns white.
7. Interphone control panel:
   a. "VOL" knob — Pull out for HOT MIC then set volume as required.
   b. Monitoring switches — As required.
   c. Rotary selector switch — VHF1 or VHF2.
   d. "EMER" switch — Lockwired off.
8. Throttle — Check for full and free movement, adjust friction knob and place in STOP.
9. Engine control panel:
   a. "IGNITION" switch — on (guard down).
   b. "ENG MASTER" switch — OFF.
   c. "JPT LIM" switch — Lockwired ON..
10. Landing gear control lever — DWN. Check position.
11. Landing gear position indicator — Correct indication.
12. "LDG-TAXI LIGHT" switch — OFF.
13. "FUEL DUMP" switch — OFF (guard down).
14. "EXT TANKS TRANS" switch — As required.
15. "FUEL BOOSTER PUMP" switch — OFF.
16. "FUEL L.P. COCK" switch — Lockwired OPEN.
17. Aileron and elevator trim tab control switch — Check aileron left to right, elevator up to down, then set to neutral observing that the indicators read NEUT.
18. Accelerometer — Check and reset.
19. "PITOT" indicator — OFF.
20. Clock — Check.
21. "ANTI-ICE — PITOT" indicator — Check NEUT.
22. "CANOPY JETTISON" handle — In and safetied.
23. "CANOPY" warning light — On. "MASTER CAUTION" reset.
24. Airspeed and Mach number indicator — Check and set the outer airspeed index for the desired reading.
25. Altimeter — Set to airfield elevation.
26. Vertical speed indicator — Check zero indication.
27. "MARKER BEACON" switch — OFF.
28. Tachometer — Check zero indication.
29. Standby compass — Check.
30. Fuel flow indicator — Check and reset to zero.
31. Fuel quantity indicator — Check contents.
32. External tanks transfer indicator — ON.
33. Parking brakes — on ("PARK & EMER BK" handle out).
34. "WARNING & CAUTION LIGHTS" switch — Press to TEST and check illumination of the following lights:
   a. "MASTER CAUTION".
   b. Landing gear control lever (blinking).
   c. Caution light panel.
   and sounding of the L.G. warning horn.
35. Cabin altimeter — Check field elevation.
36. "DC GEN" switch — ON.
37. "GYRO MASTER" switch — Lockwired ON.
38. "INVERTER" switch — STBY.
   Check that the "AC INST PWR OUT" caution light goes out.
39. "EMERG BATT" switch — on then off (guard down).
   With "EMERG BATT" switch moved to on position check the reading on the voltmeter is 28 Volts.
40. "SEC BUS RESET" switch — off (guard down).
41. "INTERIOR LIGHTS" rheostats — As required.
42. "EXTERIOR LIGHTS":
   a. "NAV LIGHTS" switches — As required.
   b. "ROT BCN" switch — BOTH.
43. "PITOT HTG" switch — ON, then OFF.
   Check operation observing indicator is ON.
44. "HYD SYS CONTR" switch — ON.
45. Circuit breakers — All made (in).
46. Armament control panel switches — All OFF.
47. "VHF1" control panel — As required.
48. "VHF2" control panel - As required.
49. "ADF" control panel — As required.

DIAGRAM OF DANGER AREAS

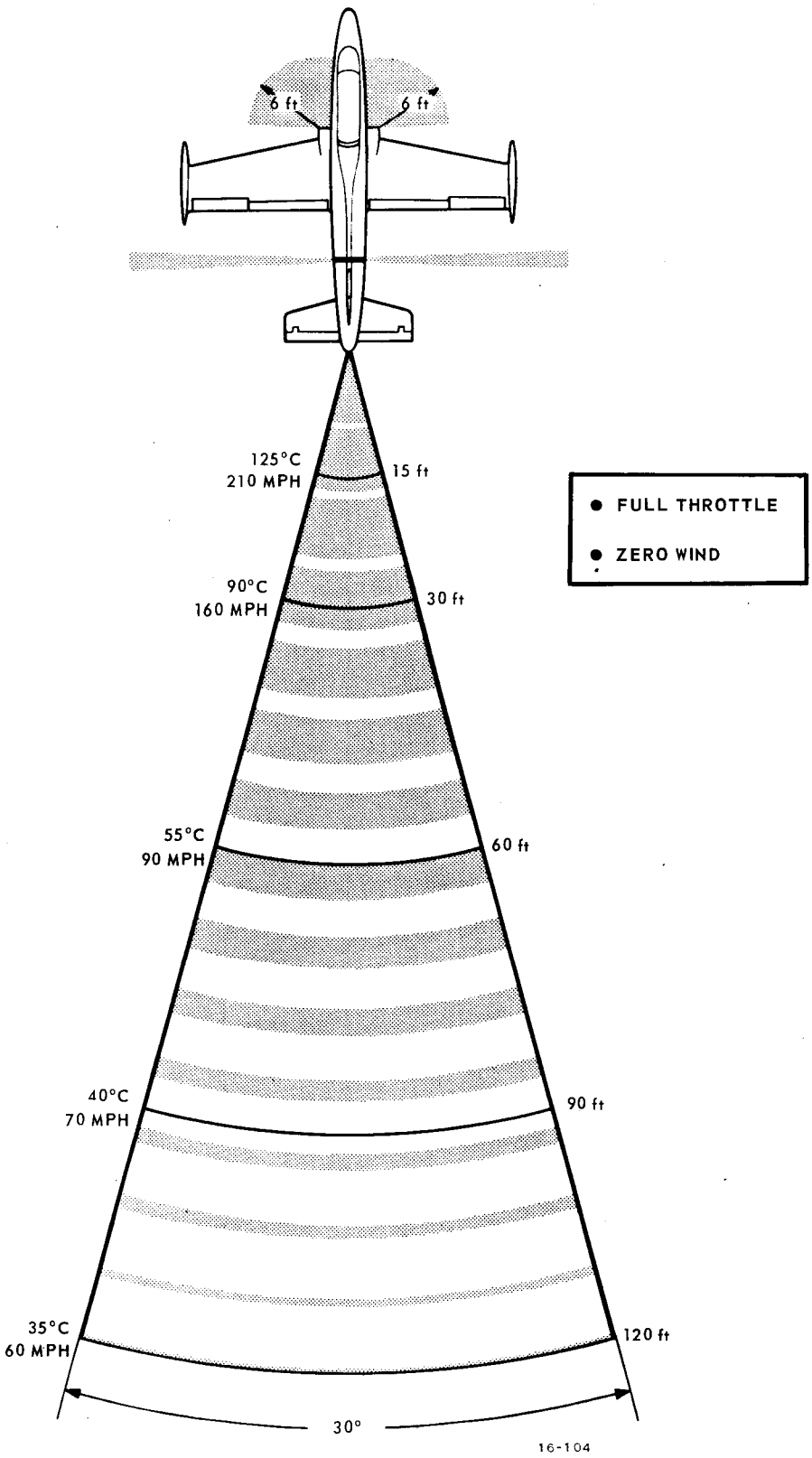


Figure 2-3

50. "NAV" control panel — As required.
51. Oxygen control panel — Check as follows:
    a. Pressure gauge reading — Min 300 psi.
    b. Oxygen "SUPPLY" green lever — Check ON.
    c. Diluter white lever — 100%, then NORMAL OXYGEN.
    d. Oxygen regulator red lever — EMERGENCY, then press to TEST MASK. When released the lever shall return to NORMAL.
52. "WSHLD DEMIST" control — Closed (handle vertical).
53. "WSHLD ANTI-ICE" control — Closed (handle vertical).

STARTING ENGINE

Perform the "Preflight Check".

CAUTION

The "PARK & EMER BK" control is not effective without pressure in the emergency hydraulic system. In this case the pedal brakes should be applied.

Start the engine as follows:

1. "ENG MASTER" switch — ON.

   Check that the "No. 1 BATT OUT" and "No. 2 BATT OUT" caution lights go out.

2. "FUEL BOOSTER PUMP" switch — ON.

   Check that the "FUEL PRESS LOW" caution light goes out.

3. Throttle — STOP. Press "RELIGHT" button to test the igniters.
4. "FIRE" and "OVERHEAT" warning lights — Test.

   Check warning lights operating by moving the "WARNING & CAUTION LIGHTS" switch to the TEST position.

5. Throttle — Advance to IDLE.
6. "START" button and clock — Press for 2 seconds and release.

   Observe the jet pipe temperature. The engine normally lights-up within 15 seconds. If it takes longer, keep a close check on jet pipe temperature when light-up is achieved. If after 20 seconds from pressing the "START" button the engine does not light-up (by reference to the jet pipe temperature and engine speed indicators) move the throttle lever to STOP and the "ENG MASTER" switch to OFF.

CAUTION

Before the next attempt to start, ensure that the engine and jet pipe are drained of excess fuel by pulling the aircraft tail down (4 persons are required for proper accomplishment of this operation). If this is not possible, perform a "dry motoring cycle" following the same procedure as for starting but with the "IGNITION" switch off (guard and lever up) and the throttle at STOP' The cycle will continue for the full duration of 24 seconds.

WARNING

- Move the aircraft if the ground beneath the tail becomes soaked with fuel.
- The interval between the starting (or motoring) cycles shall be of at least 5 minutes. Only three cycles are allowable in any 30 minutes.

7. Oil pressure — Check.

   If there is no sign of oil pressure within 30 seconds, shut down the engine and investigate.

8. 40% rpm — At 40 seconds.
9. Oil pressure — 7 ÷ 25 psi (after 3 minutes from starting engine).
10. J.P.T. — Check

CAUTION

- If the J.P.T. rises too quickly and exceeds 750°C, move the throttle to STOP immediately. Investigate the reason.
- If the J.P.T. exceeds 800°C, report the temperature attained and the overtemperature period since flight safety and engine overhaul life are affected.

11. "FIRE" and "OVERHEAT" warning lights — Out.
12. "DC GEN OUT" caution light — Out.
13. External power — Disconnect.

AFTER STARTING CHECKS

Note

No engine warm-up is necessary. As soon as the engine stabilizes at idling speed with normal gauge readings, the throttle may be opened to full power. Idle rpm should be about 40%, but will vary slightly with the setting of each individual aircraft.

1. Voltammeter — Check:
   a. Ammeter — For normal indication
   b. Voltmeter — Check (Nominal value 28.5 Volts).
2. "INVERTER" switch — MAIN
   Check that the "MAIN INV OUT" caution light goes out.
3. "VHF 1" and VHF 2" control panels — PWR. Select proper frequencies.
4. "ADF" control panel — As required.
5. "NAV" control panel — As required.
6. "MKR BCN" control panel — As required.
7. Hydraulic pressure — Check that the pressure reading on both gauges is 2200 ÷ 2600 psi.
8. Wing flap — UP then to TAKE-OFF.
9. Speed brake — IN.
10. Attitude indicator — Check erected, OFF flag away. Set horizon index.
11. RMI and course indicator — Check and compare with standby compass. Fast slave if required by pushing the "GYRO COMPASS FAST SLAVE" button.
12. Altimeter — Set to QNH.
    Note error against actual field elevation. This error should be considered when resetting altimeter during flight.

WARNING

If the altimeter error is more than 75 feet, do not fly the aircraft.

13. External tanks transfer indicator — Correct indication.
14. Seat and canopy safety pins removed and stowed.

CAUTION

All safety pins shall be stored in the appropriate holders on the left side of each cockpit.

WARNING

After the ground safety pins have been removed, the seat canopy ejection systems are fully armed.

15. Have access ladder removed.
16. Canopy — Close or partially open.
    Close fully to check operation of "CANOPY" warning light before setting canopy to partially open position.
17. Wheel chocks — Remove.

TAXIING

Observe the following rules for taxiing:

CAUTION

Maintain a minimum distance of 80 feet from the exhaust blast of any other aircraft that is operating at Military Thrust, to prevent damage to the canopy. When the blast is from afterburner operation, the minimum distance should be 150 feet.

1. Taxi at the lowest practical rpm.
   Move the aircraft at 80% rpm. Once the aircraft is moving, it can be taxied with the throttle in the IDLE position (about 40% rpm) on a hard surface.

Note

Keep the taxi time to an absolute minimum. The aircraft range is considerably decreased by high fuel consumption during taxiing. Fuel consumption during taxi is about 10 pounds per minute with the engine at 40% rpm.

2. Maintain directional control of the aircraft by differential braking.
3. Oxygen regulator diluter lever — As required.
   If the aircraft is to be operated on the ground under possible conditions of carbon monoxide contamination, such as when taxiing directly behind another jet aircraft or during operation with the tail pointed into the wind, use oxygen with the diluter lever at 100% OXYGEN.
4. Flight instruments — Check.
   Perform an operational check of all flight (gyro) instruments during taxiing.

BEFORE TAKE-OFF

Pre Take-Off Vital Actions

The following checks should be completed before

lining up for take-off.

1. Trims — All neutral.
2. Air brake — IN.
3. Fuel — Contents
   Flow
   Low press light out
   Tip tank feed ON
4. Flap — T/O
5. Instruments — Check correct operation of:
   Attitude Indicator
   Course Indicator
   RMI
   Pitot heat ON
   Clock started
6. Oxygen — Contents (min 300 psi)
   Normal flow
   Connections
   Emergency OFF
7. Harness — Secure and locked.
8. Hydraulics — Check 2200 ÷ 2600 both gauges.
9. Hatches — Closed, Warning light out.
10. Controls — Full and free movement, correct sense.

TAKE-OFF

NORMAL TAKE-OFF

Note

Refer to take-off distance chart in Appendix I for take-off distances and speeds.

1. After line up check all warning and caution lights are out.
2. Apply the brakes.
3. Open throttle to 60% and allow to stabilize.
4. Slam to FULL, taking one-half to one second for the movement, and check:
   a. Max RPM — Not over 100%
      (98% reached in 3.6 ÷ 4.1 seconds).
   b. JPT — Not over 730°C.
   c. Oil pressure — Within limits.
   d. Warning and caution lights — Out.
5. Release the brakes.

During the early phase of the take-off maintain directional control with gentle application of brake. The rudder becomes effective at approximately 45 ÷ 50 Knots IAS. At 90 Knots (V_R), raise the nose to the take-off attitude with gentle back pressure and at 100 knots (V_{LO}) lift the aircraft off with further back pressure. Carry out the after take-off checks at a safe height, hold a shallow angle of climb and allow the aircraft to accelerate to normal climbing speed.

Note

Above mentioned speeds (V_R and V_{LO}) are valid only for clean aircraft. For different weight and configuration, see Appendix I.

CROSS-WIND TAKE-OFF

Note

Refer to cross-wind take-off and landing chart in Appendix I for effect of varying cross-winds.

During a cross-wind take-off, use the same procedures as for normal take-offs. However, a higher nos wheel lift-off speed is recommended to improve the aircraft controllability. Be prepared to apply rudder pressure after nose wheel lift-off to keep the take-off roll straight down the runway until the aircraft is airborne. After breaking ground, be prepared to counteract the aircraft drift.

WET RUNWAY TAKE-OFF

Instances of engine surge may occur during wet runway take-offs. To preclude this possibility, the following precautions should be taken:

a. Taxi at minimum practical speed, avoiding puddles and water-covered areas.

b. During take-off, raise the nose wheel off the ground as soon as possibile.

WARNING

Pilots are to be aware that at speeds lower than 50 kts, forward visibility may be prevented by the water sprayed by the nose wheel.

During wet runway take-offs, pilots are to monitor the engine instruments and to close the throttle and abort the take-off if there are any signs of a surge.
The symptoms of a typical surge are low frequency buzzing and engine vibration, marked aircraft deceleration and a possible rapid drop in RPM to between 70 and 80% with a rise in JPT after about one second.

AFTER TAKE-OFF — CLIMB

When the aircraft is definitely airborne, proceed as follows:

TYPICAL TAKE-OFF

- BASED ON A NORMAL TAKE-OFF GROSS WEIGHT OF 8800 lb
- REFER TO APPENDIX FOR TAKE--OFF DISTANCE AND SPEED AT OTHER GROSS WEIGHT.

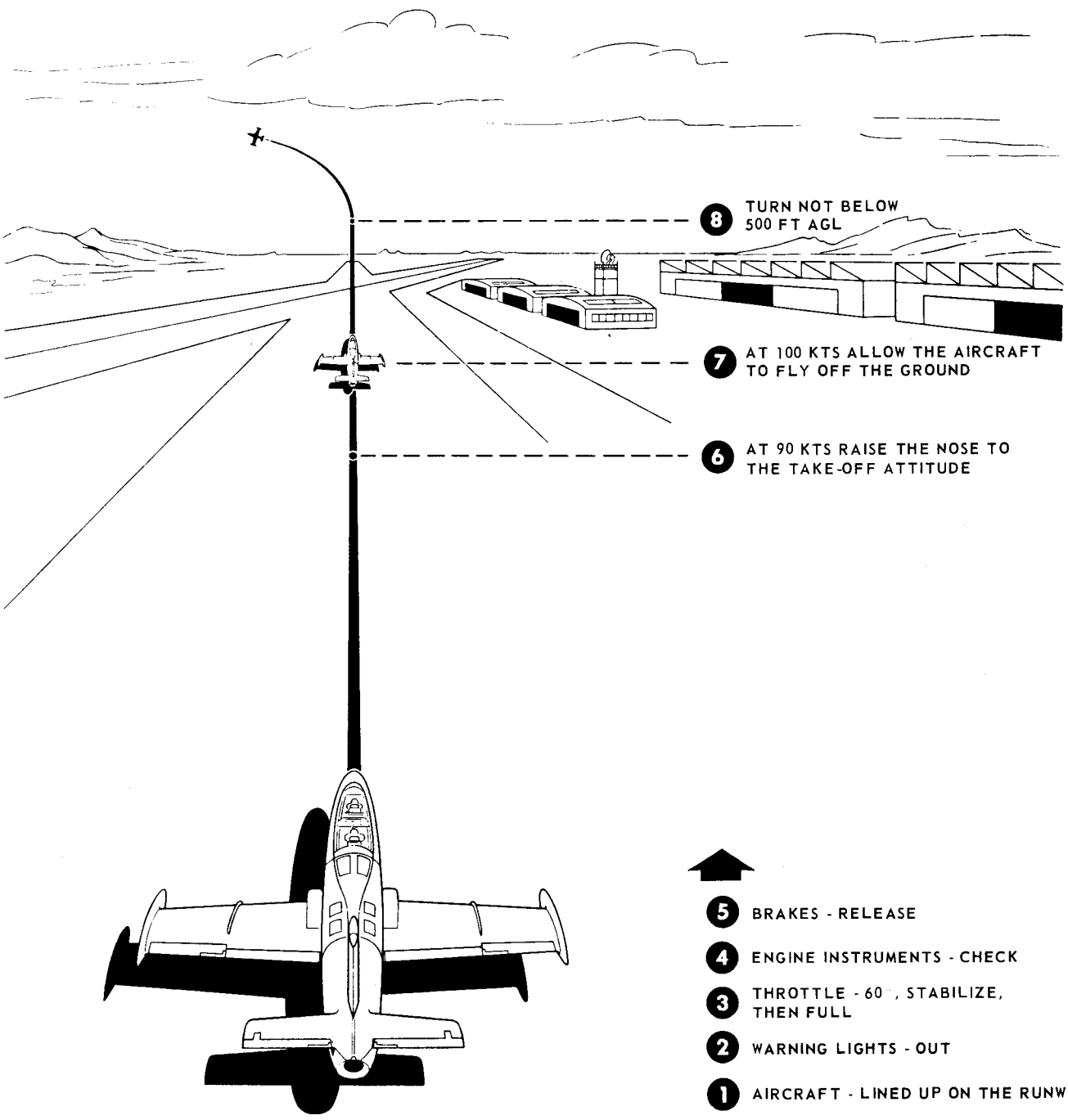


Figure 2-4

1. Wheel brakes — Apply and release
2. Landing gear lever — UP

   Check the landing gear position indicators. Retraction of the landing gear requires about 5 seconds.

CAUTION

Retract the landing gear below limit airspeeds, or excessive air loads might damage the landing gear doors, preventing their successive operation.

3. Wing flap lever — UP.

   Wing flaps up above 110 knots IAS. The trimming change is negligible.

CAUTION

Raise the flaps below limit airspeeds in order not to over-stress structures. A valve is however provided which allows flaps to retract when 140 knots are exceeded.

4. Landing light — Retract.

CAUTION

When the landing light is used for take-off, it should be retracted before the landing light airspeed limit is reached, to prevent damage by heavy air loads to the operating mechanism.

5. Longitudinal trim — As required.
6. Attitude — Hold a shallow angle of climb whilst the airspeed increases.

   Start climb about 10 knots IAS before reaching the best climb speed for that particular altitude to stabilize on desired climb schedule as quickly as possible. Maintain the best climb speed for minimum time to altitude. Refer to Appendix I for further information.

7. Oxygen diluter lever — NORMAL OXYGEN.

   If 100% oxygen was used for take-off, return the diluter lever to NORMAL OXYGEN, unless carbon monoxide contamination is suspected. If such is the case, continue using 100 percent oxygen as long as it is considered necessary.

WARNING

The oxygen diluter lever must be returned to NORMAL OXYGEN as soon as possible, because of the high consumption rate.

CLIMB

At maximum power

In full-throttle climb at the recommended speed and Mach number, the rpm may increase owing to governor characteristics. When the J.P.T. limiter is controlling at 730°C, the rpm may be less than 100%. Operating at rpm above 98% or at J.P.T. above 705°C is permitted for twenty minutes only aggregate per flight.

At intermediate power

Operating at between 95% and 98% rpm and with J.P.T. between 655°C and 705°C, is recommended for thirty minutes per flight.
The following checks are to be carried out in climb every 10,000 feet altitude and every 10 to 15 minutes of flight:

1. Warning and caution lights out.
2. RPM
3. J.P.T.
4. Oil pressure.
5. Cabin altitude.
6. Oxygen: available quantity, lever at NORMAL. "FLOW" indicator for system operation.

CRUISE

For cruise data, refer to Appendix I.
During climb to and cruising at high altitude it is recommended that the windshield demister cock be partially opened and the cabin temperature adjusted so as to have the pointer on the relevant instrument at the second mark.
To prevent the formation of fog on the windshield and canopy interior surfaces during descents from higher altitudes, several minutes prior to starting a descent adjust the cabin heat to maximum temperature (pointer at "HOT") and fully open the "WSHLD DEMIST" cock.

SIMULATED EMERGENCIES

EXTENSION OF LANDING GEAR IN SIMULATED EMERGENCY

1. Reduce airspeed below 150 kts.

Note

Speed reduction involves retarding the throttle with consequent sounding of the horn and illumination of the warning lights incorporated in the landing gear control levers. To stop horn sounding, depress the "HORN CUTOUT" push-button.

2. Landing gear control lever — Check UP.
3. "L.G. EMER SELECTOR" handle — Pull.

CAUTION

This manoeuver sets the hydraulic pressure in the main system to zero.

4. Check that the landing gear has extended by observing the relevant position indicator.
5. Landing gear control lever — Move to DOWN.
6. "L.G. EMER SELECTOR" handle — Full down.
7. Check that pressure is reset in the main and emergency hydraulic systems.
8. Landing gear control lever — UP.
9. Check that the landing gear has retracted by observing the relevant position indicator.

FLIGHT CHARACTERISTICS

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

DESCENT

Circumstances may arise which require a descent from high altitude in the shortest possible time. Rates of descent as high as 25,000 feet per minute can be obtained with this aircraft. For a typical descent, refer to the descent charts in Appendix I.

Note

The windshield and canopy demisting system provides enough heating of the transparent surfaces to effectively eliminate the formation of frost or fog during descent.

1. Throttle — IDLE

With the throttle at IDLE, the idling rpm will increase with altitude and airspeed. At 30,000 feet the engine idling is approximately 70% rpm. At approach IAS, the engine idling is about 60% rpm.

2. J.P.T. indicator — Check.

The minimum J.P.T. in flight should normally be above 200°C. J.P.T. below 200°C may indicate flame-out.

BEFORE LANDING CHECKS

Before descending or entering the circuit pattern carry out the following checks:

1. Altimeter — Set.
2. Radio — Correct channel selected.
3. Instruments — Checked.
4. Fuel — Contents.
5. Shoulder harness — Tight.

LANDING

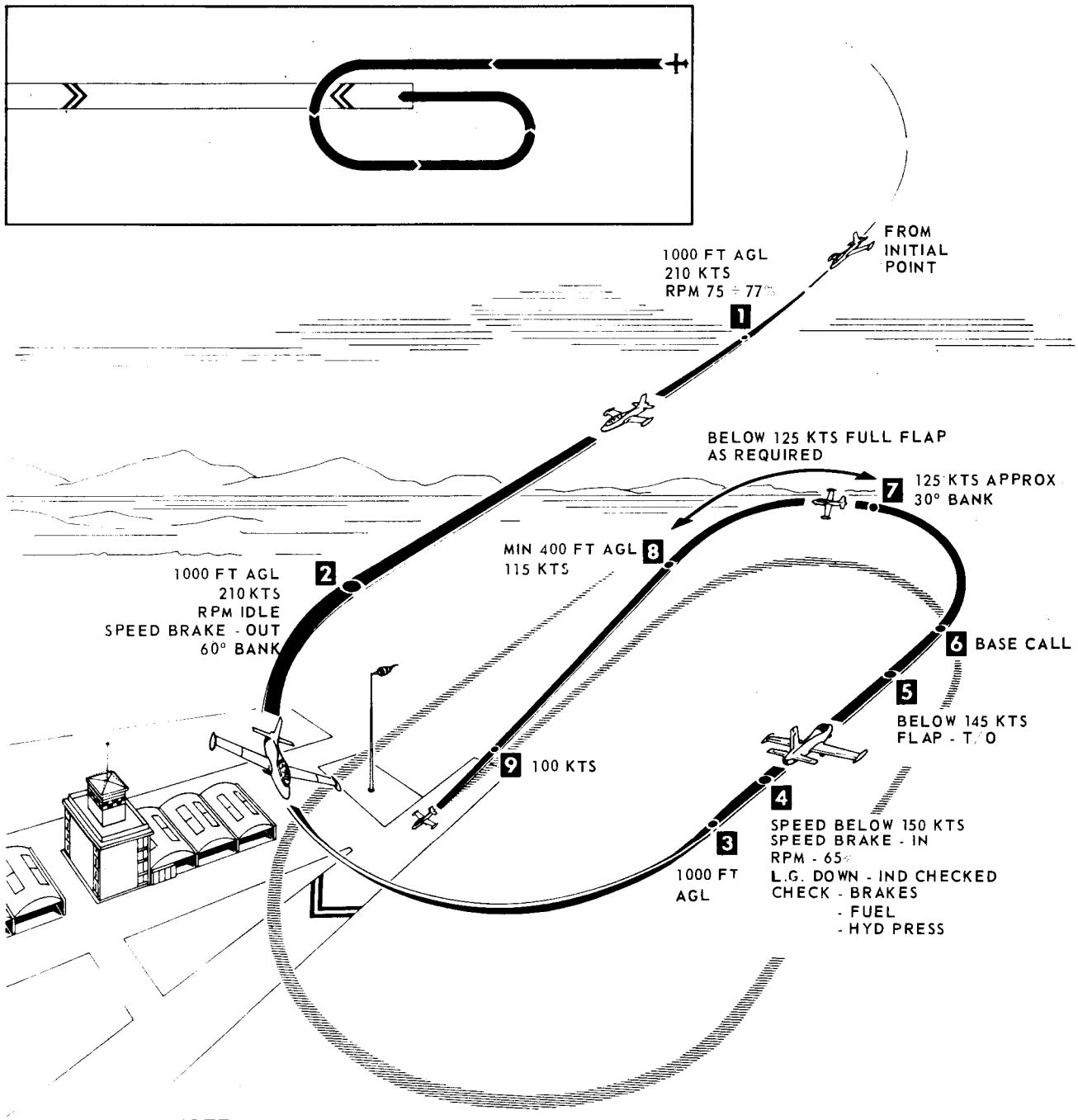
NORMAL LANDING

The procedure set forth produces the results shown in the landing charts in Appendix I. Refer to the proper charts for the applicable aircraft configuration. While following the procedure outlined in figure 2-5 for a normal landing, observe the following precautions.
The full length of the runway should be used during the landing roll, so that the brakes can be used as little and as lightly as possible for stopping. In case of brake overheating, retraction of the landing gear during the next flight is to be delayed so as to allow good cooling effect.

WARNING

- Should fire of the wheels occur, the use of CO_2 or foam estinguishers is strictly forbidden to avoid the risk of explosion. Use only powder extinguishers and have the spray directed normal to the wheel axis to keep personnel clear of possible explosion areas.
- If there is no fire but only smoke, it is advisable to taxi the aircraft to a stop, without applying the brakes, deflate the tire and, if possible, remove the wheel.

TYPICAL LANDING FROM INITIAL POINT



NOTE

1 - ADJUST BANK TO ROLL OUT DOWN WIND WITH TIP TANK ON RUNWAY.

2 - FOR AVERAGE CONDITIONS START BASE TURN AS THRESHOLD DISAPPEARS UNDER LEADING EDGE OF WING.

3 - MIN. RPM ON FINAL TILL LANDING IS ASSURED 60

4 - AT HIGH AUW OR GUSTY CONDITIONS INCREASE THRESHOLD SPEED BY 10 KTS.

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Figure 2-5

Do no attempt a full-stall landing, since the angle of attack at stall is so high that the tail will drag the ground. Maintain directional control during the landing roll by use of rudder and differential braking.

CROSS–WIND LANDING

Cross-wind landings may be easily performed in this aircraft by using the normal landing procedures. However, while using normal approach speeds, crab or lower the wing into the wind to keep the aircraft lined up with the runway and level the wings just before touchdown. After touchdown, lower the nose wheel smoothly to the runway as soon as practical.

Notes

Refer to cross-wind take-off and landing chart in Appendix I for effect of varying cross winds.

USE OF WHEEL BRAKES

Wheel Brake Operation

To minimize brake wear, the brakes should be used as little and as lightly as possible. Care should be exercised to take full advantage of the length of runway during landing or aborted take-off, to minimize use of brakes during turns, and to avoid dragging the brakes during taxiing. When there is considerable lift on the wings, such as immediately after touchdown, heavy brake pressure will lock the wheel more easily than when the same pressure is applied after the full weight of the aircraft is on the tires. A wheel, once locked, will remain locked if the same or greater brake pressure is maintained, even though weight on the wheels increases as lift decreases. Optimum braking occurs when the wheel is in an incipient skid-i.e., the wheel is still rotating but only a slight increase in brake pressure would cause a complete skid. A complete skid decreases braking action because of a decrease in the coefficient of friction between the sliding tire and the runway surface; the scuffing action causes small bits of rubber to act as rollers under the tire, and as skidding continues, the heat generated starts to melt the rubber and the molten rubber acts as lubricant. Further application of brake pressure during a skid could increase the tendency for the aircraft to turn away from the wheel developing the greater skid, the end result possibly being a blown tire with no braking action on that wheel but a tendency for the aircraft to turn in the direction of the blown tire.

Optimum Braking Action

Apply brakes in a single, smooth application with constantly increasing pedal pressure. If skidding occurs, momentarily release brake pressure and immediately reapply brakes. This procedure will provide the shortest stopping distance possible from wheel braking action. If runway length is insufficient to completely stop the aircraft, prepare for barrier engagement.

Brake Operation at High Speed

Extreme care should be used in applying brakes at high speed to prevent skidding of the tire. As discussed above, very little pressure is required to develop a skid while considerable lift is on the wings. If skidding is believed to be occurring, momentarily release pressure and again gradually apply increasing brake pressure. Lift may be reduced by lowering the nose as soon as possible, or even by retracting the flaps.

GO–ROUND

Make the decision to go-round as early as possible do not hesitate to use maximum power. If conditions do not permit an aerial go-round, do not try the aircraft off the runway; continue to fly the aircraft to touchdown and follow this procedure:

1. Advance throttle to FULL.
2. Raise the speed brake if out.
3. Maintain a constant altitude and increase airspeed.
4. When definitely airborne retract the landing gear.
5. Raise the wing flaps between 110 and 125 knots.
6. Longitudinal trim as required.
7. Check the landing gear, speed brake and wing flap position indicators.

Note

If a touchdown is made, lower the nose slightly and accelerate to take-off speed, then establish take-off attitude and allow the aircraft to fly-off the runway.

TOUCH–AND–GO–LANDING

The following procedure is to be adopted when a normal landing has been attempted, the landing wheels are in contact with the runway and it is found necessary to take-off again immediately, before allowing the aircraft to come to a stop:

1. Advance throttle to FULL.
2. Raise the speed brake if out.

Note

Leave the flap in the position as previously selected for landing.

3. Accelerate to take-off speed then establish take-off

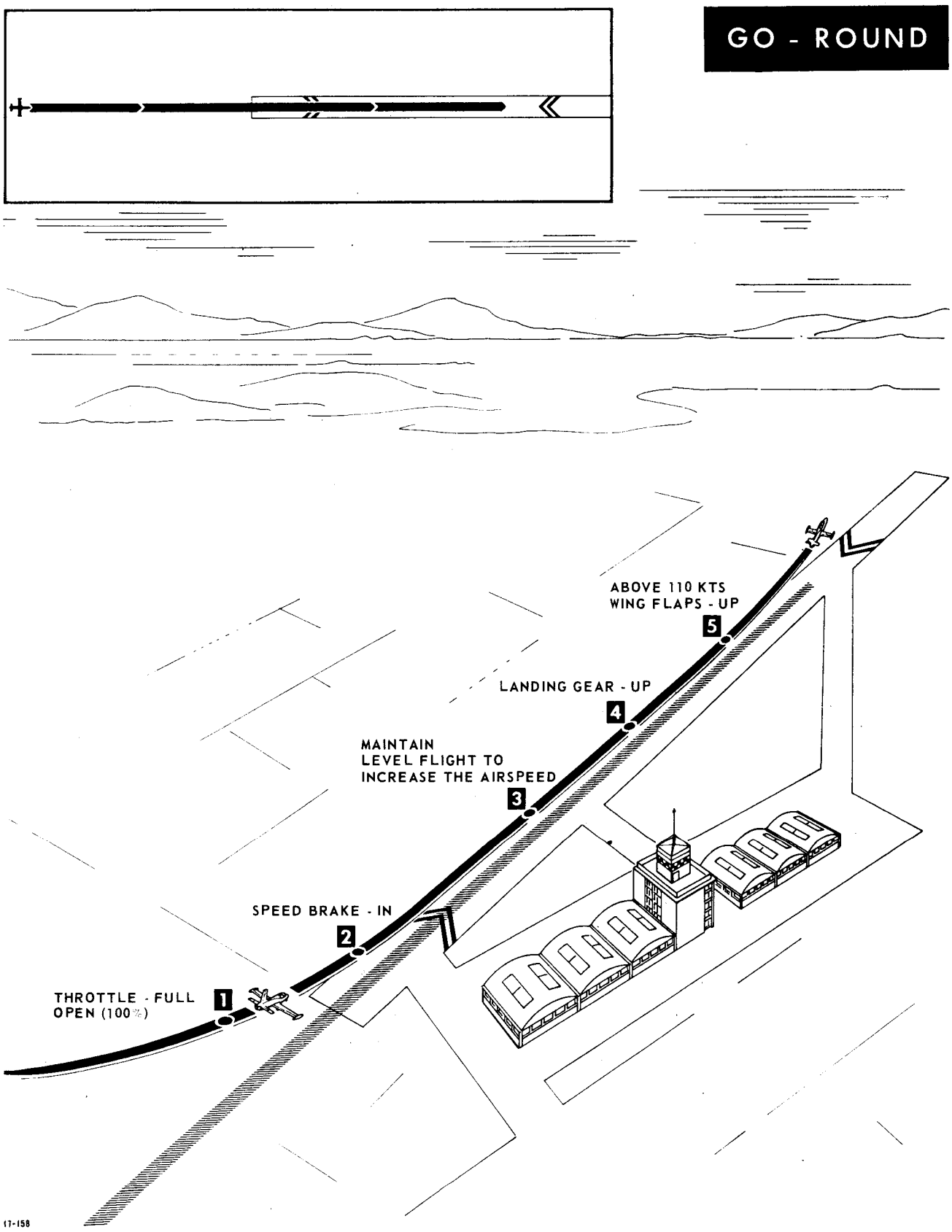

GO - ROUND
ABOVE 110 KTS
WING FLAPS - UP
5
LANDING GEAR - UP
4
MAINTAIN
LEVEL FLIGHT TO
INCREASE THE AIRSPEED
3
SPEED BRAKE - IN
2
THROTTLE - FULL
OPEN (100%)
1
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Figure 2-6

attitude and allow the aircraft to fly-off the runway.

4. Apply the wheel brakes when definitely airborne.
5. Retract the landing gear.
6. Raise the wing flaps between 110 and 125 knots.
7. Longitudinal trim as required.
8. Check the landing gear, speed brake and wing flap position indicators.

WARNING

Touch-and-go landings encompass all aspects of the landing and take-off procedures in a relatively short time span. Be constantly alert for possible aircraft malfunctions and/or unsafe operator technique during these two critical phases of flight.

AFTER LANDING

After completion of the landing roll and when clear of the runway.

1. Speed brake — IN.
2. Hydraulic pressure — 2200 ÷ 2600 psi.
3. "PITOT HTG" switch — OFF.
4. Trim — Set at neutral position.
5. Demist and anti-ice controls — closed (handles vertical).
6. Canopy — As desired.

   Canopy may be partially opened during taxiing after the relevant latch has been properly set.

ENGINE SHUTDOWN

1. Park brakes — As required.

CAUTION

Avoid applying the parking brakes if brakes are overheated.

2. Throttle — 60% rpm.

   Leave the throttle at 60% rpm until JPT stabilization is obtained.

3. Speed brake — OUT.
4. Flaps — DOWN
5. Throttle — STOP.
6. "ENG MASTER" switch — OFF.
7. "VHF" — OFF.
8. "ADF" — OFF.
9. "NAV" — OFF.
10. "MKR BCN" — OFF.
11. "INVERTER" switch — OFF.
12. "ROT BCN" switch — OFF.
13. "HYD SYS CONTR" switch — OFF.
14. "FUEL BOOSTER PUMP" switch — OFF (when engine has stopped).
15. Pressurization switch — OFF.
16. "BATT" switch — OFF.
17. Wheel chocks — in place, then park brakes off.

WARNING

Keep clear of the tail pipe and do not move the aircraft into a hangar for at least 15 minutes after shutdown, because of the possibility of explosion from fuel vapour accumulation.

BEFORE LEAVING AIRCRAFT

Before leaving the aircraft the following checks should be completed.

1. Seat and canopy safety pins inserted.
2. Disconnect the following:
   a. Oxygen supply line (normal and emergency).
   b. Radio connection.
   c. Anti-G suit hose.
3. Release the leg restraint straps.
4. Release combined parachute-safety harness.

If aircraft is to be parked overnight or for an extended period, the following checks should also be completed.

1. Apply the distance tube to the nose wheel actuating cylinder.
2. Apply the distance braces to the main landing gear.
3. Raise flaps.
4. Raise speed brake.
5. Zero hydraulic pressure.
6. Close the canopy.
7. Fit intake covers, Pitot covers, canopy covers, exhaust pipe cover, static pressure fitting blanking plates and B.O.V. outlet blanking plate.

SECTION III

EMERGENCY PROCEDURES

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ENGINE FAILURE

Complete engine failures are rare on this aircraft. However, engine flame-outs and malfunctions of various types do occur from time to time. When time and altitude permit, air starts can usually be accomplished if engine failure is due to malfunction of the fuel control system. Air starts should never be attempted if engine failure can be attributed to some obvious mechanical failure within the engine proper.

ENGINE FAILURE DURING TAKE-OFF RUN (NO RUNWAY OVERRUN BARRIER)

Note

For the procedure to be followed when using a runway equipped with runway overrun barrier, refer to paragraph "Engaging Runway Overrun Barrier" in this section.

If the engine fails, or if take-off is aborted before the aircraft leaves the ground and sufficient runway remains for normal stop, accomplish as much of the following as time permits:

1. Throttle — STOP.
2. Brakes — Apply as necessary.

CAUTION

The heat generated in the brake during an aborted take-off continues to build up during the subsequent 10 to 20 minutes. This heat is transmitted to the wheel and into the tire itself, and may cause melting of the wheel rim fuse with consequent tire deflation.

If the action of the brakes appears to be insufficient to stop the aircraft within the airfield limits, the landing gear could be retracted as follows:

3. "LEVER LOCK RELEASE" push button — Depress and raise the landing gear control lever to UP.

WARNING

Use of the landing gear "LEVER LOCK RELEASE" emergency up button should be avoided. The nose gear will retract immediately, and the aircraft will go down on its nose. One main gear will probably fold before the other, and severe structural damage and possible pilot injury may result.

4. "FUEL L.P. COCK" switch — CLOSE.
5. "BATT" switch — OFF.
6. "DC. GEN" switch — OFF (if time permits).

ENGINE FAILURE DURING TAKE-OFF (AIRCRAFT AIRBORNE)

If engine failure occurs on take-off after the aircraft is airborne, prepare for an emergency landing, accomplishing as much of the following as time permits:

1. Throttle — STOP.
2. "SALVO" button — Press (if external stores are carried)

3. Landing gear control lever — DWN.
4. Flap control lever — DOWN.
5. "FUEL L.P. COCK" switch — CLOSE.
6. "BATT" switch — OFF.
7. "DC GEN" switch — OFF.
8. Shoulder harness — Tight.
9. Land straight ahead.
   Change course only enough to miss obstacles.

WARNING

If landing is judged dangerous, bail out.

ENGINE FAILURE DURING FLIGHT

If engine failure occurs during flight, proceed as follows:

Note

Before closing the throttle, check fuel flow and jet pipe temperature indicator. If engine has not flamed out, do not close the throttle.

1. Attempt to relight the engine immediately (if mechanical malfunction is not apparent).
   Refer to paragraph "Relighting in flight" in this section.

If engine failure necessitates a forced landing, maximum gliding distance can be obtained by establishing a glide of 150 knots IAS with landing gear and wing flaps up and speed brake closed.
If the engine is running at idling rpm, use it as required to reach the runway even if there is a positive evidence of overtemperature conditions. Provided the engine is not damaged, it will windmill at sufficient rpm to maintain correct functioning of the hydraulic system. The landing gear, wing flaps and speed brake will however move more slowly than normal.
The hydraulic system accumulator has sufficient capacity for only one operation of landing gear extension, wing flaps lowering and speed brake opening. With a dead engine, electrical power will be available from the 28 V dc primary and essential busses for a minimum of 30 minutes. It is therefore necessary to turn the "INVERTER" switch to STBY. The armament controls will be inoperative, unless the "SEC BUS RESET" switch is actuated with the "INVERTER" switch back to MAIN. With the "SEC BUS RESET" switch on, battery life is limited to 20 minutes (day flight) or 15 minutes (night flight).

RESTRICTION OF RPM

If an abrupt restriction of rpm which might be also preceded by thrust pulsations occurs in flight, move the "JPT LIM" switch to OFF, leaving the throttle position unaltered.
If initial rpm are restored, continue the flight but bear in mind that the max. JPT automatic control is disconnected.
If the trouble persists and the rpm fail to raise above 70% when the throttle is at FULL, it indicates a blockage of the A/F.R.C. orifice. It may be possible to clear the blockage by closing and opening the throttle several times at low altitude.

BIRD INGESTION

Should the aircraft encounter a flock of small birds and a bird, or birds are ingested by the engine, the throttle must not be moved after the ingestion, unless absolutely necessary, until the aircraft has reached a safe height, as difficulty in handling may be experienced. When subsequently it is required to select different engine speeds move the throttle lever slowly and progressively.

ENGINE STALL

ENGINE SURGE

Surge is normally concomitant with a slam throttle opening at altitude or a defective operation of the A/F.R.C. or B.O.V.

Proceed as follows:

1. Retard the throttle to idle.
2. Increase airspeed until normal rpm and J.P.T. are restored.
3. Advance the throttle slowly.

COMPRESSOR LOCKED STALL

A stall is defined as "locked" when it fails to clear even after the engine rpm has been reduced to minimum (throttle to IDLE). It may occur under unstable intake conditions when an engine acceleration is initiated with a faulty or incorrectly set A/F.R.C., and is characterized by:

- Lower than normal idling rpm.
- A J.P.T. 100 to 200°C higher than normal with throttle at IDLE.
- A slight change in noise level in which a low burbling sound may be heard.

When a locked stall is identified, proceed as follows:

1. Regain a normal flying attitude and simultaneously press the relight button for 2 to 3 seconds.
   If the condition of locked stall persists proceed as specified in step 2 below:
2. Increase IAS to at least:
   a. 200 kts at 30,000 ft.
   b. 160 kts at 25,000 ft.
   c. 120 kts at 20,000 ft.

   Below 20,000 ft, the stall should clear at any normal operating IAS. If, even after this action the stall does not clear, proceed as specified in step 3 below:
3. Retard the engine throttle to STOP for approx. 2 to 3 seconds, then advance it to IDLE while pressing the relight button.

Recovery from a locked stall is indicated by a rise in rpm to normal idling rpm (as a function of altitude) together with a decrease in J.P.T.
Following recovery from a locked stall, the pilot is to assume that the A/F.R.C. is inoperative. The throttle is to be handled carefully and the aircraft landed as soon as possible.

ENGINE ICING

There is no de-icing equipment installed on this aircraft. Cruising in areas of known or suspected icing conditions is not recommended.
If prolonged icing conditions have not been avoided, the engine may suffer from icing, which can cause simultaneous loss of rpm and increase of J.P.T., followed by surge and possible flame-out.
If surge occurs:

1. Throttle — Retard to IDLE.
2. Descend below the icing level until normal operating conditions are restored.

If flame-out occurs, a relight should not be attempted until the aircraft is clear of the icing conditions.
After relight, the throttle movements must be made carefully and the engine must be run at 90% rpm for at least five minutes for de-icing to take place.

ENGINE FLAME-OUT

The symptoms are J.P.T. below 200°C and rpm falling. This could occur due to:

- No fuel supply, due to a chocked filter or "FUEL L.P. COCK" switch off ("FUEL PRESS LOW" caution light on).
- Slam throttle opening at low IAS, with wrongly set or defective compressor air bleed valve system (B.O.V.) or A/F.R.C. ("FUEL PRESS LOW" caution light out).
- Fuel starvation due to prolonged inverted flight.
- Engine icing.

If the engine flames out proceed in accordance with the "Relighting in flight" procedure.

RELIGHTING IN FLIGHT

Note

To avoid possible interferences imputable to the JPT limiter system, it is recommended that the "JPT LIM" switch be turned to OFF and be left in this position until re-lighting has taken place.

IMMEDIATE HOT RELIGHT

An immediate hot relight may be attempted at any altitude.
Proceed as follows:

1. On flame-out (J.P.T. below 200°C) immediately retard the throttle to IDLE and press and hold the "RELIGHT" button.
2. The simultaneous rise of J.P.T. and rpm will indicate successful relight.
3. Release the "RELIGHT" button when the rpm reaches 40%

Unsuccessful Immediate Relight

If no relight occurs within 30 seconds or if the engine relights but the J.P.T. rises rapidly above 700°C, proceed as follows:

1. Release the "RELIGHT" button.
2. Retard the throttle to STOP.
3. Wait one minute then carry out the "Cold relight" procedure.

COLD RELIGHT

Relight of a cold engine must be attempted below 25,000 feet altitude.

1. Check throttle on STOP position.
2. Adjust airspeed within 120 ÷ 200 kts (optimum windmilling rpm 16% ± 3%).
3. Check for:
   a. "BATT" switch — ON.

b. "ENG MASTER" switch — ON.

c. "FUEL BOOSTER PUMP" switch — ON.

d. "FUEL L.P. COCK" switch — OPEN.

e. "FUEL PRESS LOW" caution light — Out.

4. Advance the throttle to IDLE and press and hold the "RELIGHT" button.
5. The simultaneous rise of J.P.T. and rpm will indicate successful relight.
6. Release the "RELIGHT" button when rpm has increased above 40%.
7. Move the throttle to give the required rpm.

CAUTION

Do not advance the throttle beyond IDLE until the engine has lit and is running at steady idling rpm.

Unsuccessful Cold Relight

If no relight occurs within 30 seconds or if the engine relights but the J.P.T. rises rapidly above 750°C, proceed as follows:

1. Release the "RELIGHT" button and retard the throttle to STOP.
2. Wait one minute, maintaining the airspeed required for windmilling in order to drain excess fuel.
3. Reduce altitude by 3000 feet, then repeat the "Cold relight" procedure.
4. If the engine does not relight and the altitude is not sufficient to repeat the cold relight procedure, prepare for a forced landing or for ejection.

MAXIMUM GLIDING DISTANCE (fig. 3-1)

To obtain the maximum gliding distance, the optimum speed is 150 knots IAS with retracted landing gear and wing flaps, 130 knots IAS with landing gear down and 100 knots IAS with landing gear and wing flaps down. These speeds assume speed brake closed and an average weight of approximately 7500 ÷ 8500 lb.
At the speed of 150 knots IAS, below 10,000 feet, the altitude loss is of about 1200 feet per minute. For each 5,000 feet altitude the average gliding distance is about 11 nautical miles (without wind).

EJECTION VS FORCED LANDING

Normally, ejection is the best course of action with a windmilling or frozen engine. However, because of the many variables encountered, the final decision to attempt a flame-out landing or to eject 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 of this nature. The basic conditions listed, combined with the pilot's analysis of the condition of the aircraft, type of emergency, and his proficiency are of prime importance in determining whether to attempt a flame-out landing or to eject. These variables make a quick and accurate decision difficult. If the decision is made to eject, before ejection, if possible, the pilot should attempt to turn the aircraft toward an area where injury or damage to persons or property on the ground or water is least likely to occur. Before a decision is made to attempt a flame-out landing, the following basic conditions should exist.

a. Approaches to the runway should be clear and should not present a problem during a flame-out approach.

b. Weather and terrain conditions must be favorable. Cloud cover, ceiling, visibility, turbulence, surface wind, etc., must not impede in any manner the establishment of a proper flame-out landing pattern.

c. Flame-out landings should only be attempted when either a satisfactory "High Key" or "Low Key" position can be achieved.

d. If at any time during the flame-out approach, conditions do not appear ideal for successful completion of the landing, ejection should be accomplished.

FORCED LANDING (WINDMILLING OR FROZEN ENGINE)

If engine failure during flight necessitates a forced landing, a maximum gliding distance can be obtained by establishing a glide of 150 knots IAS, with landing gear and wing flaps up, speed brake closed.

The following procedure, outlined in figure 3-2 is recommended for a forced landing:

1. Airspeed — 150 knots IAS.
2. Check that the throttle is set at STOP.
   Glide to the field, while accomplishing the following operations:
3. "SALVO" button — Press (if external stores are carried)
4. "FUEL DUMP" switch — ON.
5. "FUEL L.P. COCK" switch — CLOSE.
6. "FUEL BOOSTER PUMP" switch — OFF.
7. Landing gear, wing flaps and speed brake — UP.
8. MAY DAY on the channel in use (if contact is not

obtained, turn to the guard channel).

9. High key point: 2500 feet above the ground.
   a. Extend the landing gear.
   b. Airspeed — 130 knots IAS.
10. Low key (downwind): 1500 feet above the ground
    a. Wing flaps — As required.
    b. Airspeed — 120 knots IAS (with flaps down).
11. Final approach:
    a. Wing flaps — As required.
    b. Airspeed — 110 knots IAS.

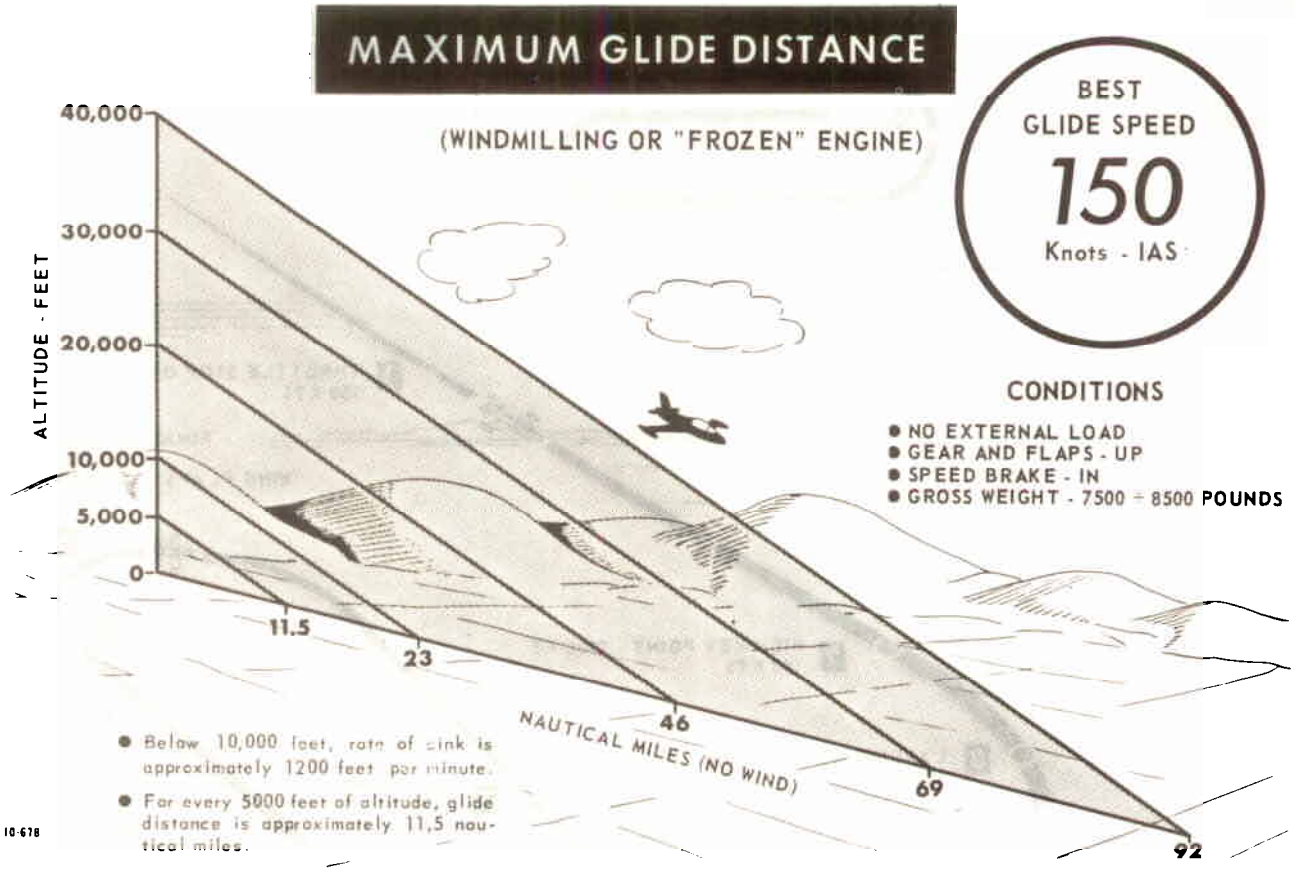


Figure 3-1

12. If landing is considered unsafe, eject.
13. If an emergency retraction of the landing gear is not anticipated, turn the "BATT" switch to OFF.

WARNING

Advise the ground personnel assigned to the handling of the aircraft that the ejection seats and the canopy jettison guns are not safe, so that safety pins can be installed as soon as possible, prior to any other action.

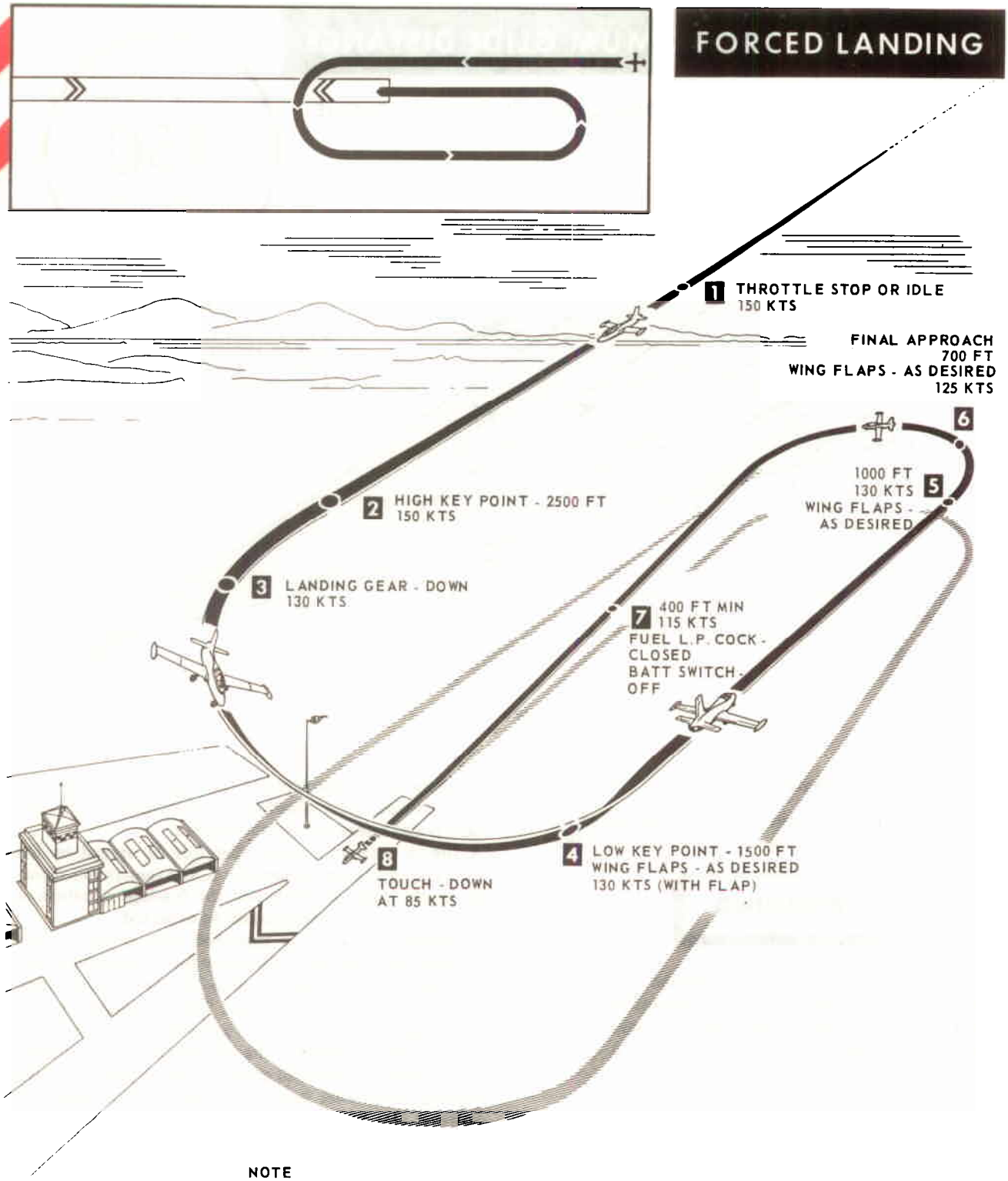
FIRE

The fire warning system consists of two detector circuits, each circuit controlling a cockpit warning light. The "FIRE" red warning light is controlled by the circuit designed to sense fire in the engine forward compartment (section 1). The "OVERHEAT" yellow warning light is controlled by the circuit that senses overheat conditions or fire in the aft fuselage bay comprising the engine "hot" section and the jet pipe (section 2). Section 1 is the area of greater danger in that it comprises pipes and components of the engine fuel system and the hydraulic fluid reservoir. Its proximity to the fuel tank is also a reason of further hazard.
A fire in section 1 could therefore be spread by the presence of fuel and hydraulic oil, and remarkable damage to the flight controls and the fuselage structure as well as explosion hazards could be expected.
Conversely, section 2 is separated from section 1 by a firewall and does not contain any fuel or hydraulic fluid for fire feeding, exception made for the accidental presence of small amounts of fuel. The illumination of the yellow light can therefore be brought about by an overheat condition caused in the aft section by the outflow of hot gases due to small cracks in the jet pipe, or by the burning of residual fuel. The yellow warning light can however also be brought on by rupture or disconnection of the jet pipe: in this case, severe damage could result to the flying controls and the fuselage structure.

Note

The aircraft is not equipped with a fire extinguishing system.

If either the "FIRE" or the "OVERHEAT" warning light comes on and it is borne in mind that the warning



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NOTE

1 - If at 2000 ft altitude no possible field is in view: **EJECT**

2 - If at 1000 ft altitude it is felt that the runway cannot be engaged:

a. If engine is dead: **EJECT**

b. If engine is idling, even in case of definite overheat conditions: **USE POWER AS REQUIRED.**

Figure 3-2

system, too, could be defective, basically proceed as follows:

FIRE DURING STARTING

If the "FIRE" or the "OVERHEAT" warning light illuminates or there are other indications of fire from the outside, proceed as follows:

1. Throttle — STOP.
2. "FUEL L.P. COCK" switch — CLOSE.
3. "BATT" switch — OFF.
4. Leave the aircraft as quickly as possible.

FIRE DURING TAKE-OFF

The procedure to follow will vary with the circumstances, depending upon airspeed, length of runway, possibility of going ahead with the take-off run, location of populated areas, etc. The pilot should take these factors into account and follow as far as possible the typical procedures listed hereunder:

Illuminated Warning Light (Ground Roll)

If the "FIRE" or the "OVERHEAT" warning light illuminates during ground roll and there is still sufficient runway or overrun area to allow for an aborted take-off or a runway overrun barrier is available, proceed as follows:

1. Throttle — STOP.
2. "FUEL L.P. COCK" switch — CLOSE.
3. Use maximum braking.
4. "BATT" switch — OFF.
5. Abandon the aircraft as quickly as possible.

Illuminated Warning Light (Airborne)

If the "FIRE" or the "OVERHEAT" warning light illuminates after the aircraft is airborne and take-off cannot be safely aborted, proceed as follows:

1. "SALVO" button — Press (if external stores are carried).
2. "FUEL DUMP" switch — ON.
3. Throttle — Maintain take-off power and begin immediate climb.
4. Reach a safe altitude of at least 1000 ft.
5. Follow the "FIRE DURING FLIGHT" procedure.

FIRE DURING FLIGHT

If the "FIRE" or the "OVERHEAT" warning light illuminates during flight, proceed as follows:

1. Throttle — Retard to IDLE if altitude is above minimum safe altitude or adjust to minimum practical power to maintain safe altitude.
2. Warning light — Check.
   a. If light goes out — Continue flight at reduced power, and land as soon as practical.
   b. If light remains on — Check for positive indications of fire such as smoke trail noted following a turn, report from ground or from another aircraft, abnormal engine instrument readings (RPM, JPT, oil pressure), unusual engine noise or vibration, fumes, heat, cockpit smoke.
3. If no fire is apparent — Continue flight at reduced power and land as soon as possible.
4. If fire is confirmed — Eject.

SMOKE IN THE COCKPIT

CONDENSATION VAPOUR

1. Increase the air cabin temperature by holding the relevant switch on HOT.
2. Move the "WSHLD DEMIST" control to OPEN (handle horizontal).

SMOKE

Should the air coming from the engine compressor be contaminated with smoke, proceed as follows:

1. Oxygen diluter lever — 100% OXYGEN.
2. Cabin pressurization switch — OFF.
3. "WSHLD DEMIST" control — CLOSED (handle vertical).
4. "VENTIL" emergency switch for cabin ventilation — on (guard and lever up).

CAUTION

At altitudes above 10,000 feet, wait approximately 10 seconds before operating the "VENTIL" switch to allow the cabin pressure to stabilize with the pressure of the nose air inlet.

5. If the smoke is suspected to be produced by an electrical shorting, turn the 'BATT" switch to OFF.
6. If after these operations air is still unbreatheable, reduce rpm and jettison the canopy by pulling

the relevant handle, after removal of the safety pin.

Note

- Should canopy jettisoning not occur, turn the handle clockwise and pull for a further portion of its travel; this will allow firing of the second canopy gun cartridge.
- Trials have showed that the canopy trajectory in various attitudes and at different speeds of the aircraft, both with pressurized and unpressurized cabin, is such as to ensure that no possibility exists for the pilot to be injured and for the aircraft to be damaged.

EJECTION

If the decision has been made to abandon the aircraft in flight, escape should be made with the ejection seat.

WARNING

If overwater ejection is made, remove the oxygen mask before hitting water to prevent sucking water into the mask.

Note

Refer to paragraph "Ejection vs Forced Landing" in this section for additional information.

When an ejection must be accomplished, bear in mind the following:

a. The ejection seat allowed ejection at runway level provided ghe aircraft speed in level flight is not below 100 knots IAS or over 400 knots IAS.

b. At an airspeed of 100 knots IAS, the altitude attained by the seat during ejection is approximately 85 feet (26 m) and the free drop of the pilot approximately 30 feet (9 m).

c. The maximum aircraft speed permissible for a safe ejection at the different altitudes is unlimited with this aircraft.

The ejection sequence (fig 3-3) is as follows:

a. Jettisoning of the canopy occurs when the handle has attained the end of its stroke.

Note

In the very improbable case that the canopy should fail to jettison, seat ejection is still possible through the canopy. A few trials have been made to ascertain the possibility for the pilot to eject through the canopy. All tests have given positive results. The dummies used in the trials were fitted with shock-meters and revealed no damage or special stress as a conseguence of their passing through the canopy after seat ejection. The seats, too, pratically did not suffer such damage as to have negative influence on the normal operation during the automatic sequence after ejection.

b. One second later, the seat is ejected. During the initial stage of movement, the pilot's legs are retracted against the seat, so as to avoid any impact with the aircraft structure.

c. Automatic release of the pilot from the seat and deployment of the personal parachute occur 1¼ seconds after actuation of the handle if the seat deceleration is under 4 G, otherwise the separation from the seat is delayed until deceleration decreases to this value.

d. Besides being governed by the aircraft speed (hence by the seat deceleratio), the delay in automatic release from the seat and in parachute opening is also dependent on altitude: the barostatic control will allow the automatic sequence of separation of the pilot from the seat to start at altitudes below 10,000 feet (approx. 3000 m) only.

To eject from the aircraft, proceed as follows:

1. When time permits, check that the safety harness is tight and adjust the seat to the full bottom position.
2. If possible, reduce airspeed below 250 knots IAS.

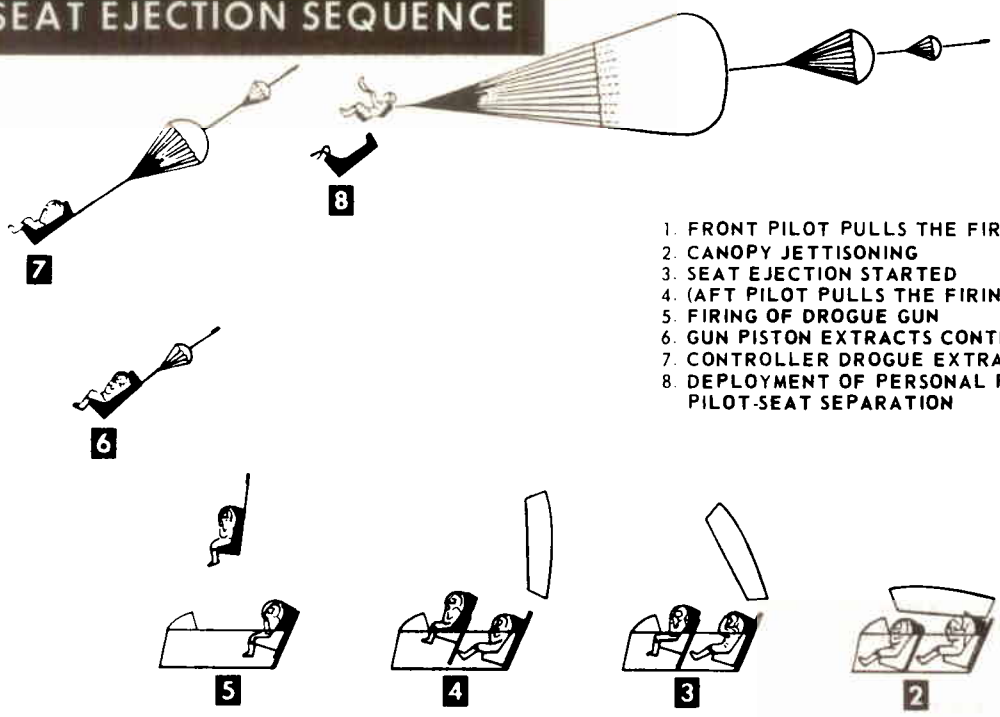
   Grasp the blind firing handle on the headrest with both hands, knuckles facing outwards and elbows as close together as possible.

4. Pull the firing handle strongly forward and downwards, drawing the face blind over the face. The ejection sequence occurs only when the handle attains the limit of its stroke.

Note

Should strong accelerations prevent grasping the main firing handle located on the headrest, use the alternative handle located on the front seat pan, taking care, however, to maintain as much an upright position as

SEAT EJECTION SEQUENCE



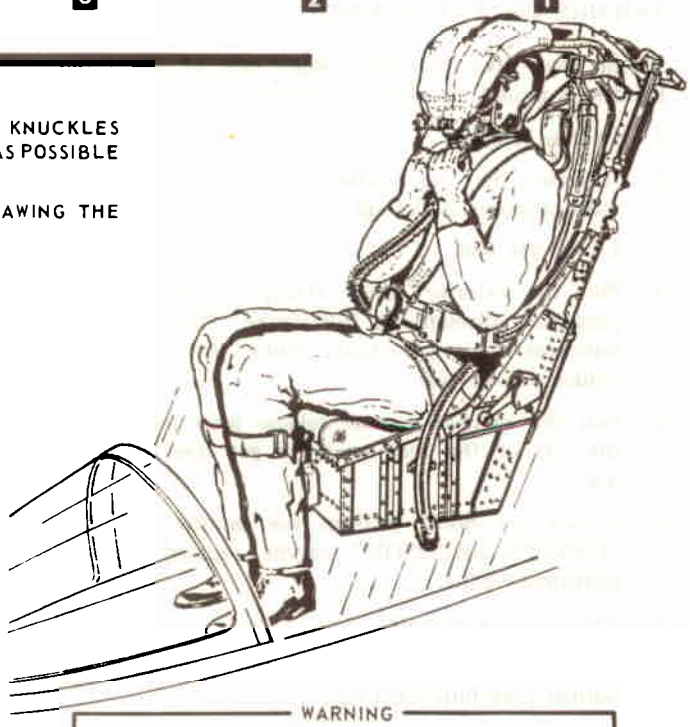
1. FRONT PILOT PULLS THE FIRING HANDLE
2. CANOPY JETTISONING
3. SEAT EJECTION STARTED
4. (AFT PILOT PULLS THE FIRING HANDLE)
5. FIRING OF DROGUE GUN
6. GUN PISTON EXTRACTS CONTROLLER DROGUE
7. CONTROLLER DROGUE EXTRACTS MAIN DROGUE
8. DEPLOYMENT OF PERSONAL PARACHUTE AND PILOT-SEAT SEPARATION

(1) GRASP THE BLIND FIRING HANDLE WITH BOTH HANDS, KNUCKLES FACING OUTWARDS AND ELBOWS AS CLOSE TOGETHER AS POSSIBLE

(2) PULL THE FIRING HANDLE SMARTLY DOWNWARDS, DRAWING THE FACE SCREEN OVER THE FACE.



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WARNING

- Pulling the face blind over the face, it is extremely important that a conscious effort is made to hold the head hard back against the wedge pad. The natural consequence of pulling the arms down is for the head to move forward, thus placing the spine in a curved position at the time the ejection gun fires. This must be avoided if at all possible.
- Holding the head back is equally important when reaching down to use the alternative firing handle in the leading face of the seat pan.

Figure 3-3

possible. This will avoid suffering strong ejection accelerations in an incorrect and dangerous position.

WARNING

It is advisable for the aft pilot to accomplish ejection at least one second after ejection of the front seat; he should take position by placing his hands over the ejection seat blind handle before the canopy is jettisoned from the forward cockpit (either on independent or synchronized operation), to ensure that the blind handle can be actuated even under the most difficult conditions. Trials accomplished have in fact revealed that the blind handles on the headrests bend backwards at high airspeed (the front handle bends at approx. 250 knots IAS, the rear handle at approx. 280 knots IAS).

FAILURE OF SEAT TO EJECT

If the seat does not eject when one of the firing handles is pulled, proceed as follows:

1. Reduce airspeed.
2. Release the leg garters by means of the quick-disconnect fittings.
3. Lower the seat.
4. Pull the exterior (first) D-ring of the personal parachute through its full stroke. This operation separates the parachute from the automatic system of the seat.
5. Pull the harness manual release lever located on the left of the seat so as to get free from the seat.
6. If not yet done, jettison the canopy with the "CANOPY JETTISON" handle located on the instrument panel.
7. Abandon the aircraft.
8. Pull the second D-ring of the parachute for normal parachute opening.

LANDING EMERGENCIES

FLAPLESS LANDING

In case of failure of the hydraulic system, the emergency system can be used only for landing gear extension and brakes operation. A flapless landing may therefore be necessary. The procedure to be followed in this case is shown at fig. 3-4.

ENGAGING RUNWAY OVERRUN BARRIER

For a safe engagement of the barrier, accomplish as much of the following as possible:

1. Throttle — STOP.
2. "FUEL L.P. COCK" switch — CLOSE.
3. "BATT" switch — OFF.
4. Apply brakes.

CAUTION

Excessive use of the brakes should be avoided to prevent that a tire blowout may result in a loss of directional control.

5. Keep the canopy closed and the nosewheel in contact with the ground.
6. The pilot in the aft cockpit shall adjust the seat to the full bottom position.
7. Both pilots shall lower their heads leaning as far forward as possible.
8. Engage the barrier at center.
9. Leave the aircraft as soon as possible.

WARNING

For MA-1 barrier engagements, the speed brake must be closed (IN).

LANDING ON UNPREPARED SURFACE

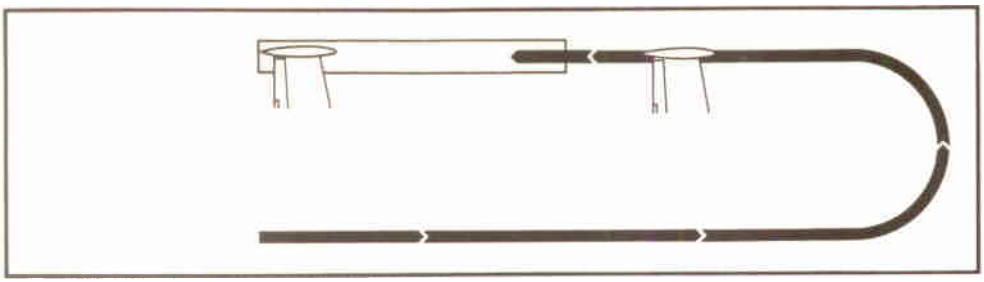
If a forced landing is unavoidable, and if time and terrain permit, fire out all ammunition and expend excess fuel.

(This will lighten the landing load and minimize the danger of explosion or fire after landing).

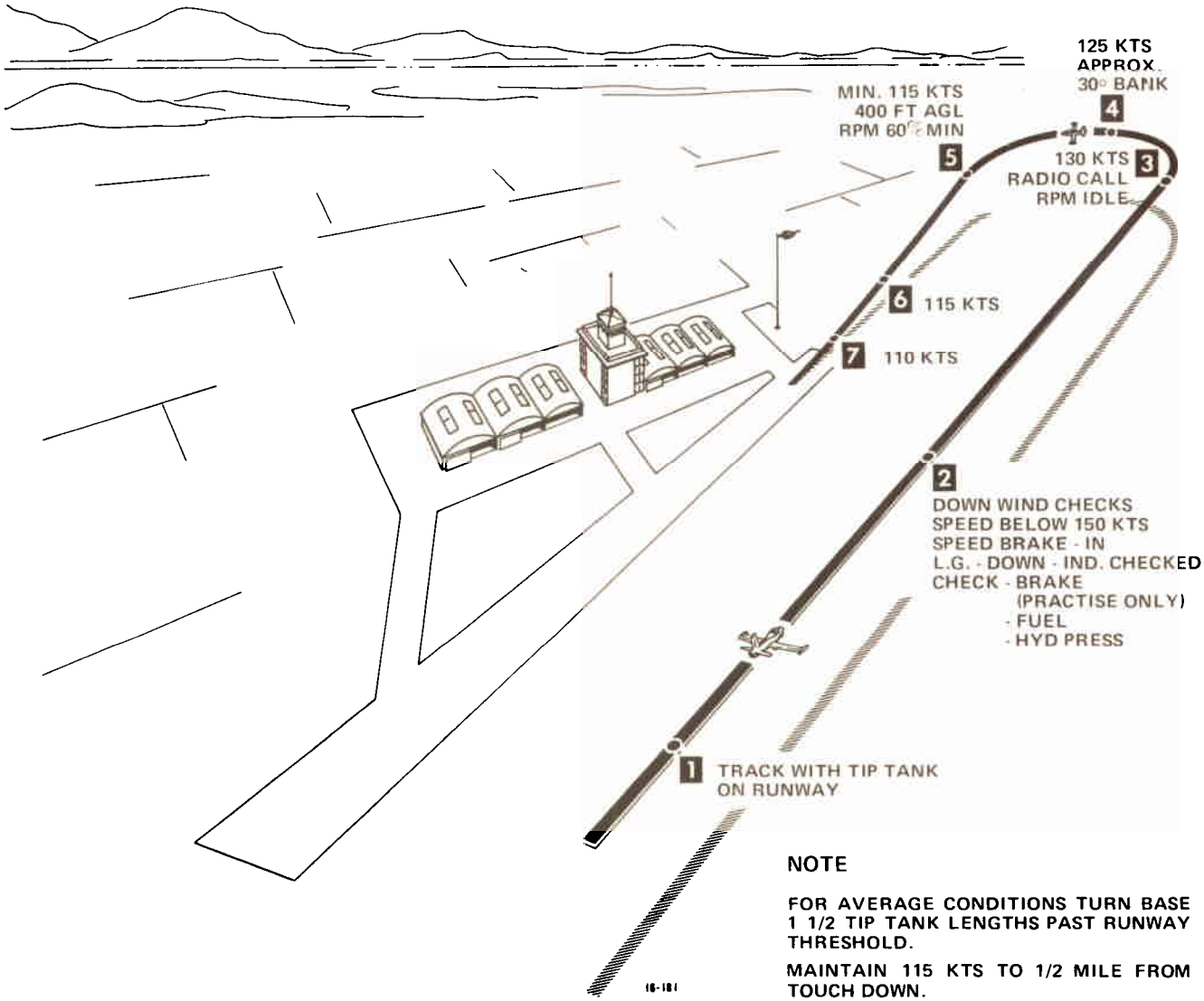
Landings on unprepared surfaces are not recommended. However, if an emergency landing on an unprepared surface is unavoidable, it should be made with as much of landing gear down as possible. Investigation has shown that landings made on unprepared surfaces with the landing gear down have resulted in less pilot injury and less damage to the aircraft than those made with landing gear up.

Proceed as follows:

1. "SALVO" button — Press (if external stores are carried).
2. "FUEL DUMP" switch — on (lever and guard up).



FLAPLESS LANDING



NOTE

FOR AVERAGE CONDITIONS TURN BASE 1 1/2 TIP TANK LENGTHS PAST RUNWAY THRESHOLD.

MAINTAIN 115 KTS TO 1/2 MILE FROM TOUCH DOWN.

AT HIGH AUW OR GUSTY CONDITIONS INCREASE THRESHOLD SPEED BY 10 KTS.

Figure 3-4

3. Consume fuel down to 400 lb.
4. Make a normal approach.
5. Wing flap control lever — DOWN, for final approach.
6. Speed brake switch — OUT.
7. Landing gear control lever — DWN.
8. Throttle — STOP, when landing is ensured.
9. "FUEL L.P. COCK" switch — CLOSE.
10. "BATT" switch — OFF.

    Just before touchdown, turn the "BATT" switch OFF. This switch should be turned off last, so that power is available to close the fuel shutoff cock.

11. Shoulder harness — Locked.
12. Touch down in normal landing attitude.
13. Leave the aircraft immediately after it stops.

LANDING GEAR UNSAFE INDICATIONS

If an unsafe gear-down indication still exists after the "L.G. emergency lowering" procedure has been accomplished, attempt to obtain from the tower or chase plane a positive confirmation of the gear condition. Particular courses of action should be followed, depending upon the gear condition.

GEAR–UP LANDING

1. "SALVO" button — Press (if external stores are carried).
2. "FUEL DUMP" switch — ON.
3. Consume fuel down to 400 lb to reduce load on landing and to limit fire hazard.
4. Check speed brake — IN.
5. Make a normal approach.

   Just before contact with the ground:

6. Throttle — STOP.
7. "FUEL L.P. COCK" switch — CLOSE.
8. "BATT" switch — OFF.
9. Touch down in normal landing attitude.
10. Leave the aircraft as soon as possible.

WARNING

Advise the ground personnel assigned to the handling of the aircraft that the ejection seats and the canopy jettison guns are not safe, so that safety pins can be installed both in the seats and in the canopy jettison guns as soon as possible, prior to any other action.

LANDING WITH ONE OF THE MAIN LANDING GEAR UP (PREPARED SURFACE ONLY)

A landing with one of the main landing gears up or unlocked shall only be made on prepared surface or runway. Should not be possible, retract the landing gear and proceed as indicated under "Gear-up Landing".
If the aircraft is in a position to land on a prepared surface or runway, proceed as follows:

1. "SALVO" button — Press (if external stores are carried).
2. "FUEL DUMP" switch — ON.
3. Consume fuel down to 400 lb.
4. Check speed brake — IN.
5. Make a normal approach.

Just before contact with the ground:

6. Throttle — STOP.
7. "FUEL L.P. COCK" switch — CLOSE.
8. "BATT" switch — OFF.
9. Touch down on the side of the down-locked gear.
10. Hold the opposite wing off the ground as long as possible by use of the ailerons.
11. Try to keep direction when the tip tank comes in contact with the ground by acting on the only brake available.
12. Leave the aircraft as soon as possible.

WARNING

Advise the ground personnel assigned to the handling of the aircraft that the ejection seats and the canopy jettison guns are not safe, so that safety pins can be installed both in the seats and in the canopy jettison guns as soon as possible, prior to any other action.

LANDING WITH NOSE GEAR UP (PREPARED SURFACE ONLY)

A landing with nose gear up or unlocked shall only be made on prepared surface or runway. Should this not be possible, retract the landing gear and proceed as indicated under "Gear-up Landing". If the aircraft is in a position to land on a prepared surface or runway proceed as follows:

1. "SALVO" button — Press (if external stores are carried).

2. "FUEL DUMP" switch — ON.
3. Consume fuel down to 400 lb.
4. Make a normal approach.

Just before contact with the ground:

5. Throttle — STOP.
6. "FUEL L.P. COCK" switch — CLOSE.
7. "BATT" switch — OFF.
8. Lower the aircraft nose to the ground gently before elevator control is lost.
9. After the aircraft nose has contacted the ground, apply brakes, smoothly and continuously until the aircraft is brought to a stop.
10. Leave the aircraft as soon as possible.

CAUTION

Advise the ground personnel assigned to the aircraft that the ejection seats and the canopy jettison guns are not safe, so that safety pins can be installed both in the seats and in the canopy jettison guns as soon as possible, prior to any other action.

LOSS OF CANOPY

The flight characteristics with or without the canopy are the same. Stall speeds with or without the canopy are the same, and the stall warning of general airframe buffeting remains unchanged.Without the canopy, the noise level caused by the airflow over the open cockpits is extremely disturbing but is not considered dangerous. If the canopy should be lost during the take-off roll and there is not enough runway remaining to abort the take-off, it is recommended that the take-off be completed. Use higher power settings and maiintain normal approach speed during landing. It should be remembered, however, that if a landing is made immediately after take-off, the aircraft weight will be higher than normal and therefore the approach and touchdown speeds will be higher.

CANOPY UNLOCKED

If, due to a pilot's oversight or for any other reason, the canopy should be unlocked when the aircraft is already airborne and there is not sufficient runway left to abort the take-off, proceed as follows:

1. Reduce speed to 120 knots IAS and prevent yawing.

WARNING

- Do not jettison the canopy when it is not locked on the sill.
- Do not attempt to lock canopy in flight.

2. Advise tower and carry out normal circuit and full stop landing.
3. Have canopy checked before further flight.

GROUND EVACUATION OF CABIN THROUGH A CLOSED CANOPY

(fig. 3-5)

If after an abnormal landing the fuselage should be so distorted as to prevent opening of the canopy by the normal means available, proceed as follows:

1. Get clear of the seat belt and harness as for a normal exit.
2. If there is no immediate danger and a quick escape from the aircraft is not considered necessary, accomplish a normal safetying of the ejection seats and canopy jettison guns.
3. Slide the fastening pin out of the canopy breaking tool located on the right side of the canopy frame and grasp the tool.

Note

Gloves should be put on before grasping the tool to avoid scratching the hands.

4. Holding the tool firmly with both hands, strike the canopy transparent panel in a vertical direction and as hard as possible until a opening sufficient to permit evacuation is obtained.

OIL SYSTEM FAILURE

If oil pressure falls below 20 psi, or even the "OIL PRESS LOW" caution light comes on, with positive "G", proceed as follows:

1. Throttle — Retard to minimum practical power to continue the flight.
2. Land as soon as possible using a flame-out pattern.

EMERGENCY GROUND ABANDONMENT

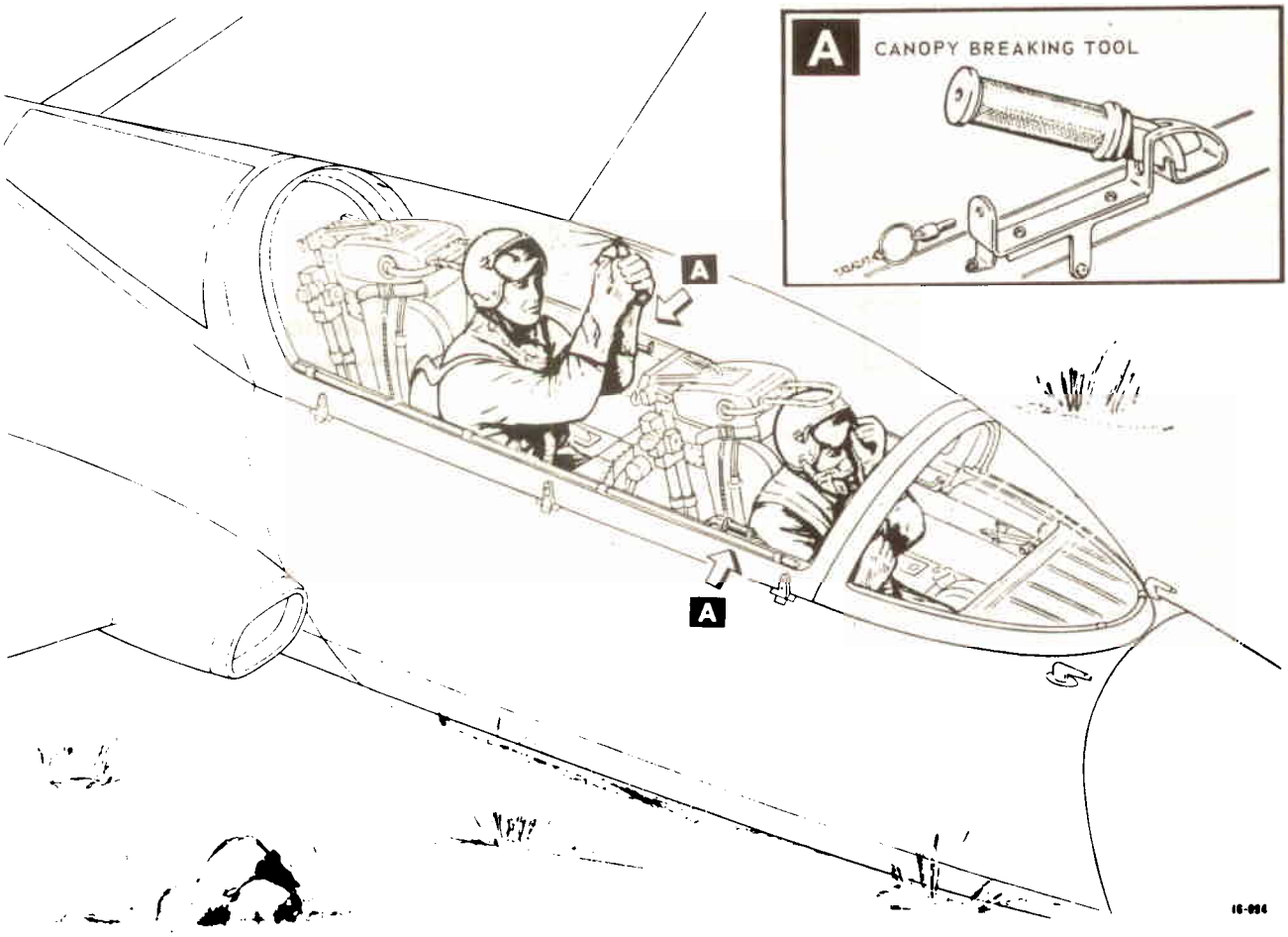


Figure 3-5

FUEL SYSTEM FAILURE

"FUEL PRESS LOW" CAUTION LIGHT ILLUMINATED

If the "FUEL PRESS LOW" caution light comes on, check that the "FUEL L.P. COCK" switch is OPEN, or a deficiency is present in the fuel supply because the booster pump has failed or because the fuel filter is chocked. Also a negative "G" maintained for longer than 12 seconds will cause temporary illumination of the caution light.

If the "FUEL PRESS LOW" caution light remains on, proceed as follows:

1. "FUEL BOOSTER PUMP" switch — Check ON.
2. Throttle — Reduce rpm as much as possible.

CAUTION

If booster pump failure occurs above 30,000 ft, it is possible for the engine to flame-out. This is more likely at high fuel temperature with JP4 fuel.

3. Descend below 20,000 ft.
4. Throttle — Below 87% rpm.
5. Bring the aircraft back to the base on a forced landing circuit.

CAUTION

Operation on suction feed at any time must be

logged and reported after flight as it may be necessary to change the engine fuel pump.

FAULTY TRANSFER OF FUEL FROM TIP TANKS OR UNDERWING PYLON TANKS

If during fuel transfer from the tip tanks or the underwing pylon tanks ("EXT TANKS TRANS" magnetic indicator reading ON), it is observed that the fuel quantity (read on the fuel quantity indicator) falls below 850 pounds, it may be assumed that one or both tanks selected have failed to transfer.

CAUTION

At engine speeds exceeding 90% rpm, the rate of fuel transfer is lower than engine consumption. However, under normal conditions, the level of fuel during transfer will never decrease below 850 pounds.

If this condition is noted during fuel transfer from the underwing pylon tanks, turn the "EXT TANKS TRANS" switch to TIP and reduce engine rpm down to 85%. Then check the quantity of fuel in the fuselage tank: if the level shows a tendency to increase, transfer from the tip tanks is taking place normally. Conversely, it may be assumed that fuel transfer from the tip tanks, too, is defective.
The failure to transfer or the partial depletion of one or both underwing tanks does not impair the aircraft controllability. When such condition occurs, it is sufficient that a speed 5 kts higher than normal landing speed be maintained on landing.

WARNING

If a landing with full underwing pylon tanks is considered unsafe, drop the tanks.

Under all circumstances, when a faulty or partial transfer from one or both tip tanks is suspected, all fuel must be dumped before landing by actuating the "FUEL DUMP" switch.

Note

Fuel dumping is directly confirmed to the pilot by a trail of vaporized fuel that is clearly visible behind the tip tank.

In the event the aircraft should be landed with one tip tank full due to faulty transfer and failure of the dumping cock to operate (a circumstance which is rather unlikely to occur), the lateral controllability can still be maintained by use of the trim switch located on the control stick. After the pilot has ensured that the aircraft is fully controllable by checking its lateral controllability at safe altitude and at a speed 10 knots IAS higher than the stalling speed, a landing may be carried out. In this case it is necessary that speed be maintained at least 10 knots IAS higher than normal landing speed.

CAUTION

The pilot shall however bear in mind that a faulty transfer from the tip tanks or the underwing pylon tanks will obviously reduce the aircraft range and will therefore involve a revision of the flight planning.

ELECTRICAL SYSTEM EMERGENCY OPERATION

GENERATOR FAILURE

If the "DC GEN OUT" caution light illuminates, indicating that the generator is out, the equipment powered by the secondary 28 V dc bus (including the main inverter) will be cut off. When this condition arises, the "AC INST PWR OUT" and the "MAIN INV OUT" caution lights will also illuminate.
Proceed as follows:

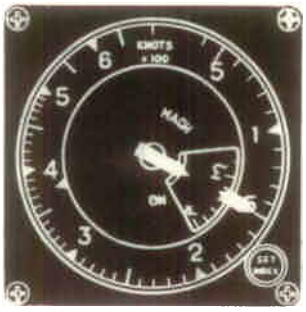
1. "INVERTER" switch — STBY.

   When the "INVERTER" switch is moved to STBY, the "AC INST PWR OUT" caution light will go out, indicating that the equipment powered by the primary 115 V ac bus is restored to operation. The "MAIN INV OUT" caution light will however remain on.

When the generator is out, power to primary 28 V dc and essential 28 V dc busses is exclusively supplied by the aircraft batteries, while the secondary 28 V dc bus remains disconnected.

Note

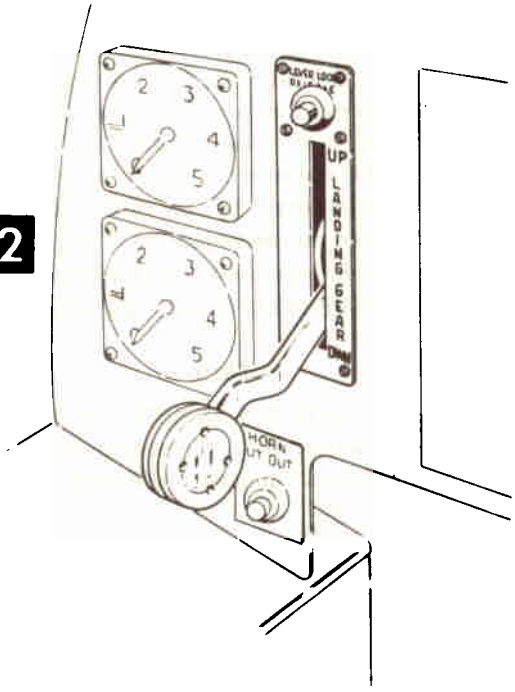
The battery can supply power to the aircraft equipment for a period of time depending upon the battery state-of-charge. The duration times for the following two flight conditions are:

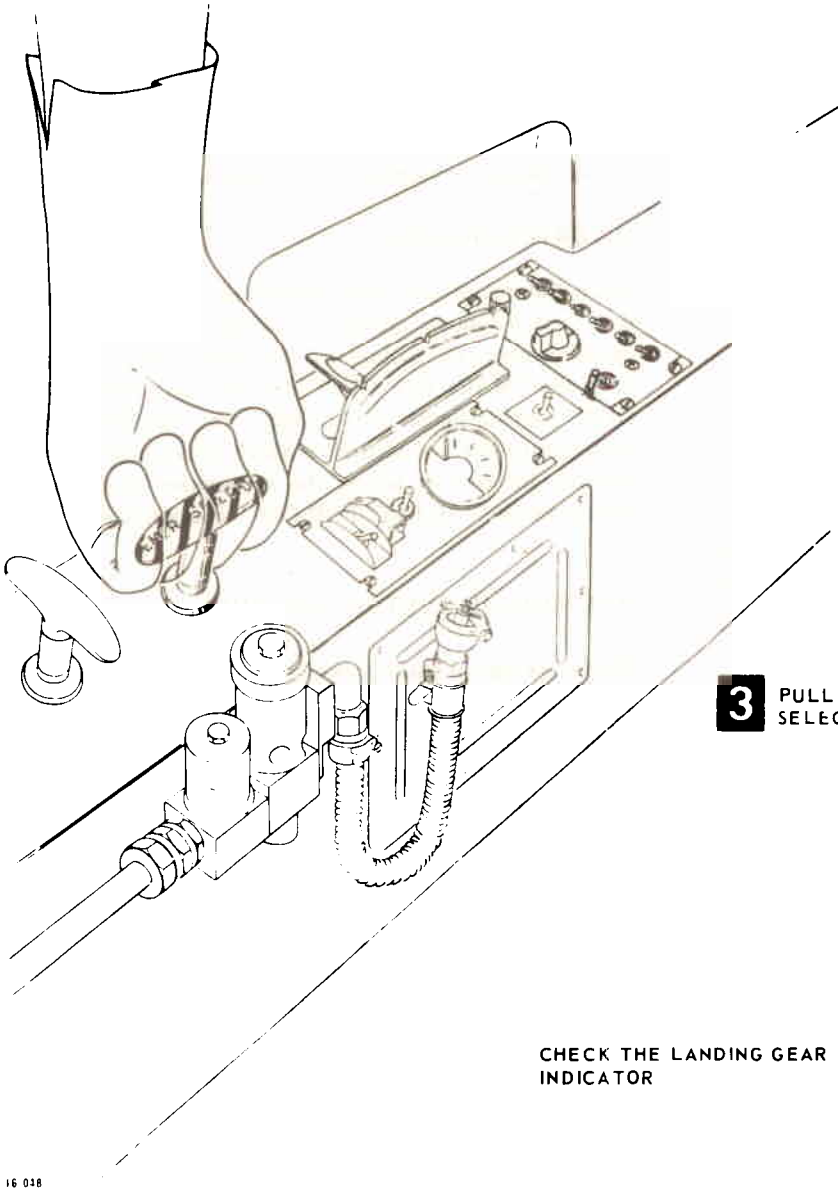


LANDING GEAR EMERGENCY EXTENSION

1 MAINTAIN AIRCRAFT SPEED BELOW 150 KNOTS IAS

CHECK LANDING GEAR HANDLE AT DOWN POSITION **2**





3 PULL HARD THE "L.G. EMER SELECTOR" HANDLE

CHECK THE LANDING GEAR POSITION INDICATOR **4**



16 038

Figure 3-6

	Battery state-of-charge	
	100%	80%
Day flight Night flight	47' 33'	38' 26'

However, for special flight requirements, the pilot has available the "SEC BUS RESET" switch which, when turned on, permits him to reset the secondary 28 V dc bus. Obviously, in this case the pilot shall bear in mind that the flight endurance allowed by the battery is proportionally reduced by the loads that are kept energized. After the secondary 28 V dc bus has been reset, the main inverter must be restored to operation by turning the "INVERTER" switch back to MAIN.

Note

With the "SEC BUS RESET" switch turned ON, the battery life is limited to 18 minutes (day flight) or 13 minutes (night flight).

2. Voltmeter — Check.
   Periodically check voltage to ensure that it remains above 22 volts.

Note

In order to effectively prolong battery life, the equipment that is not absolutely needed must be turned off.

When the voltmeter reads 22 volts:

3. "EMERG BATT" switch — ON (lever and guard up).
   This action will separate the essential load 28 V dc bus, and the emergency battery will provide power to the essential bus only.

Note

The duration times for the following two flight conditions are:

	Battery state-of-charge		
	100%	80%	60%
Day flight Night flight	47' 30'	36' 24'	28' 19'

COMPLETE ELECTRICAL FAILURE

In the event of complete electrical failure, the following essential conditions should be borne in mind:

a. The fuel booster pump is inoperative. Proceed as instructed in paragraph "FUEL PRESS LOW Caution Light Illuminated".

b. The landing gear must be lowered by use of the emergency circuit, as instructed in paragraph "Landing Gear Emergency Lowering" in this section. Consequently the brakes must be applied by using the emergency circuit through the "PARK & EMER BK" handle.

CAUTION

Bear in mind that the landing gear position indicators are inoperative but take up the landing gear unlocked (striped) position.

c. The flaps remain as set prior to electrical failure. Should flaps be up, a landing as indicated in fig. 3-4 "Flapless Landing" will be required.

d. Trim tabs, electrical instruments and radio equipment will not operate.

e. No release of external stores is possible.

INVERTER FAILURE

When failures of the main inverter or of both inverters occur, such failures are shown by the inverter caution lights coming on. Failure of the main inverter causes both the "MAIN INV OUT" and the "AC INST PWR OUT" caution lights to illuminate. The "INVERTER" switch must then be moved to STBY; this will allow the standby inverter to power the ac primary busses and extinguish the "AC INST PWR OUT" caution light.

HYDRAULIC SYSTEM FAILURE

The following circumstances may occur:

a. Pressure indication on the main system gauge comprised between 1500 and 2200 psi.
   This indicates a failure of the hydraulic pump or of the pressure regulating valve.
   The following conditions will therefore take place:
   — Possibility of normal landing gear lowering.

CAUTION

If pressure is insufficient for the landing gear to be lowered and locked, follow the "Landing Gear Emergency Lowering" procedure.

   — Possibility of normal wing flaps lowering.
   — Possibility of normal wheel brakes application.

CAUTION

If pressure in the main hydraulic system is below 1000 psi, follow the "Use of Emergency Wheel Brake" procedure.

b. Zero pressure reading on the main system pressure gauge and normal pressure reading on the wheel brake pressure gauge. This means that fuel leaks are present in the system past the wheel brake accumulator.
The following conditions will therefore take place:
   - Necessity of lowering the landing gear through the emergency circuit following the "Landing Gear Emergency Lowering" procedure.
   - Impossibility of lowering the wing flaps.
   - Necessity of applying the wheel brakes through the emergency circuit following the "Use of Emergency Wheel Brake" procedure.

LANDING GEAR EMERGENCY LOWERING (fig. 3-6)

Before operating the lever for landing gear emergency lowering, make sure that the speed brake is not in the full down position, since the speed brake automatic partial retraction does not occur when the landing gear is extended through the emergency circuit. If the speed brake fails to retract, refer to paragraph "Speed Brake Emergency Retraction" in this section.

CAUTION

Because of the contraction resulting in the air and hydraulic fluid from the low temperatures that are encountered when flying at altitude, the pressure reading on the emergency circuit pressure gauge may drop down to 1700 psi. This does not preclude in any way the possibility of lowering the landing gear or applying the wheel brakes.

1. Airspeed — below 150 knots.
2. Make sure that the landing gear control lever is in the DOWN position.
   This is necessary to prevent the unexpected reatraction of the landing gear from accidental reasons.
3. Pull hard (to break the locking wire) on the "L.G. EMER. SELECTOR" handle located on the left console in the forward cockpit and ensure that the handle is fully out.

CAUTION

When the handle is pulled, the main system pressure drops to zero while pressure is still available in the emergency circuit for wheel brakes application. Application of the brakes can therefore be made only through the "PARK & EMER BK" handle.

4. Ensure that the landing gear position indicators give confirmation that the landing gear is lowered and locked.

CAUTION

Do not press in again the "L.G. EMERG SELECTOR" handle to avoid pressure in the landing gear hydraulic actuating cylinders.

SPEED BRAKE EMERGENCY RETRACTION

If the speed brake must be partially retracted in view of a landing gear emergency extension, proceed as follows:

1. Release pressure in the hydraulic system by pulling the "HYD SYS ZERO SETTING" handle.
2. Put the aircraft in nose-down attitude up to approximately 300 knots and until the pointer on the speed brake position indicator sets halfway to indicate that the speed brake has partially retracted (28°).

USE OF EMERGENCY WHEEL BRAKE

Use of the wheel brake emergency circuit is required when no pressure is available in the main hydraulic system.

CAUTION

With no pressure in the main system, the action on the pedals and thereby on the wheel brakes is ineffective.

To obtain braking, proceed as follows:

1. Pull the "PARK & EMER BK" handle by metering the movement in relation to the braking requirements.

CAUTION

When using the "PARK & EMER BK" handle, hydraulic pressure acts concurrently and to the same extent on both brakes.

It must be borne in mind that, as a consequence of the landing gear emergency lowering, the pressure reading on the emergency circuit pressure gauge may go down even below 800 psi (emergency pressure gauge charge pressure) due to the temperature decrease that may have occurred during a flight at altitude. Even if pressure in the emergency circuit should be lower than 750 psi, a minimum of ten brake applications are still possible by use of the emergency handle.

FAILURE OF ELEVATOR TRIM

FULL NOSE–DOWN TRIM

1. Reduce engine power as required to decelerate.
2. Lower the speed brake.

FULL NOSE–UP TRIM

1. Bank the aircraft.
2. Reduce engine power as required to decelerate.
3. If required, extend the landing gear and flaps.

SECTION IV

AUXILIARY EQUIPMENT

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CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM

The cabin is air conditioned and pressurized by air from the engine compressor (see fig. 4-2). The canopy is sealed, when closed, by a rubber seal automatically inflated by the air system. Pressurization air enters the cockpit through appropriate inlet ducts located in each cockpit. Cabin temperature is regulated by a valve which governs the passage of air from the engine compressor into a cooling circuit. Before entering the cabin, the air of both circuits (compressor hot air and air from the cooling circuit) is mixed and issues from the inlet ducts at the desired temperature. The cabin temperature valve is electrically operated from the forward cockpit. Cabin pressure differential (3.5 psi) is automatically maintained by the cockpit pressure regulator; should this fail to operate, a dump valve operates to prevent the limit value of 3.7 psi being exceeded. The dump valve also prevents dangerous values of reverse differential pressure in the cockpit due to rapid descents.

The initial pressurization altitude is 8000 feet.

CABIN AIR CONDITIONING CONTROL PANEL

The cabin air conditioning control panel (fig. 4-1) is located on the left console in the forward cockpit. It carries the switches and an instrument for controlling cabin pressurization, temperature and ventilation.

Cabin Pressurization Switch

The cabin pressurization switch has two positions (ON-OFF) and is located on the cabin air conditioning control panel (fig. 4-1). When the switch is moved to ON the pressurization cock is opened, while the cabin dump cock in the dynamic air duct for cabin ventilation is closed. When the switch is placed in the OFF position, the pressurization cock is closed and the cabin dump cock is opened, thus gradually reducing the cabin pressure, at altitudes above 8000 feet, to the same value as the dynamic pressure in the ventilation duct.

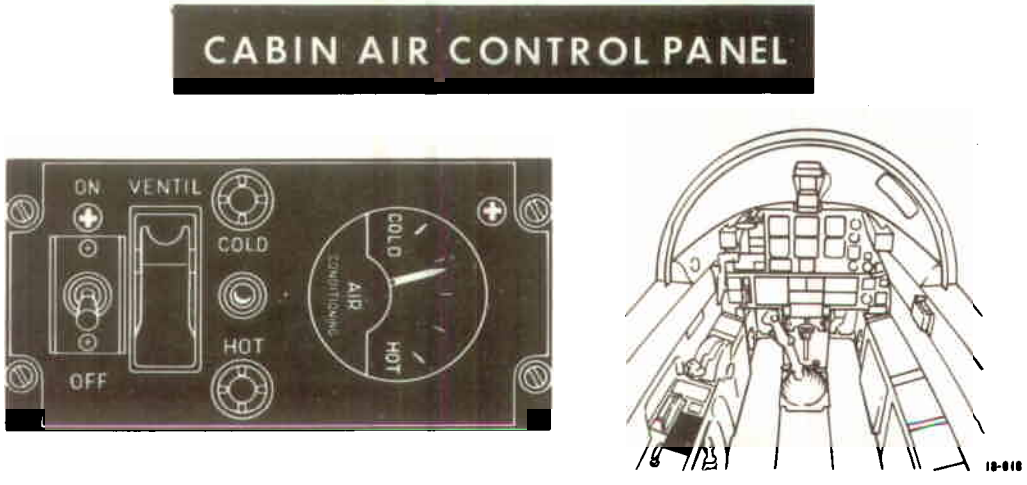


Figure 4-1

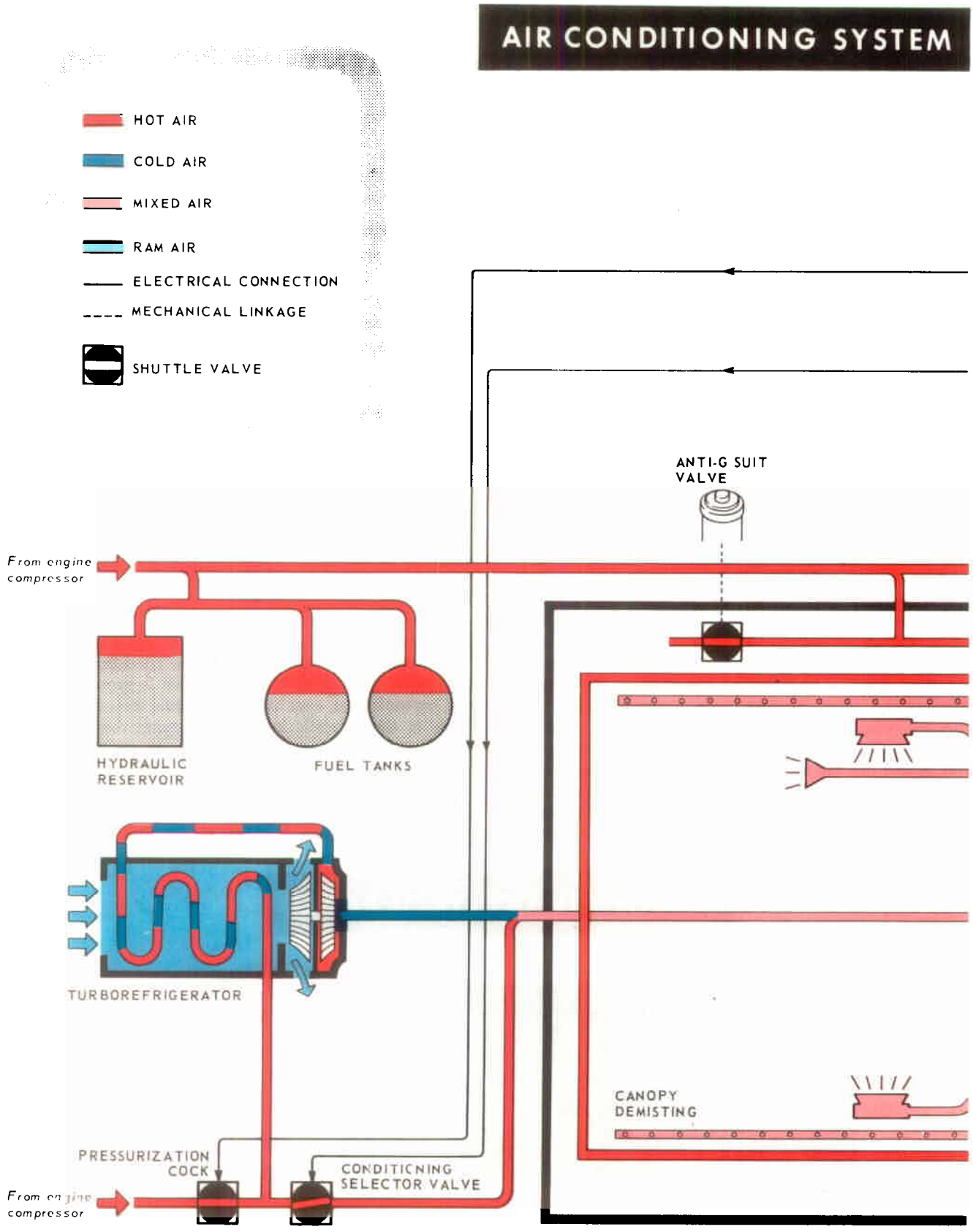


Figure 4-2 (Sheet 1 of 2)

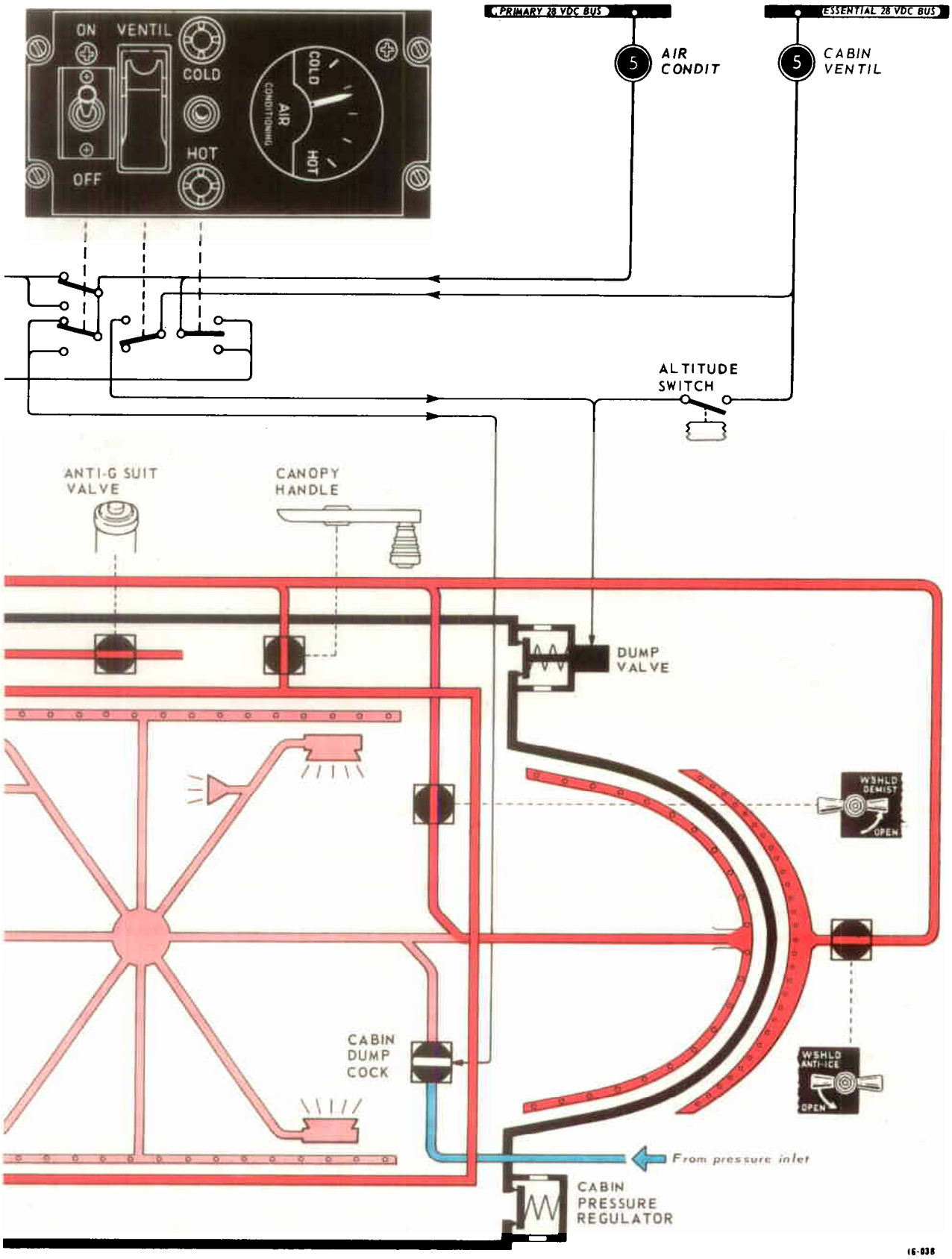


Figure 4-2 (Sheet 2 of 2)

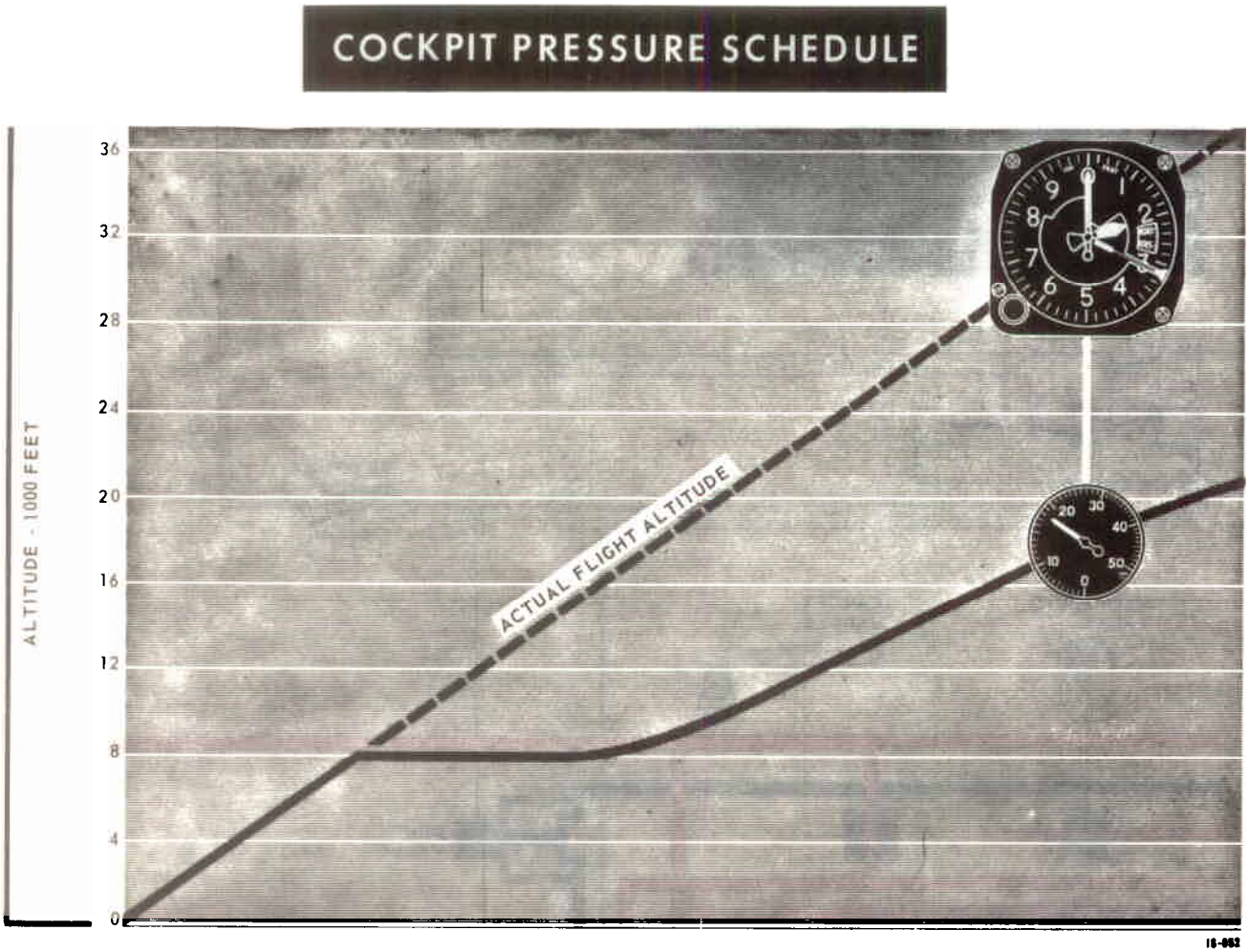


Figure 4-3

Cabin Air Temperature Switch

The temperature of the air admitted to the cabin is controlled by a center-off two-position (COLD-HOT) switch located on the cabin air conditioning control panel (fig. 4-1). The switch will be moved to COLD or HOT until the desired cabin temperature is reached.

"Ventil" Switch

The "VENTIL" switch for cabin ventilation is located on the cabin air conditioning control panel (fig. 4-1) and is protected by a red guard. This switch should be operated after the cabin pressurization switch has been set to OFF. This opens the dump valve and connects the cabin to the atmosphere. Air from the dynamic duct will thus be able to enter the cabin through the cabin dump cock and to exhaust through the dump valve, thus providing and efficient ventilation of the cockpit. At altitudes above 8000 feet, the "VENTIL" switch should be operated with some delay (approximately 10 seconds) with respect to the pressurization switch in order to allow the gradual dumping of the cabin pressure through the dynamic air duct.

Air Conditioning Indicator

The position of the valve which indirectly regulates temperature in the cabin is displayed to the pilot by an indicator (fig. 4-1) located on the cabin air conditioning control panel.
When the cabin air temperature switch is actuated, the pointer sets in a position, in the COLD-HOT range, corresponding to the position assumed by the air conditioning valve.

CABIN ALTIMETER

The pressure altitude of the cabin is indicated by a cabin pressure altimeter (fig. 1-6 and 1-9) located on the lower right side of each instrument panel. The instrument has one pointer only and gives a direct cabin pressure altitude reading. For a rough check of the instrument reading above 9000 feet to 24000 feet, it is sufficient to halve the actual altitude and check the instrument for correct reading ±500 feet. Above 24000 feet, halve the actual altitude and add 1000 ÷ 2000 feet.

DEMISTING AND ANTI-ICING SYSTEM

WINDSHIELD AND CANOPY DEMISTING

Air for demisting the interior surfaces of the windshield and canopy is directly bled from the air conditioning and pressurization system.
A portion of the conditioning air is diverted to a set of outlets on the windshield and canopy base and is distributed, through these outlets, all over the interior surface of the windshield and canopy. No control for operation of this system is available in this aircraft.

SUPPLEMENTARY WINDSHIELD DEMISTING

The efficiency of the windshield demisting may be increased by diverting hot air from the anti-ice system into the windshield demisting duct, through a cock controlled by the "WSHLD DEMIST" handle.

"Wshld Demist" Handle

The "WSHLD DEMIST" handle is located below the forward instrument panel, on the left side. When the handle is rotated counterclockwise to the horizontal position, hot air from the anti-ice system is directed into the windshield demisting system to intensify the normal demisting action.

ANTI–ICING SYSTEM

The purpose of the anti-icing system is to prevent the formation of ice, rather than to remove ice already accumulated. Hot air bled from the engine compressor is passed through ducts in the windshield frame and is discharged at the outside base of the windshield. Both the Pitot heads are electrically heated to prevent ice formation.

"Wshld Anti-Ice" Handle

The "WSHLD ANTI–ICE" handle is located below the forward instrument panel, on the right side. When the handle is rotated counterclockwise to the horizontal position, hot air from the anti-ice system is directed into the windshield outside diffuser to prevent icing.

Note

The anti-icing airflow over the windshield is sufficient to effectively improve visibility in rain.

"Pitot Htg" Switch

The "PITOT HTG" switch is on the right console in each cockpit (fig. 1-8 and 1-9) and receives power from the primary 28 V dc bus. Moving the switch to ON causes the pitot head to be electrically heated.

"Anti-ice Pitot" Magnetic Indicator

The "ANTI–ICE PITOT" magnetic indicator is located on the left side of each instrument panel. The indicator read ON when the "PITOT HTG" switch is moved to ON.

ANTI–G SUIT SYSTEM

The pilot has the possibility of connecting the tube incorporated in the anti-G suit to a coupling located on the left side of each cockpit. This coupling is connected to a pressure regulator valve which receives pressurized air from the engine compressor. The pressure regulator valve is located on the left console and functions at a predetermined number of G. Positive acceleration causes the valve to open, inflating the anti-G suit. For each additional G acceleration force, a corresponding increase of air pressure is exerted in the anti-G suit. A button on top of the valve can be manually depressed to check the system operation.

COMMUNICATION EQUIPMENT

INTERPHONE

The aircraft interphone system allows interphone communication between the crew members. In addition, the interphone control panel provides, in each cockpit, control and monitoring of the received radio signals as well as transmitter selection. The interphone system receives direct current from the essential 28 V dc bus and includes the control panel, the "MIC" button and the "INT" button.

Interphone Control Panel

The interphone control panel is installed on the left console in each cockpit (figure 4-5) and incorporates the following controls:

"Vol" Control. The volume control knob "VOL" provides for audio level adjustment of the signals arriving at the control panel from the radio receivers.

Note

When operating the communication equipment, it is a good rule to set the overall volume control knob approximately at half travel in order to obtain a satisfactory interphone signal level. Then, the volume knob of each radio set should be adjusted until the output levels of all receivers are properly balanced.

TABLE OF COMMUNICATION AND NAVIGATION EQUIPMENT

TYPE	DESIGNATION	FUNCTION	RANGE	CONTROL LOCATION
Interphone	Macchi GB793-12-40 (derived from AN/AIC 18)	Intercommunication between the crew members	Cockpit	Left console and grips
VHF 1 and VHF 2	Collins 618M-2D	Two-way voice communication	Line-of-sight	Front and rear instrument panels and grips
ADF	Collins DF 203	Reception of voice and code communication, position finding, homing	about 200 miles	Front and rear instrument panels
VOR/ILS	Collins 51RV-1 ARINC 547	Bearing and course	VOR: Line-of-sight LOC: 85 miles G.S.: 35 miles	Front and rear instrument panels
Marker Beacon	Collins 51Z-4	Reference points during approach	Vertical	Front and rear instrument panels

18-T001

Figure 4-4

In addition to the rotation movement, the volume control knob can be pulled outwards or inwards. When the volume knob is pulled out, the interphone system is set for "hot mike" communication.
Interphone communication is on "cold" microphone if the "VOL" control knob on the interphone control panel is pushed in and on "hot" microphone if the "VOL" control knob is pulled out. (In the latter case it is possible to talk even without pressing the "INT" button).

Monitoring Switches. The monitoring switches are labelled VHF1, VHF2, ADF, NAV and MKR.
When turned on (forward), they allow individual or simultaneous reception of the audio signals coming from the following sets:

VHF1 — Communication Transceiver n. 1

VHF2 — Communication Transceiver n. 2

ADF — Automatic Direction Finder

NAV — VOR/ILS Receiver

MKR — Marker Beacon Receiver

Rotary Selector Switch. The rotary selector switch, operating on two positions labelled VHF1 and VHF2, is utilized to direct the microphone signal towards either transmitter.

Actual activation of the transmitter is however obtained by depressing the "MIC" button switch on the engine throttle grip.

"Emer" Switch. The toggle switch labelled "EMER" can be used in case of failure of one of the interphone amplifiers: when moved to the EMER position by the pilot whose amplifier has failed, this switch cuts out both his interphone and isolation amplifiers and puts his microphone and headset in parallel with those of the other pilot. Communication can therefore be continued using the remaining amplifiers and the whole system remains operative with only a slight reduction in the audio signal level.

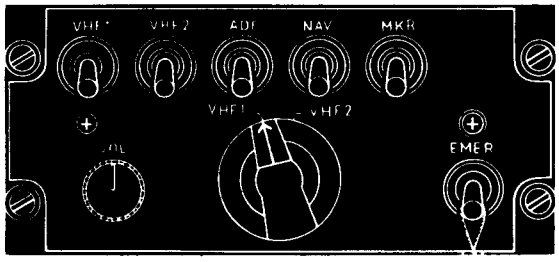
"Mic" Button

A press-to-transmit button labelled "MIC" is provided on the engine throttle lever in each cockpit. This button controls the transceiver sets, and, when pushed, puts the chosen set into the transmission mode. Transmission can be made through one transmitter only at a time. Selection between the two transmitters shall be made through the selector switch VHF1 — VHF2 located on the interphone control panel.

Note

Transmission when both radio sets are tuned to

INTERPHONE CONTROL PANEL



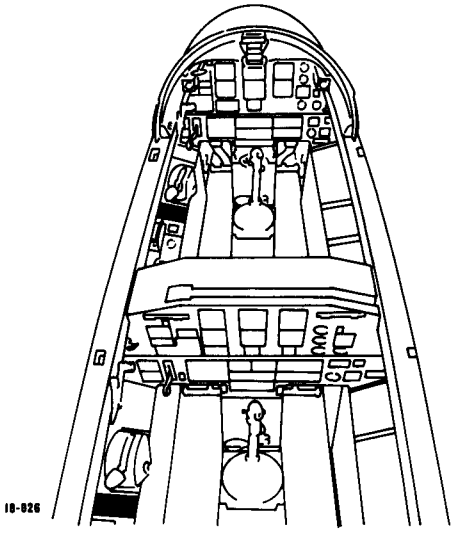


Figure 4-5

the same frequency should be avoided.

Interphone Button

A red push-button, located on each control stick grip (fig. 1-15), is used for interphone communication between the crew members. When the "VOL" Knob, on the interphone panel, is pushed in (Cold Mic) the pilot can talk on interphone with the other pilot.

VHF SYSTEM

The VHF system enables both pilots to perform voice communications with ground stations or with other aircraft in flight.

The system consists of two identical and self-contained units, called VHF1 and VHF2, which incorporate a receiver-transmitter each.

Each crew member can utilize both VHF sets: two VHF control panels are therefore available in each cockpit, on the central area of the lower portion of the instrument panel, and two indicators are fitted to show which member has control. The Collins 618M-2D receiver--transmitters operate in the VHF frequency range of 116.00 to 151.975 megacycles spaced 25 kilocycles apart; a total of 1440 channels are thus available.

The VHF units operate within the line-of-sight range with an average antenna output of 25 watts. Reception through the two sets can be simultaneous since signals are mixed by the interphone system but transmission can be made through one transmitter only at a time in each cockpit.

Both crew members can however transmit simultaneously by operating one the VHF1 set and the other the VHF2 set respectively without interference.

A radio frequency card holder is provided in each cockpit on the right side.

VHF Control Panel

The VHF system is controlled by two identical control panels located on the central area of the lower portion of each instrument panel (fig. 4-6). The left panel controls the VHF1 radio set, the right panel controls the VHF2 radio set. However, each radio set can be controlled from one control panel only at a time (the rear one or the front one).

Each control panel comprises the following controls:

"Off-Pwr-Test" Selector

OFF — Removes operating power from the transceiver

PWR — Applies power to the transceiver and permits transmission and reception.

TEST — Controls the squelch disable. When the selector is moved to the TEST position, the squelch is not operative and it is possible to hear any audio noise in the headset.

"Vol" Knob. The rheostat type volume control permits to adjust the amplitude of the audio signal heard in the headset.

Frequency Selection Knobs. The left knob, concentric

with the "OFF—PWR—TEST" selector, selects frequencies in 1 mc steps (second and third numbers, left to right on the MC indicator) The right knob, concentric with the "VOL" knob, selects frequencies in 25 kc steps (fourth and fifth numbers on the MC indicator).

VHF Control Shift Button

Two control shift buttons, on the central area of the lower portion of each instrument panel, labelled VHF1 and VHF2, are provided to take control of the VHF1 (or VHF2) radio control panel from the other cockpit. This may be done in either of the two cockpits. The illumination of the button indicates availability of the selected radio control in that cockpit.

Note

When a break in the electrical power supply occurs, the control function is shifted to the front cockpit.

VHF System Operation

Note

These instructions apply to both the VHF1 and VHF2 transceivers.

1. Rotary selector switch on the interphone control panel — VHF1 (or VHF2).
2. "VHF1" (or "VHF2") monitoring switch on the interphone control panel — On (forward).
3. "VHF1 (or "VHF2") control shift button — press and check light on.
4. "OFF—PWR—TEST" selector on the VHF control panel — PWR.
5. Select the desired frequency by rotating the two selection knobs.
6. Before message transmission, check for operation and warm-up of trasmitter by pressing the "MIC" button and listening for sidetone.
7. When the first received signal is heard in the headset, readjust the volume control to desired audio level.
8. Turn the "OFF—PWR—TEST" selector to OFF to de-energize the set.

NAVIGATION EQUIPMENT

ADF SYSTEM — COLLINS DF—203

The Collins DF-203 automatic direction finder is a visual and navigation aid used in conjunction with the Radio Magnetic Indicator (RMI) on each instrument panel.
The ADF system provides for the following functions:

a. As an "automatic" direction finder it provides both pilots with a continuous indication of the magnetic bearing to a radio station.

b. As a "manual" radio compass it enables the operator to determine the magnetic bearing to a radio station.

c. As an aural navigation receiver it can be utilized to

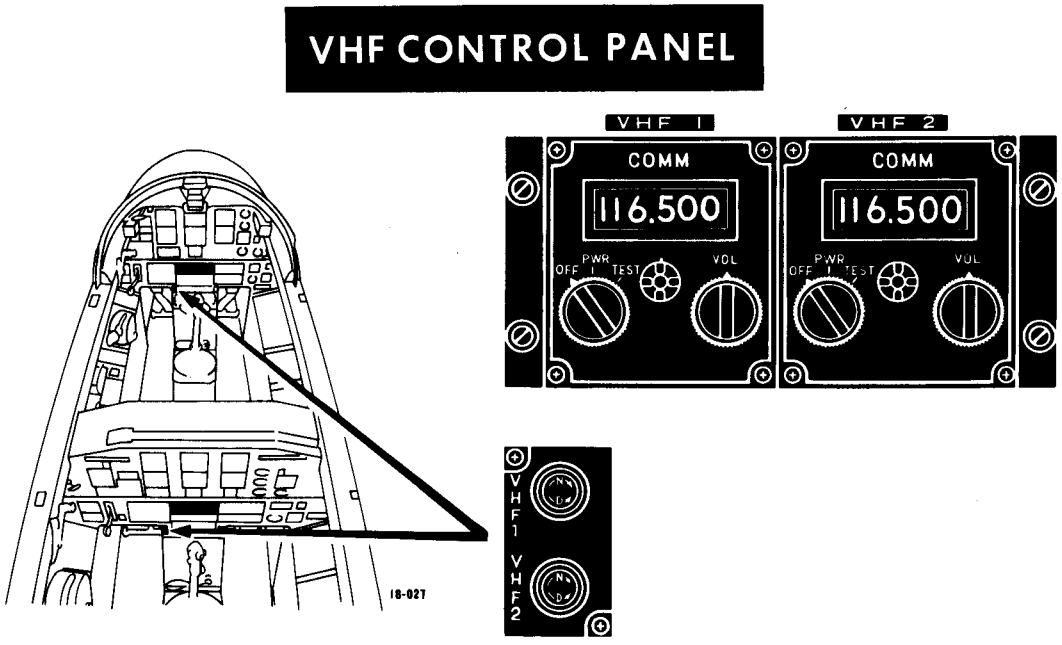


Figure 4-6

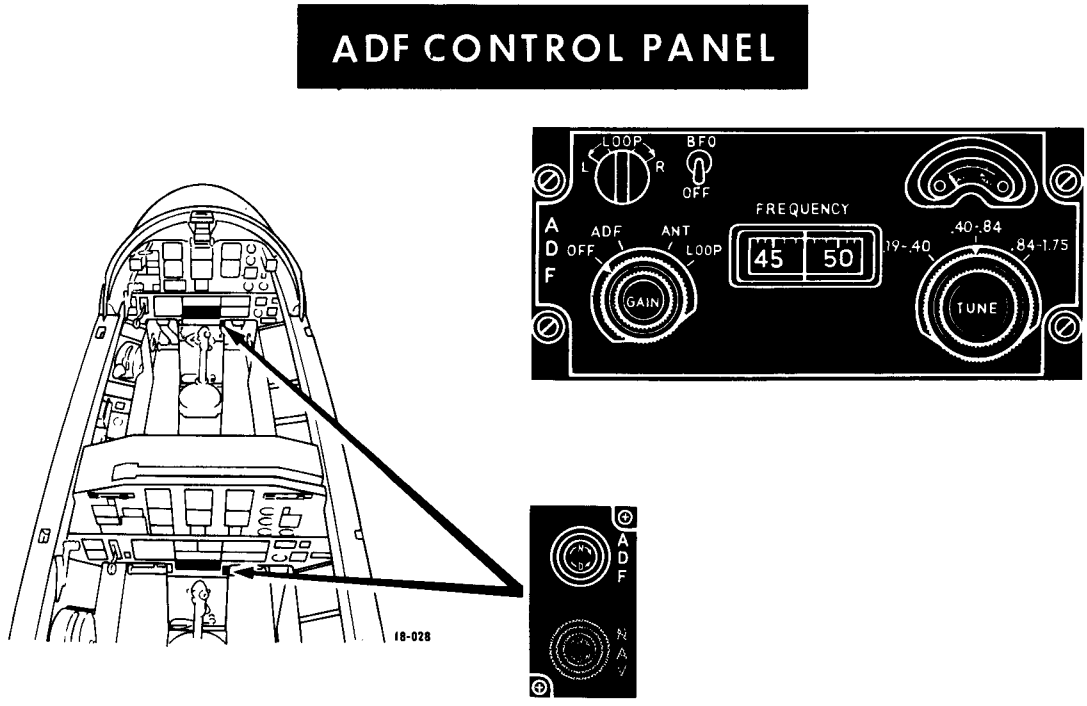


Figure 4-7

obtain navigation data from Radio Range stations. The audio output level is approximately proportional to the intensity of the incoming signal. This feature allows the operator to determine whether the aircraft is approaching or leaving the radio station.

d. As a conventional receiver it permits aural reception of any amplitude modulated signals in the frequency range of 0.19 to 1.75 megacycles.

The receiver is a fully transistorized set. It receives non-directional radio signals from the sense antenna and directional radio signals from the loop antenna. The receiver processes the signals so obtained into a polar bearing indication which is transmitted to pointer "2" in the RMI. The ADF system is concurrently fed from the primary 28 V dc bus and from the primary 26 V ac bus.

ADF Control Panel

The ADF control panel located on the central area of the lower portion of each instrument panel (fig. 4-7), incorporates the following controls:

Function Selector Switch:

OFF — The set is de-energized.

ADF — Used for compass homing or for position finding: with the switch in this position the set supplies on the RMI continuous visual magnetic bearing indications of a selected radio transmitter site with respect to the aircraft.

ANT — Used when flying radio range or when the set is used as a general radio receiver.

LOOP — Used for compass homing or for position finding: with the switch in this position, the set determines the magnetic bearing of a selected transmitter site with respect to the aircraft by manual operation to null the received signal.

elector Switch. The band selector switch selects any one of the three frequency bands: 190 to 400, 400 to 840 and 840 to 1750 kilocycles. The selected range only is then displayed on the frequency dial.

"Loop" Switch. Used to electrically position the loop antenna to determine the bearing quality or when using aural null for homing or position fixing.

"BFO" Switch. In the "BFO" position, it allows "zero beat" tuning to the carrier (center frequency) of weak voice or range station signals. In the BFO position, it provides audio for CW reception.

"Gain" Control. The "GAIN" control knob, concentric with the function selector switch, adjusts audio signal level to headsets.

"Tune" Control. The "TUNE" control knob, concentric with the band selector switch adjusts the receiver frequency within the band selected by the band switch. Five turns of the tune control cover the selected band.

ADF Control Shift Button

The ADF control shift button, located on the central area of the lower portion of each instrument panel, is provided to take control of the ADF control panel from the other cockpit. This may be done in either of the two cockpits. The illumination of the same button indicates availability of the ADF control in that cockpit.

Note

When a break in the electrical power supply occurs, the control function is shifted to the front cockpit.

ADF operation

1. "ADF" monitoring switch on the interphone control panel – On (forward).
2. "ADF" control shift button – Press and check light on.
3. Turn the function selector switch on the ADF control panel to ANT.
4. "BFO" switch – As required.
5. Select the desired frequency band with the band selector switch and tune the desired station with the tune knob.
6. Select type of operation, ADF or LOOP.
7. Adjust the gain control for the desired audio intensity.
8. To turn the ADF off, rotate the function selector switch to OFF.

VOR/ILS SYSTEM

The VOR/ILS receiving system consists of an airborne navigation receiving system which operates in conjunction with VHF omnidirectional range (VOR) stations, localizer and glideslope installations.

The system provides continuous bearing, to-from, and course deviation signals from any selected VOR station within a given line-of-sight distance from the aircraft; it provides deviation and glideslope signals when tuned to an ILS station. Localizer and glideslope bearing is accomplished automatically and independently from any control unit.The VOR bearing is displayed on the RMI indicators (pointer "1"). The course, course deviation, localizer and glideslope signals are displayed on the course indicators.The VOR/ILS system is concurrently powered from the primary 28 V dc bus and the primary 26 V ac bus.

The frequency range of the system is between 108.00

VOR/ILS CONTROL PANEL

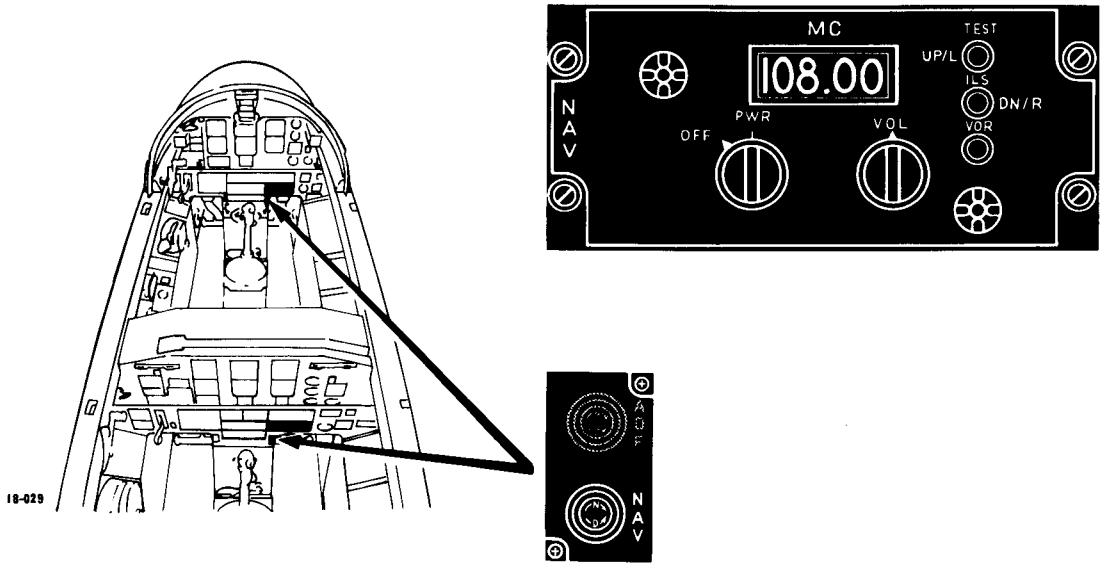


Figure 4-8

and 117.95 megacycles.

VOR/ILS Control Panel

The VOR/ILS control panel, labelled "NAV", is located on the lower right side of each instrument panel (fig. 4-8) and incorporates the following controls:

Power Control Switch. When in the PWR position, the switch energizes the set.

"Vol" Volume Control. The volume control is a potentiometer which enables the pilot to adjust the loudness of the identification signal heard in the headset.

Frequency Selector Knobs. Two knobs, concentric with the power control switch and the volume control, select the desired frequency: one (to the left) changes the frequency of operation in 1 megacycle steps, the other (to the right) changes the frequency of operation in 50 kilocycle steps.

Test Push-Buttons. Three buttons are provided for system testing. The first, labelled "VOR", permits to test the VOR receiver; the other two, labelled "UP/L" and "DN/R", permit to test the ILS audio circuits and indicators.

VOR/ILS Control Shift Button

The VOR/ILS control shift button, labelled "NAV" and located on the central area of the lower portion of each instrument panel, is provided to take control of the "NAV" control panel from the other cockpit. This may be done in either of the two cockpits. The illumination of the same button indicates availability of the VOR/ILS control in that cockpit.

VOR/ILS Operation

1. "NAV" monitoring switch on the interphone control panel — On (forward).
2. "NAV" control shift button — Press and check light on.
3. Power control switch on the NAV control panel — PWR.
4. Select the desired frequency by means of the two frequency selector knobs.
5. Adjust volume control until the desired audio level is obtained.
6. To turn the VOR/ILS off, rotate the power control switch to OFF.

MARKER BEACON SYSTEM

The marker beacon system provides visual and aural indication of the passage of the aircraft over a 75--megacycle marker beacon station; it is used during an ILS approach to provide check points on the passage of the aircraft along the ILS course, and, during airway navigation, to provide a fix on a ground check point

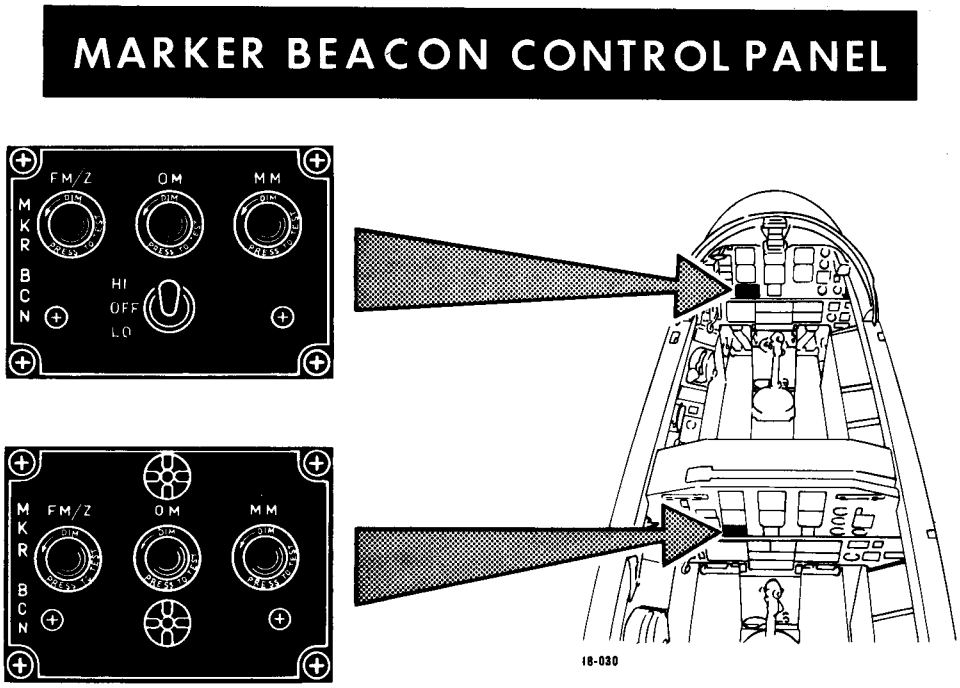


Figure 4-9

along the route.

The signals received are 75-megacycle amplitude--modulated tone signals, modulated at 400, 1300, or 3000 cps.

The marker beacon receiver converts the demodulated tone into sufficient power to light separate indicator lights for each modulating tone frequency and to provide an aural tone in the headsets.

Visual identification is by color of the indicator light: blue for ILS outer marker (400 cps), amber for ILS middle marker (1300 cps) and white for airway marker (3000 cps).

The marker beacon system is powered from the primary 28 V dc bus.

Marker Beacon Control Panel

The marker beacon control panel is located on the upper portion of each instrument panel (fig. 4-9) and incorporates the following controls:

Indicator Lights

FM/Z —This light identifies, when on, the passage over FAN or Z marker.

OM —This light identifies, when on, the passage over an ILS outer marker.

MM —This light identifies, when on, passage over an ILS middle marker.

Sensitivity Switch "Hi-Off-Lo"

A sensitivity control switch is provided on the front control panel only. The switch has three positions:

HI — The set is energized and allows high sensitivity of the receiver and bright intensity of the indicator light.

OFF — The set is de-energized.

LO — The set is energized and allows low sensitivity of the receiver and dim intensity of the indicator light.

Marker Beacon Operation

1. "MKR" monitoring switch on the interphone control panel — On (forward).
2. Sensitivity switch on the front marker beacon control panel, in HI or LO position.
3. To turn the marker beacon off, move the sensitivity switch on the front control panel to OFF.

GYRO SYSTEM

The gyro system consists essentially of a C-4T gyro compass system supplying information to the Radio Magnetic Indicator (RMI) and to the Course Indicator (CI).

The system power is controlled by a single switch ("GYRO MASTER") available to the front pilot.

The C-4T system consists of a directional gyro, a flux-valve and an amplifier. The directional gyro indicates the stabilized magnetic heading through the rotating compass cards of both the RMI and the CI on each instrument panel.

Directional Gyro

The directional gyro is automatically kept on the magnetic heading of the aircraft by a flux valve in the tail fairing. The flux valve "senses" the south-north flow of the earth's magnetic flux and indicates the magnetic heading without oscillation, swinging, or northerly turning error. The magnetic heading is indicated by a rotating compass card against a fixed index in both the RMI and CI. The gyro is energized when the "GYRO MASTER" switch is turned ON and is on fast-slaving cycle for the first 1 to 3 minutes of operation, during which it should align with the magnetic heading. The gyro then begins a slow-slaving cycle. A button switch is provided to energize the fast-slaving circuit for fast recovery during flight.

Note

After the gyro has reached the operating speed, the indications on the RMI and the CI should be checked against the standby compass indication to make sure it does not show a 180-degree ambiguity.

Gyro System Control Panel

The panel incorporating the controls of the gyro instruments is located immediately below each instrument panel, on the right side. The control panel in the forward cockpit contains the "GYRO MASTER" switch and the "GYRO COMPASS FAST SLAVE" switch. The control panel in the aft cockpit contains the "GYRO COMPASS FAST SLAVE" switch only.

"Gyro Master" Switch. This switch is provided in the forward cockpit only. When turned ON the switch operates the gyro compass system, the turn and bank indicator and the attitude indicator.

"Gyro Compass Fast Slave" Button Switch. A fast--slaving cycle of the directional gyro (which operates the rotating compass cards of the RMI and CI) can be selected by means of a push-button switch on both instrument panels. Momentary actuation of the switch interrupts dc power to the gyro amplifier. This power interruption automatically de-energizes the slow-slaving cycle and engages the fast-slaving cycle as during initial starting, permitting faster gyro recovery to the true

heading.

CAUTION

Do not hold the fast-slaving button switch depressed for more than 2 seconds and allow a minimum of 10 minutes between depressions of the switch. Excessive use can damage the slaving torque motor.

STANDBY COMPASS

Refer to paragraph "Standby Compass" in Section I.

INTEGRATED INSTRUMENTS

COURSE INDICATOR (CI)

The course indicator (CI) located on the central area of the upper portion of each instrument panel (fig. 4-10) allows the pilot "to see" exactly where he is in relation to the VOR/ILS station and in relation to the course which he has selected.

COURSE INDICATOR

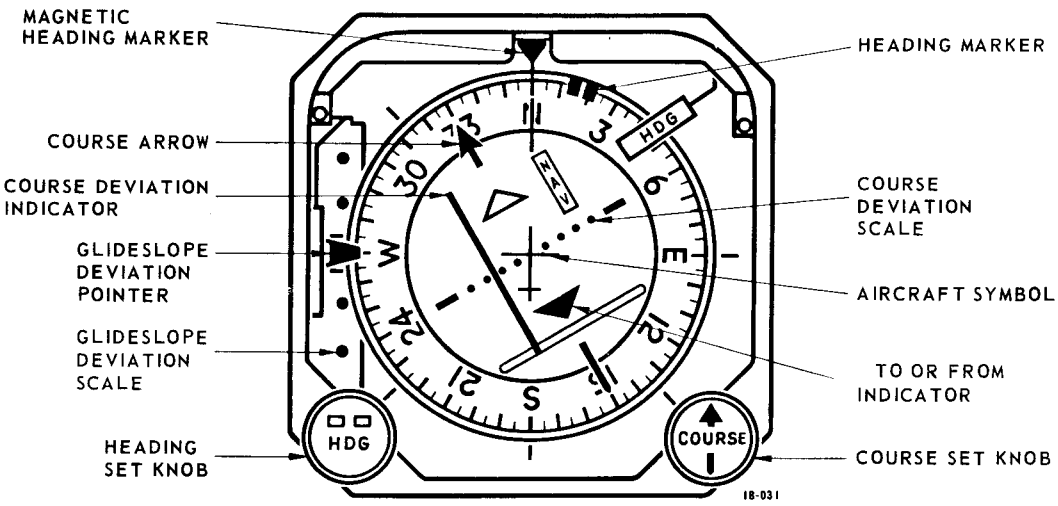


Figure 4-10

The CI provides the following information on a single display:

a. Aircraft magnetic heading

b. Heading selection

c. Course selection

d. Lateral deviation

e. Glideslope deviation

The above information are displayed as follows:

a. The magnetic heading is indicated by a rotating compass card read against a fixed lubber line on the instrument dial face. The rotating compass card is operated by the directional gyro (see paragraph "GYRO SYSTEM" in this section).

b. The heading is set by means of the "HDG SET" knob on the front of the instrument and is indicated by the split double bar located on the periphery of the compass card read against the compass card.

c. The course (VOR or LOC) is set by means of the "COURSE SET" knob on the front of the instrument and is indicated by the long arrow located in the center section of the dial face. This arrow is read against the compass card.

d. Lateral drift of the center portion of the course arrow to the right or to the left indicates: course deviation if a VOR radial is chosen or aircraft lateral deviation with respect to the chosen localizer path.

e. Glideslope deviation is indicated by a pointer located on the left of the instrument; the pointer indicates the relative position of the glideslope path to the aircraft.

In addition the instrument is provided with three flags (HDG, NAV and a black flag) and a "TO-FROM" pointer.
The HDG flag, when visible, indicates that the power source supplying the circuits that drive the compass card is either turned off or malfunctioning.
The NAV flag, when visible, indicates that the VOR/LOC navigation input is improper.
The black flag, when it covers the glideslope scale, indicates that the glideslope input signal is improper.
During tracking operation either one of two small arrows appears on the dial face to indicate if the aircraft is heading toward (TO arrow) or away from (FROM arrow) the beacon station.

RADIO MAGNETIC INDICATOR (RMI)

The radio magnetic indicator, located on the upper portion of each instrument panel, is a dual pointer instrument with a rotating compass card actuated by the directional gyro (see paragraph "Gyro System" in this section). Information from the directional gyro turns the compass card under a heading arrow at the top of the indicator to indicate the magnetic heading of the aircraft. The double-barrel pointer, marked "2", is actuated by the ADF receiver (see paragraph "ADF SYSTEM" in this section) and points to the magnetic bearing of the station being received. The smaller

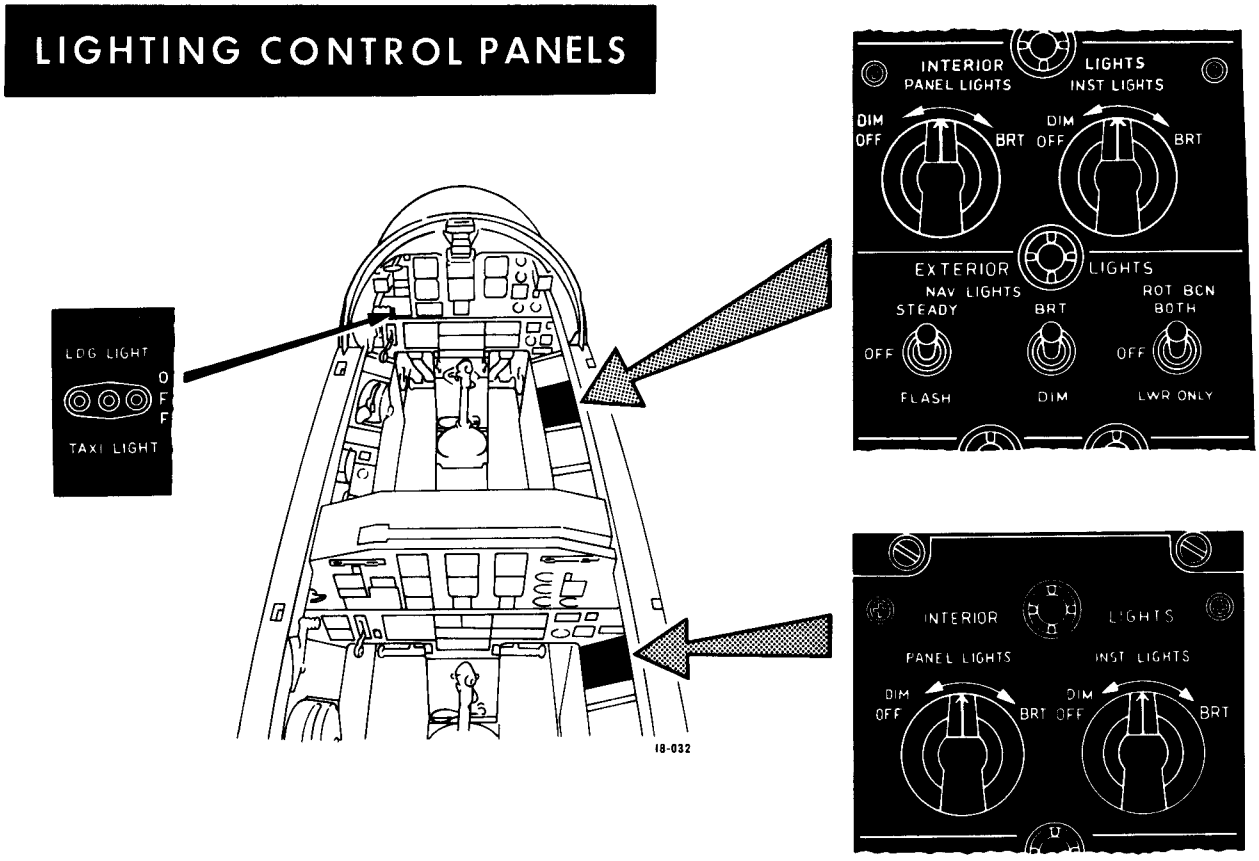


Figure 4-11

needle, marked "1" is actuated by the VOR/LOC receiver (see paragraph "VOR/ILS System" in this section) and points to the magnetic bearing of the station being received.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

The exterior lighting installation consists of five navigation lights, two rotating beacons, a landing light and a taxi light. The navigation lights comprise two wingtip lights, one on each wingtip, a tail fairing light and two fuselage lights, one on the top of the fuselage mid-section and one on the bottom of the fuselage nose. The two rotating beacons are mounted adjacent to the fuselage navigation lights. The retractable landing light is installed under the left wing. The taxi light is on the nose landing gear.

"Nav Lights" Switches

Two adjacent "NAV LIGHTS" switches, located on the "EXTERIOR LIGHTS" control panel on the right console in the forward cockpit, control the operation of the navigation lights.

The left switch can be turned from OFF to STEADY causing the five navigation lights to be on steadily, or it can be moved to FLASH, effecting a repeated regular-interval flashing of the wingtip and tail fairing lights while the fuselage lights remain steady. The right switch has two positions, DIM and BRIGHT, and controls the brilliance of all five navigation lights.

"Rot Bcn" Switch

The rotating beacons are controlled by the "ROT BCN" witch located on the "EXTERIOR LIGHTS" control panel on the right console in the forward cockpit. The switch has three positions: BOTH, OFF and LWR ONLY. With the switch in the BOTH position, both lights are on. In the LWR ONLY position, only the light on the fuselage bottom is on. In the OFF position both lights are off.

Landing and Taxi Light Switch

The landing and taxi lights are controlled by a switch located on the left side of the forward instrument

panel. The switch has tree positions: LDG LIGHT, OFF, TAXI LIGHT. With the switch in the LDG LIGHT position, power is supplied to the motor which extends the landing light and causes it to illuminate. With the switch in the TAXI LIGHT position, the taxi light on the nose landing gear is on. When the switch is moved to the OFF position, the taxi light goes out and the landing light, if extended, is retracted and turned off before it reaches the fully retracted position.

INTERIOR LIGHTING

The interior lighting system comprises the lights incorporated in the control panels and instruments, the red and white spot lights for illumination of the instrument panels and the red swivelling lights for illumination of the consoles.

The spot lights are four, one on each side of each cockpit. They are normally pointed to the instrument panel but can be detached from their supports to be manually used in any other direction as permitted by the length of their electrical cable. By turning the knurled ring until one of the two white or the two red points on the ring are set at the reference marker, a diffused light at the smaller point and a concentrated light at the lerger point will respectively be obtained. Light intensity is adjusted by rotating the red knurled knob. Depressing the push-button on the same knob will istantaneously give full light intensity. An intermittent operation of the button, with the light detached from its support, will enable Morse signals to be transmitted when necessary.

The red lights are seven and are located as follows: two on the left console and two on the right console in the forward cockpit, two on the left console and one on the right console in the aft cockpit. The red lights are normally directed downwards to illuminate the consoles but can partially swivel to direct the light beam as necessary. Except for the spot lights which are controlled directly, the interior lighting system is controlled from the "INTERIOR LIGHTS" control panel located on the right console in both cockpits.

"Inst Light" Rheostat

An instrument light rheostat, labelled "INST LIGHTS", is provided on the left side of the "INTERIOR LIGHTS" control panel. When moved from OFF to DIM or BRT, this rheostat turns on and controls the brilliance of the lights in all instruments.

"Panel Light" Rheostat

A "PANEL LIGHT" rheostat is on the left side of the "INTERIOR LIGHTS" control panel. When moved from OFF to DIM or BRT, this rheostat turns on and controls the brilliance of the console lights as well as of the lights in all control panels.

OXYGEN SYSTEM

The aircraft is equipped with a gaseous oxygen system consisting of six type D2 cylinders. The system has an operating pressure of 400 psi and can be refilled through a single filler valve accessible through an access door on the lower left side of the fuselage. A regulator provides the necessary controls for operation of the oxygen system, as well as a flow indicator and a pressure gauge. The approximate duration of the oxygen supply is given in figure 4-12.

Note

To prevent damage to the oxygen hose when not in use, the hose should be clipped to the webbing provided on the right side of the cockpit.

CABIN ALTITUDE FEET	GAGE PRESSURE—P.S.I. 400	350	300	250	200	150	100	BELOW 100
40,000	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
35,000	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
	4.2	3.6	3.0	2.4	1.8	1.2	0.6	EMERGENCY
30,000	3.2	2.7	2.2	1.8	1.4	0.9	0.5	
	3.2	2.7	2.2	1.8	1.4	0.9	0.5	
25,000	2.5	2.2	1.8	1.4	1.1	0.7	0.4	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	3.0	2.6	2.1	1.7	1.3	0.9	0.4	
20,000	2.0	1.7	1.5	1.2	0.9	0.6	0.3	
	3.4	2.9	2.4	1.9	1.4	1.0	0.5	
15,000	1.6	1.4	1.1	0.9	0.7	0.5	0.2	
	4.1	3.5	2.9	2.3	1.8	1.2	0.6	
10,000	1.4	1.2	1.0	0.8	0.6	0.4	0.2	
	5.4	4.7	3.9	3.1	2.3	1.6	0.8	

BLACK FIGURES INDICATE DILUTER LEVER "100%" OXYGEN
WHITE FIGURES INDICATE DILUTER LEVER "NORMAL" OXYGEN,

OXYGEN DURATION HOURS

NOTE

THE VALUES IN THE TABLE ARE BASED ON THE CONDITION WITH A CREW OF TWO AND OXYGEN SYSTEM INCLUDING SIX D-2 BOTTLES.

Figure 4-12

An emergency oxygen supply is available from a bottle installed on each ejection seat.

OXYGEN REGULATOR

A combination pressure-breathing, diluter-demand oxygen regulator (figure 4-13) is provided on the lower instrument panel in both cockpits. The regulator panel comprises three levers: a supply lever, a diluter lever and an emergency lever. When the diluter lever is in the NORMAL OXYGEN position and the supply lever is ON , the regulator mixes air with oxygen in varying quantities according to the existing altitudes, and supplies the mixture each time the pilot inhales. Above 28,000 feet cabin altitude, the regulator supplies oxygen at a continuous positive pressure. The delivery pressure automatically changes with cockpit altitude. An oxygen pressure gauge and a flow indicator are also provided on the regulator panel.

"Supply" Lever

The green "SUPPLY" lever on the oxygen regulator panel is used to control the supply of oxygen at the panel. This lever must be safetied in the ON position.

Diluter Lever

The black diluter lever on the oxygen regulator panel should be placed in the NORMAL OXYGEN position for normal use, or in the 100% OXYGEN position for emergency use.

Emergency Lever

The red emergency lever on the oxygen regulator panel should be in the center NORMAL position at all times, unless an oxygen pressure increase is necessary. Moving the lever to the EMERGENCY position provides continuous positive pressure to the mask. When the lever is held in the TEST MASK position, oxygen pressure is provided to test the mask for leakage.

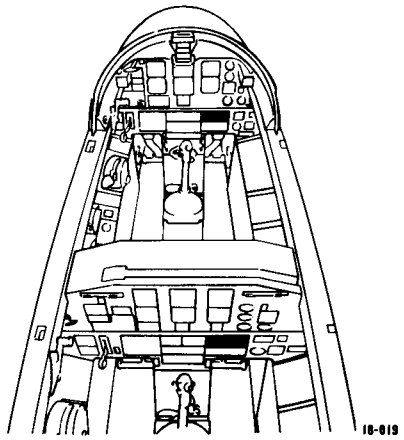
Note

100% oxygen is not necessarily provided with the lever in the EMERGENCY position.

WARNING

When positive pressures are required, the oxygen mask must be well-fitted to the face. Unless special precautions are taken to insure a leakproof fit, continued use of positive pressure will result in rapid depletion of the oxygen supply and possibly an extremely cold oxygen flow to the mask.

OXYGEN PANEL



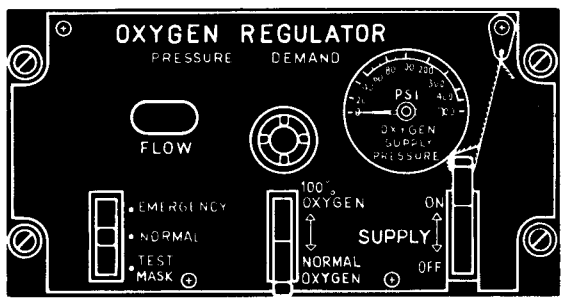


Figure 4-13

Pressure Gauge and Flow Indicator

A pressure gauge and a flow indicator are installed on the oxygen regulator panel. The pressure gauge indicates the oxygen system pressure.
The flow indicator (blinker) consists of an oblong opening on the face of the regulator panel which alternately displays black and white markers during the breathing cycle.

Note

As the aircraft ascends to high altitudes and low temperatures, the oxygen cylinders become chilled. As the cylinders become cooled, the oxygen gauge pressure indication is reduced, sometimes rather rapidly. With a 40°C decrease in temperature in the cylinders, the gauge pressure can be expected to drop 20 percent. This rapid fall in pressure occasionally causes unnecessary alarm. All the oxygen is still there, however, and as the aircraft descends to warmer altitudes, the

pressure rises again, so that the rate of oxygen use may appear to be slower than normal. A rapid fall in oxygen pressure while the aircraft is in level flight, or while it is descending, is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

OXYGEN SYSTEM PREFLIGHT CHECK

Before take-off, the oxygen systemsshould be checked as follows:

Note

This test procedure is applicable only for an initial preflight check of the system. In-flight tests, or repeated tests made within short periods, may produce false or misleading indications.

1. Check that the mask unit is properly connected to the oxygen hose and note the oxygen pressure gauge indication (300 psi minimum). See figure 4-15 for oxygen hose hook-up.
2. Check the oxygen regulator with the diluter lever first at NORMAL OXYGEN and then at 100% OXYGEN as follows:

   Remove the mask and blow gently into the end of the oxygen regulator hose as during normal exhalation. There should be resistance to blowing. Little or no resistance to blowing indicates a leak or faulty operation and the system should be checked before further flight.
3. With the oxygen regulator supply lever ON, the oxygen mask connected to the regulator, and the diluter lever at 100% OXYGEN, breathe normally into the mask and perform the following checks:
   a. Observe the blinker for proper operation.
   b. Move the emergency lever to EMERGENCY. A positive pressure should be supplied to the mask. Hold breath to determine if there is leakage around the mask. Return the lever to the center NORMAL position; positive pressure should cease.
4. Return the diluter lever to NORMAL OXYGEN.

OXYGEN SYSTEM NORMAL OPERATION

1. Before each flight, be sure the oxygen pressure

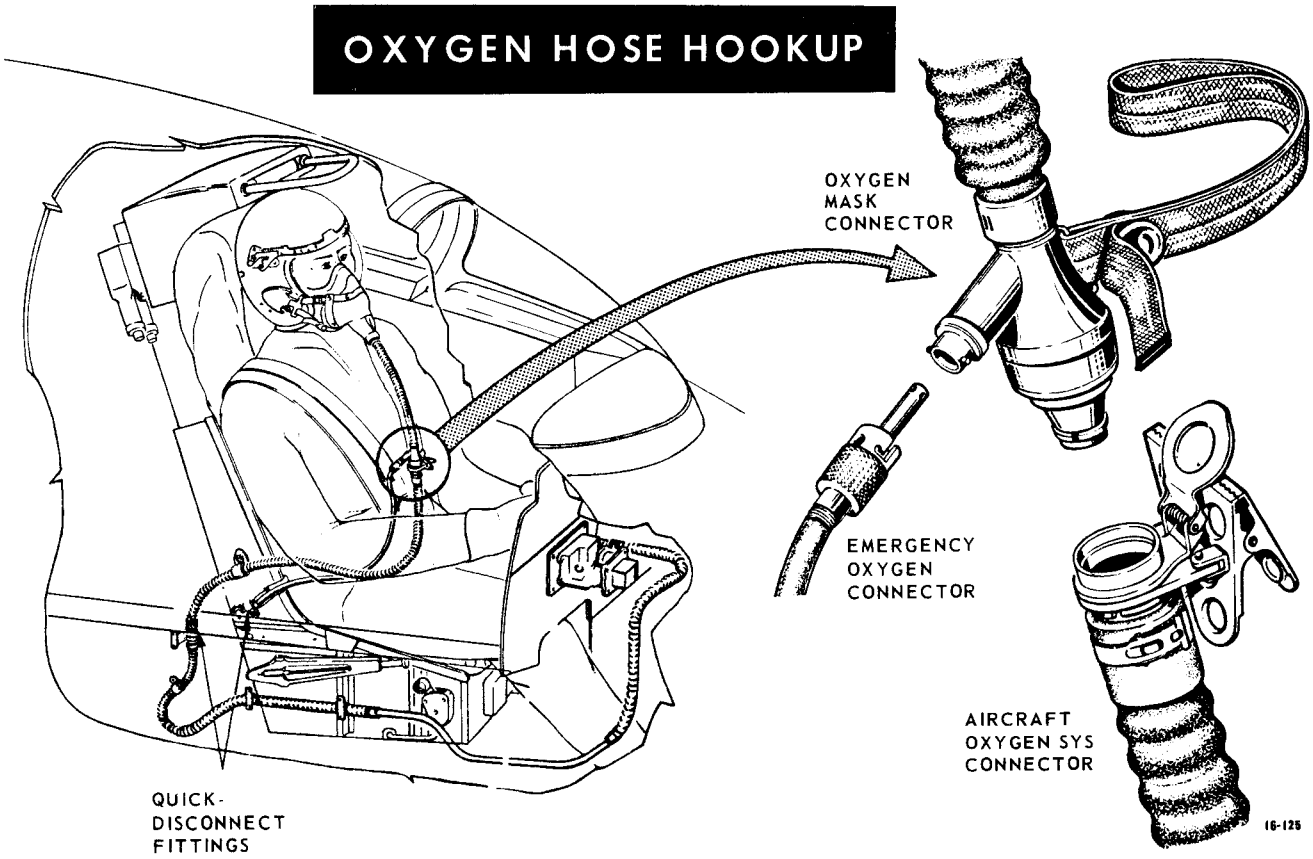


Figure 4-14

gauge reads at least 300 psi. If pressure is below this minimum, have the oxygen system charged to capacity before take-off.

2. Oxygen regulator diluter lever – NORMAL OXYGEN.
3. Emergency lever – NORMAL.
4. Oxygen regulator supply lever – ON.

Note

Above 30,000 feet, a vibration or wheezing sound may sometimes be noticed in the pressure-demand mask. This condition does not indicate a malfunction and may be overlooked.

OXYGEN SYSTEM EMERGENCY OPERATION

With symptoms of the onset of hypoxia, proceed as follows:

1. Oxygen regulator diluter lever – 100% OXYGEN.
2. Emergency lever – EMERGENCY.

Note

Placing the regulator lever to 100% OXYGEN and/or use of the emergency lever will rapidly deplete the oxygen supply. Return the diluter lever to NORMAL OXYGEN and the emergency lever to NORMAL as soon as the emergency is over.

3. If the oxygen regulator becomes inoperative, pull the operating cable of the emergency oxygen bottle on the seat.
4. Descend to an altitude where oxygen is not required.

ARMAMENT SYSTEM

The aircraft is provided with six underwing strong points for carriage of underwing pylons and stores. All armament is carried externally.

PYLON

The underwing pylon contain a standard USAF type MA-4A rack, with 14 in lug spacing. The pylon is fitted with arming solenoid and full provisions for the carriage and operation of the stores listed in figure 5-2.

MACHINE GUN POD

The machine gun pods can be installed under the wings at station 3 and 4. The function of the machine gun pod is to house a Browing-Colt type AN-M3 machine gun.

Each machine gun has a feed system under which there is a detachable ammunition box containing 350 rounds. The caliber .50 Browing-Colt machine gun type AN-M3, is a fully automatic, recoil-operated and aircooled weapon. It develops a muzzle velocity of 2,870 feet per second and fires at a rate of 1.200 rounds per minute, using disintegrating-type ammunition belts.

ARMAMENT CONTROLS

Store release and/or firing predispositions are carried out from the armament control panel in the forward cockpit. Fire of the forward-firing armament (guns and rockets) is controlled by the trigger on the forward control stick, store release is controlled by a thumb-operated push-button still on the forward control stick. An armament cutout switch is provided in the aft cockpit to enable the instructor to interrupt at any time the firing action. The repeater panel in the aft cockpit reproduces all the armament predispositions carried out by the student. An emergency external store release control, powered from the essential 28 V dc bus, is provided in each cockpit.

Armament Control Panel (Forward Cockpit)

The armamement control panel is located on the instrument panel in the forward cockpit (fig. 4-15). All controls for weapon selection and arming, as well as the warning devices provided for both the forward-firing armament and the droppable stores, are centralized on this panel. The armament control panel comprises the following:

"Fwd Armt" Selector Switch – This switch permits selection of the desired type of forward-firing armament. When set to the selected position, the switch automatically prevents any concurrent use of the other available weapons. The positions in the switch are as follows:

OFF	–	Any firing action is prevented
GUNS	–	Permits use of guns.
FFAR	–	Permits use of Folding Fin Aircraft Rockets
HVAR	–	Permits use of High Velocity Aerial Rockets (HVAR) and Sub-Caliber Aerial Rockets (SCAR)
MSL	–	(Not operable)

"Stores" Selector Switch – This switch permits selection of the type of store to drop. When set to the selected position, the switch automatically prevents arming and release of external stores other than the selected one. The positions in the switch are as follows:

ARMAMENT CONTROL PANELS

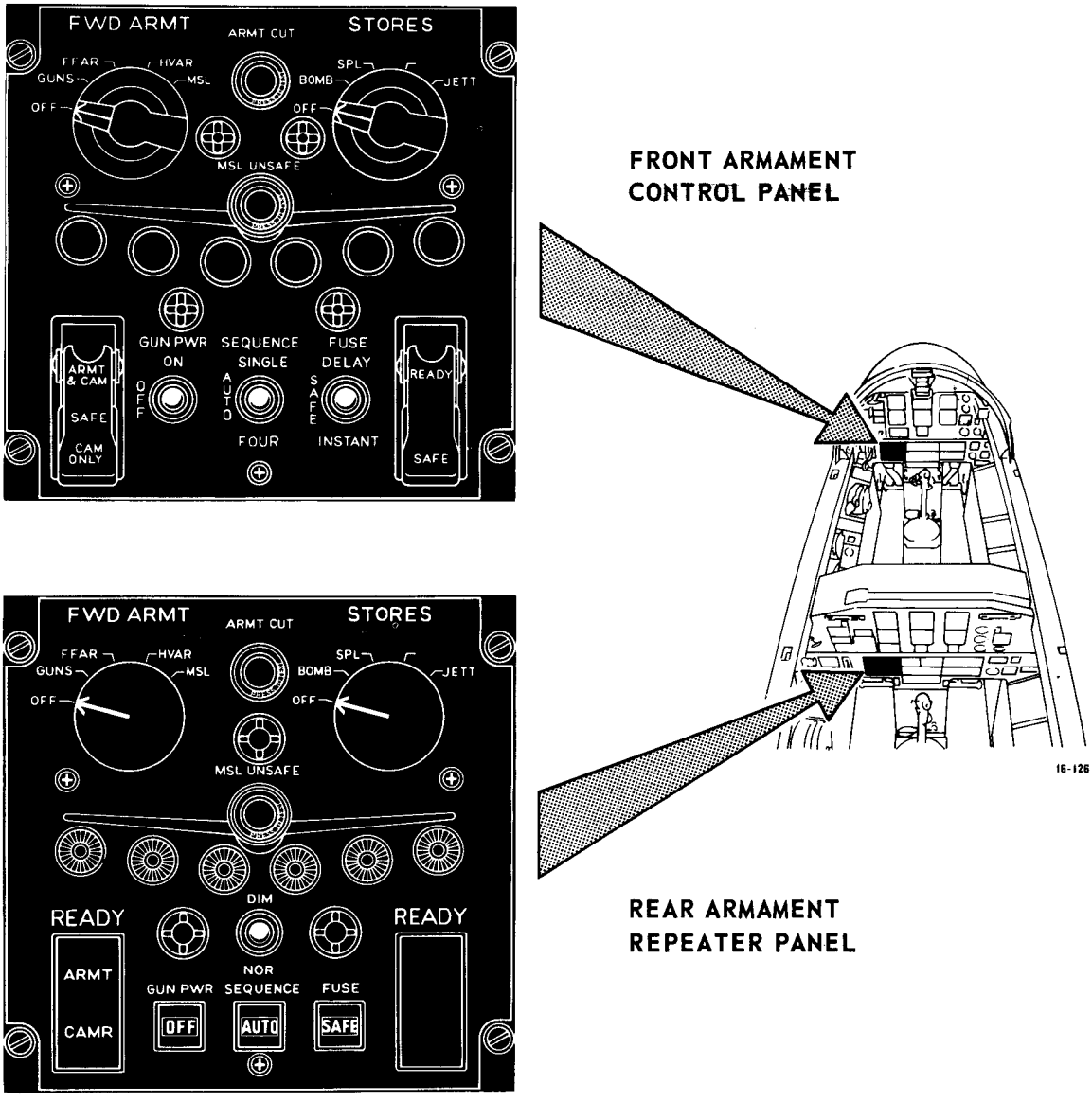


Figure 4-15

OFF — Any release action is prevented

BOMB — Permits release of 250-pound or 500-pound bombs

SPL — Permits release of practise bomb containers or of special loads and containers

JETT — Permits to jettison any load carried under the pylons, forward-firing armament included (this will however require selection by the related selector switch).

Arming Push-buttons — Six arming push-buttons are located on an aircraft profile sketched on the armament control panel, in the same positions as the pylons in the aircraft. When the buttons are pressed and remain in, the corresponding loads on the pylons are armed for release or firing. Each button remains in only when the position of the "FWD ARMT" or "STORES" selector switch is in agreement with the type of armament actually present on the pylon corresponding to the pressed button.

Note

Operation of the push-buttons is not required

when the "FWD ARMT" selector switch is set at HVAR. In this case, the firing sequence of the HVAR or SCAR rockets is automatically established by an intervallometer.

"Gun Pwr" Switch – When ON, this switch permits energization of the gun heaters.

"Sequence" Switch – This switch has three positions, each setting up a different rocket firing sequence. The SINGLE position permits firing of one rocket at a time, the AUTO position permits firing of all rockets in automatic sequence, the FOUR position permits firing of four rockets at a time.

"Fuze" Switch – This switch is used to arm the fuzes in the HVAR rockets and bombs. It can be set to INSTANT for rocket or bomb explosion on impact with the target, to DELAY for delayed explosion with respect to the impact, or to SAFE for release of bombs in a safe (unarmed) condition.

Note

The HVAR rockets are in all cases released with fuzes armed for delayed explosion, even if the "FUZE" switch is set at SAFE.

"Safe" Switch (Forward-firing Armament) – Thiis switch is located on the lower left side of the control panel and, when the red protecting guard is up, can be set to three positions: in the ARMT & CAM position, the arming push-buttons illuminate to indicate that the forward-firing armament on the corresponding pylons is ready to be fired by the trigger on the control stick grip. When the switch is in this position, the gun camera fitted to the gunsight will also be operated. In the CAM ONLY position, the actuation of the trigger operates the gun camera only. In the SAFE position, all forward-firing armament is safe.

Note

Lowering the red guard forces the switch bach to the center SAFE position from any other position.

"Safe" Switch (Stores) – This switch is located on the lower right side of the control panel and is protected by a red guard which, when lowered, throws the switch to SAFE. The droppable armament is thus safe. When the switch is moved to READY, the push-buttons will illuminate to indicate that the droppable stores on the corresponding pylons are ready to be released by the upper button on the control stick grip.

"Salvo" Push-Button

An emergency button, labelled "SALVO", is provided on the left side of each instrument panel. Pressing this button causes the immediate, simultaneous release of all external loads carried under the pylons.

"Armament" Switch

The "ARMAMENT" switch, located on the left console in the rear cockpit and protected by a red guard, is normally in the ON position. When required, this switch enables the instructor, usually seated in the aft cockpit, to cut out the firing and release controls available to the student on the forward control stick, by turning the switch OFF. An "ARMT CUT" warning light is on the forward control panel to warn the student of the instructor's cutout action and to advise that any weapon firing or release from the forward cockpit is prevented.

"Ground Fire" Switch

The "GROUND FIRE" switch, located on the left console in the forward cockpit and protected by a red guard, is only for use by ground personnel to perform ground firing tests with the landing gear down since the landing gear control lever down position renders the whole armament system safe, and ground firing tests would otherwise be impossible.

Trigger Switch

The trigger switch on the forward control stick fires all forward-firing armament as selected and armed. The trigger has two detent positions. With the "SAFE" switch (forward-firing armament) in the CAM ONLY position, squeezing the trigger to either detent position operates the camera. With the same switch in the ARMT & CAM position, the first detent position operates the camera only. The second detent position fires the selected forward-firing armament and, at the same time, operates the camera.

Droppable Store Release Button

The store release button, located on the forward control stick grip, releases all droppable stores as selected and armed.

Armament Repeater Panel (Aft Cockpit)

An armament repeater panel reproducing the basic layout of the armament control panel in the forward cockpit, is provided in a corresponding position on the aft instrument panel. This panel enables the rear pilot to be aware of the predispositions that are being introduced into the armament control panel by the front pilot. Two arrows indicate on two dials the corresponding movements of the "FWD ARMT" and "STORES" selector switches, while the illumination of the indicator lights indicates the movements of the switches available on the forward armament control panel.

GUNSIGHT

The gunsight is mounted on a support located above the front instrument panel.
Either a SFOM type 83A3 or a Ferranti type LFS5 gunsight can be installed on this support.

SFOM 83A3 Gunsight

The S.F.O.M. 83A3 gunsight consists essentially of a reticle, a mirror, a lens, a semitransparent reflector glass and a lamp for illumination of the reticle. When the S.F.O.M. 83A3 gunsight is used in daylight, the light rays passing through the reticle are reflected to the semi-transparent glass and from this to the pilot's eyes while the target is presented to the pilot through the semi-transparent reflector glass.
The contrast between the reticle image and the target is therefore maintained at a convenient value and remains constant whether the field of view is dull or strongly illuminated.
In poor external light conditions, the semi-trasparent glass must be replaced with a transparent glass.
Under these conditions the reticle is illuminated by a lamp, the brightness of which can be adjusted by a rheostat.

Ferranti LFS5 Gunsight

The Ferranti LFS5 is a gyroscopic sight providing a computed sight line for the aiming of guns, rockets and bombs against surface targets and for gun air-to-air aiming. The sight automatically provides aiming allowances for the relative movement of the target and compensates for the effect of gravity on the trajectory of whichever weapon is fired. It may be adjusted to any desired attack configuration and tolerates considerable deviations from the pre-set parameters. The gyro rotor incorporates a mirror off which a graticule pattern — the aiming mark — is projected into the pilot's view. The aiming mark will therefore occupy a position, relative to the aircraft axis, which depends on the sensitivity of the gyro, the rate of turn of the aircraft and the datum setting of the magnetic center.

GUN CAMERA

The Sephot type AA8-20-1 gun camera is mounted on the gunsight and permits simultaneous recording of the gunsight graticule and target. This is obtained when the "SAFE" switch related to the forward-firing armament is in either the ARMT & CAM or the CAM ONLY position and the firing trigger is actuated.

PHOTO-RECONNAISSANCE SYSTEM

A photo-reconnaissance pod containing four 70 mm "Vinten" cameras may be mounted under the port wing. The arrangement of the four cameras in the pod is as follows: one forward with 6" f2.8 lens, depressed at approximately 15° below horizontal; one fixed vertical mounted with the optical axis perpendicular to the direction of flight; one port oblique depressed at 18° below horizontal and one starboard oblique depressed at 25° below horizontal. The vertical and oblique cameras are fitted with 3" f2.0 lenses. The magazine in each camera can be loaded with 100 ft of twin-perforated (Aviopancro) film sufficient for 500 exposures.
An automatic exposure control contained in each camera provides to adjust the len aperture to the light

PHOTOGRAPHIC CONTROL PANEL

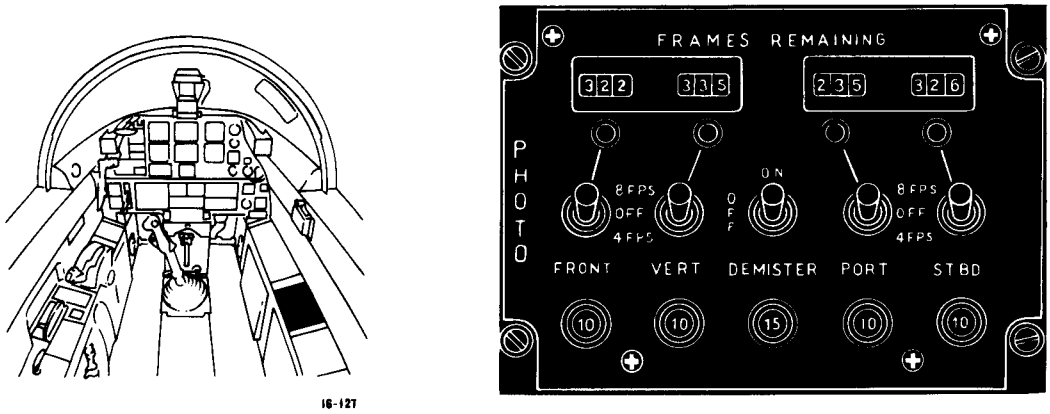


Figure 4-16

conditions in which the aircraft is operating.
A heater-blower unit, mounted in the pod, supplies warm air for the conditioning of the pod and, through appropriate diffusers, for the demisting of the camera windows. A temperature between + 25° and + 32°C is constantly maintained in the pod. During operation of the cameras, the heater-blower unit is automatically disconnected to avoid refraction phenomena. When the cameras stop operating, the heater-blower unit is restored to normal operation.
Transparent plastic protective covers are mounted on the glasses to protect them during take-off from the abrading action of dust and other foreign matters. These covers are then automatically jettisoned on retraction of the landing gear.

CAMERA CONTROL PANEL (fig. 4-16)

The camera control panel that provides for selection and control of the cameras, is mounted on the R.H. console in the front cockpit.

Camera selector switches

These switches are four, one for each camera, and are labelled "FRONT" (forward camera), "VERT" (vertical camera), "PORT" (port oblique camera) and "STBD" (starboard oblique camera). Push-to-reset circuit breakers are provided at each switch to protect the relevant circuit. Each switch can be set to one of the following three positions:

OFF — The corresponding camera is inoperative.

8FPS — The corresponding camera is set to operate at 8 frames per second.

4FPS — The corresponding camera is set to operate at 4 frames per second.

"Frames remaining" counters

Four numerical counters are mounted on the upper portion of the camera control panel to provide indication of the number of frames remaining in each camera. A knurled knob adjacent to each counter permits initial manual setting of the number of frames available in the magazine of each camera.

"Demister" switch

The "DEMISTER" switch provides a means to control the operation of the heater-blower unit which provides warm air for the conditioning of the pod and the demisting of the lenses.
The circuit to this switch is protected by a push-to-reset circuit breaker.

OPERATION

1. Make sure that the "DEMISTER", "FRONT", "VERT", "PORT" and "STDB" circuit breakers are pushed in.
2. Check that the "FRAMES REMAINING" counters on the camera control panel are set-up with the number of frames available (standard roll: 500 exposures). If required, turn and depress the knurled knobs of each counter.
3. Select the cameras to be used by setting the appropriate switches on the camera control panel to 8FPS or 4FPS.
5. Immediately after take-off, the "DEMISTER" switch shall be turned ON.
6. To operate the selected cameras, depress the push-button on the front control stick as required.

MISCELLANEOUS EQUIPMENT

MAP CASE

A map case is provided on the right console in each cockpit for storage of the instrument flight charts.

REAR–VISION MIRROR

An adjustable rear-vision mirror is attached to the upper right side of the windshield frame.

BLIND FLYNG HOOD

A blind flying hood can be installed on the appropriate fittings at the aft cockpit. The hood is slided backwards directly by the rear pilot.

SECTION V

OPERATING LIMITATIONS

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	PAGE
Instrument markings	5-1
Engine limitations	5-1
Airspeed limitations	5-4
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Prohibited maneuvers	5-4
Acceleration limitations	5-4
Weight limitations	5-12
Center of gravity limitations	5-12
Contact sinking speed	5-12

INSTRUMENT MARKINGS

Cognizance must be taken of the instrument markings as shown on figure 5-1, since they represent limitations that are not necessarily repeated elsewhere.

ENGINE LIMITATIONS

All normal engine limitations are shown in figure 5-1. The following data are the operating limitations for which the Viper 20 MK540 engine has been approved.

CONDITIONS	ENGINE SPEED (100 = 13760 rpm)	J.P.T. °C	TIME LIMIT (per flight)
Maximum rpm	● 100	* 730 (max.)	20 minutes
Intermediate	98,5	705	30 minutes
Maximum continuous	95,5	655	Unrestricted
Ground idling	40 (min.)	655	Unrestricted

NOTE

During prolonged ground running the above time limits apply per hour run.
● See para "Engine Setting Limit" item 1
● See para "Engine Setting Limit" item 3

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ENGINE SETTING LIMITS

1. The maximum speed governor should be set to 100% $(^{+0}_{-0.25\%})$ rpm with the J.P.T. limiter OFF.
2. Overswing during accelerations should not exceed 103% rpm for more than 20 seconds. At ambient temperatures below + 5°C, the maximum rpm obtained will be determined by the maximum fuel flow available from the flow control.
3. The datum of the J.P.T. limiter should be set to 725°C. A momentary J.P.T. of 800°C 5 second limit is permitted during starting and relighting.
4. On the ground, (with the pressurization switch at OFF) in response to slam opening of the throttle the engine must accelerate from 60% to 98% rpm without stall, within the time limit of 3.6 ÷ 4.1 seconds.
5. The blow-off valve (B.O.V.) must operate within the rpm band of 78 to 80% at I.S.A. conditions.

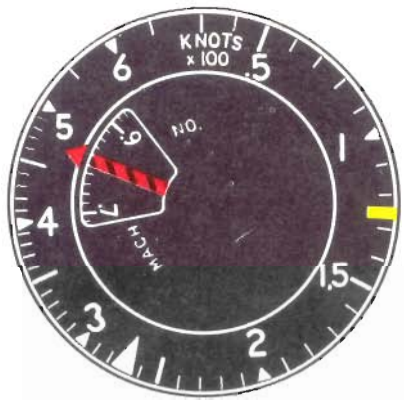
The overriding limit of rpm or of J.P.T. is the one first attained.
Any engine running outside these limits must be reported since overhaul life and flight safety are affected.

COMPRESSOR STALLS

It is recommended that slam openings of the throttle

INSTRUMENT MARKINGS

MACH AND AIRSPEED INDICATOR



- 125 KTS MAXIMUM PERMISSIBLE WITH FLAPS "DOWN"
- 145 KTS MAXIMUM PERMISSIBLE WITH FLAPS AT "TAKE-OFF"
- 150 KTS MAXIMUM PERMISSIBLE WITH LANDING GEAR "DOWN"
- 470 KTS MAXIMUM PERMISSIBLE FROM SEA LEVEL TO 6000 FT
- 0.8 MACH MAXIMUM PERMISSIBLE

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ACCELEROMETER

SYMMETRICAL MANOEUVER LIMITS
WITH FULL FUEL TIP TANKS



- +7.5 G MAXIMUM WITHOUT EXTERNAL STORES
- +6 G MAXIMUM WITH EXTERNAL STORES
- −2.5 G MAXIMUM WITHOUT EXTERNAL STORES
- −2 G MAXIMUM WITH EXTERNAL STORES

WARNING

Acceleration limits vary with airspeed, altitude and external stores configuration.
See figures 5-4 and 5-5.

Figure 5-1 (Sheet 1 of 2)

INSTRUMENT MARKINGS



J.P.T. INDICATOR

	200°C	MINIMUM TO AVOID FLAME-OUT IN FLIGHT
	200 655°C	CONTINUOUS OPERATION
	705°C	MAXIMUM PERMISSIBLE FOR 30 MIN
	730°C	MAXIMUM PERMISSIBLE IN FLIGHT FOR 20 MINUTES

TACHOMETER



	70 95,5	CONTINUOUS OPERATION
	98,5	MAXIMUM PERMISSIBLE FOR 30 MIN.
	100	MAXIMUM PERMISSIBLE IN FLIGHT FOR 20 MINUTES

OIL PRESSURE GAUGE



	20 PSI	MINIMUM IN FLIGHT
	27 38 PSI	NORMAL RANGE

HYDRAULIC PRESSURE GAUGES



Main system

	860 PSI	MINIMUM (accumulator charge pressure)
	2200 2600 PSI	NORMAL
	3200 PSI	MAXIMUM

Emergency system



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	860 PSI	MAXIMUM (accumulator charge pressure)
	2000 2800 PSI	NORMAL
	3200 PSI	MAXIMUM

Figure 5-1 (Sheet 2 of 2)

be avoided at airspeeds 10 kts lower than the aircraft stall speeds. This to prevent surge phenomena from taking place.

ENGINE OPERATION IN ICING CONDITIONS

The engine has no anti-icing. In common with many other axial flow turbine engines it is necessary to guard against icing of compressor blading when operating in icing conditions. The following limitations must be observed.

On the ground

Icing can occur on the ground at ambient temperature of + 3°C or below in foggy weather with visibility less than 1500 ft, or relative humidity of 95% or above. Ground running in icing conditions defined above must not be attempted.

In flight

Avoid flight in cloud at a true ambient temperature of + 1°C and below.

Note

Should inadvertent operating in such conditions cause simultaneous loss of rpm and rise in J.P.T. the circumstances must be reported.

AIRSPEED LIMITATIONS

LANDING GEAR OPERATION SPEED

The limit airspeed for raising or lowering the landing gear or for flight with landing gear down is 150 knots IAS. If the landing gear is lowered at speeds above this value, resulting air loads may damage the doors or operating mechanism.

WING FLAP OPERATION SPEEDS

The limit airspeed for operating the flaps or for flight with flaps lowered are:

- Take-off position 145 knots IAS
- Down position 125 knots IAS

LANDING LIGHT LOWERING SPEED

The limit airspeed for lowering the landing light is 150 knots IAS.

CANOPY OPENING SPEED

The canopy is not to be opened in flight. On the ground, at normal taxiing speed, the canopy may be partially opened (and locked in this position). If the canopy is operated at excessive speeds, damage to the canopy and canopy locking device may result. Care should be taken when opening in crosswind.

SAFE EJECTION SPEED

The minimum speed for a safe ejection at runway level with the aircraft in level flight (5° nose-down max.) is 100 knots IAS, the maximum speed 400 knots IAS. For ejection at higher altitudes, the speed is unlimited.

MAXIMUM ALLOWABLE AIRSPEED

The maximum allowable airspeed and Mach number limits, specified for the aircraft at the various altitudes in the clean configuration (no external load) and in the armed version (external load installed as indicated in figure 5-3), are shown in figure 5-2.

TIRE LIMIT SPEED

The tire limit speed is the maximum ground speed allowable for safe operation of tire.
The maximum tire limit speed is 120 knots.
Refer to part II of the Appendix for the limit gross weight, various runway temperatures, pressure altitudes and wind velocities.

EXTERNAL STORES

The approved external stores (weapons and fuel tanks) and the stations on which these stores may be loaded are shown in figure 5-3. This figure also gives the speed and acceleration limits not to be exceeded by the aircraft when fitted with the various external stores.

PROHIBITED MANEUVERS

There are no prohibited maneuvers inside the flight envelope as indicated in figure 5-4 for the clean configuration, and within the limitations shown in figure 5-3 for the armed version.

INVERTED FLIGHT

Inverted flight, or any maneuver resulting in negative acceleration, with the engine at maximum rpm, is permitted for not more than 12 seconds.

ACCELERATION LIMITATIONS

MAXIMUM ACCELERATION IN CLEAN CONFIGURATION

For the maximum allowable acceleration (g units) during

MAXIMUM ALLOWABLE AIRSPEEDS

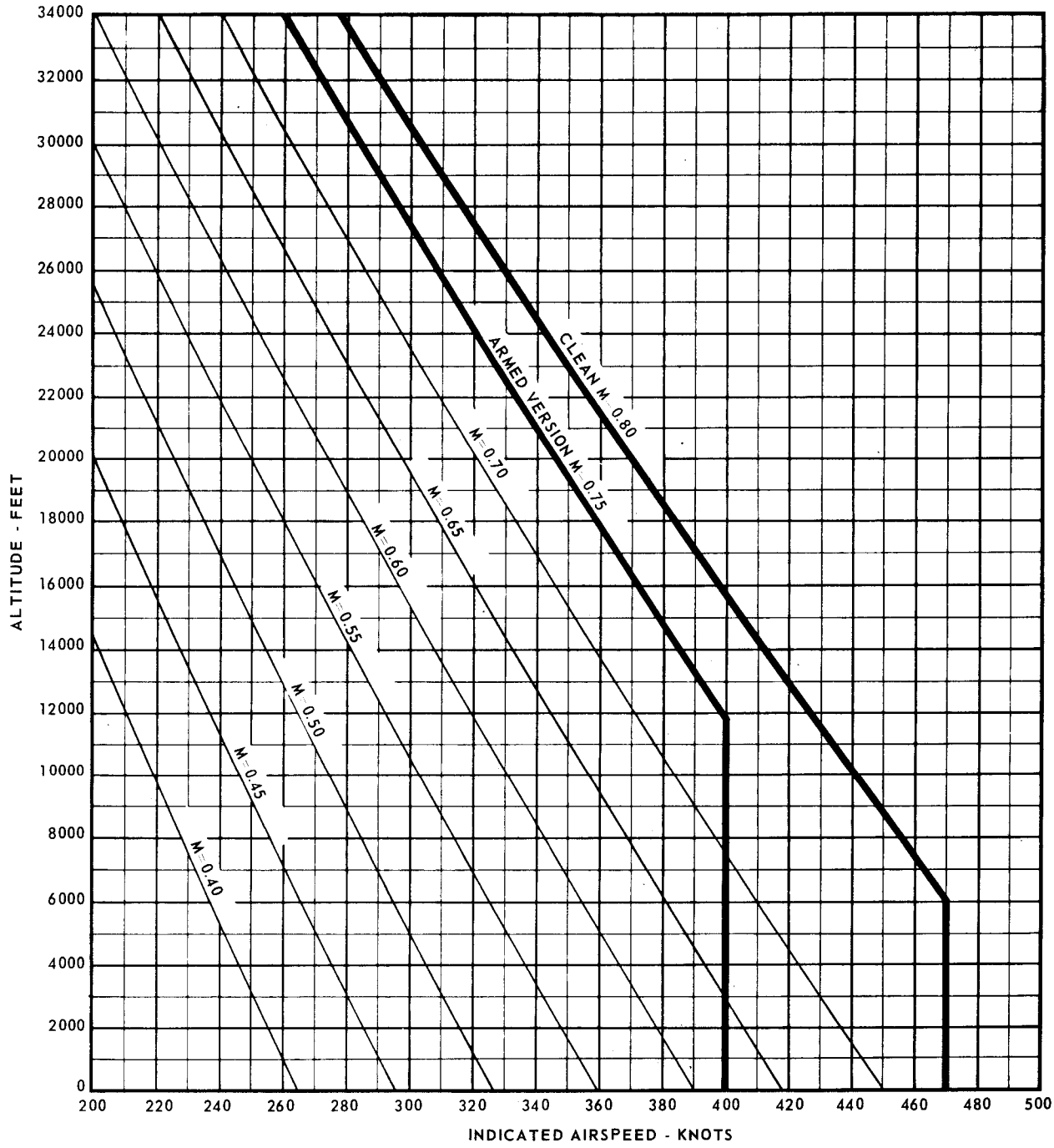
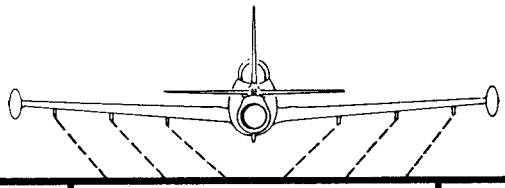


Figure 5-2

EXTERNAL STORES



STORE	SUSPENSION	CONDITION	STATION LOADING						CARRIAGE				JETTISON	
									AIRSPEED		ACCELERATION G.		AIRSPEED	
			1	2	3	4	5	6	KTS	M	SYM.	UNSYM.	KTS	M
Underwing tanks (Bristol Plastic 75-19-1003)	Pylon	Full Empty		●			●		400	0.75	4 7 5	2.5 5	300 250	0.65
Underwing tanks (Aerea 53 ORG II Serie)	Pylon	Full Empty		●			●		400	0.75	4 7 5	2.5 5	300 250	0.65
Photo-reconnaissance pod (M850.21.00)	Wing				●				450	0.75	7.5	5	NA	NA
Machine gun pod (M910-21/22 - 10A)	Wing				●	●			450	0.75	7.5	5	NA	NA
"Mini gun" pod (SUU-11A/A)	Pylon		●	●	●	●	●	●	420	0.75	6	4	300	0.65
100 LB bomb (AN-M30A1)	Pylon		●	●	●	●	●	●	420	0.75	6	4	420	0.75
250 LB bomb (AN-M57A1)	Pylon		●	●	●	●	●	●	420	0.75	6	4	420	0.75
500 LB bomb (AN-M64A1)	Pylon		Ⓐ	●	●	●	●	Ⓐ	420	0.75	6	3	420	0.75
Practice bomb containers (Aero-2B)	Pylon		●	●	●	●	●	●	420	0.75	6	4	420	0.75
5" HVAR Rockets	Pylon adapt.		⋈	⋈	⋈	⋈	⋈	⋈	420	0.75	4	2.5	300	0.65
2.25" SCAR Rockets	Pylon adapt.		⋈	⋈	⋈	⋈	⋈	⋈	420	0.75	6	4	300	0.65
MA-2A Rocket launcher	Pylon adapt.		⋈	⋈	⋈	⋈	⋈	⋈	420	0.75	6	4	300 200	0.65

18-039

Figure 5-3 (Sheet 1 of 4)

- Speeds or G quoted in the "employment" column are applicable to the firing limitations of the guns, the launching limitations of the rockets and missiles, etc.
- Speeds or G quoted in the "Release" column are applicable only to releasing the bombs or containers from its suspension equipment.
- Speeds quoted in the "Jettison" column are applicable to jettisoning the stores from its pylons.

NOTE

For mixed load configurations, base on the load that is subject to the most severe limitations.

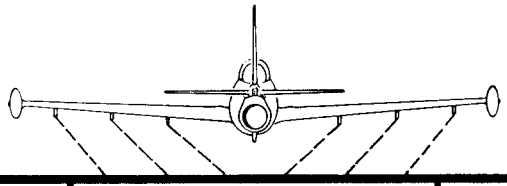
NA NOT APPLICABLE

EMPLOYMENT			RELEASE			MAX. DELIVERY ANGLE	REMARKS
AIRSPEED		ACCELER.	AIRSPEED		ACCELER.		
KTS	M	G	KTS	M	G		
NA	NA	NA	NA	NA	NA	40	With full underwing tanks avoid carrying out abrupt manoeuvers with the aileron control.
NA	NA	NA	NA	NA	NA	40	With full underwing tanks avoid carrying out abrupt manoeuvers with the aileron control.
NA	NA	NA	NA	NA	NA	NA	
450	0.75	4	NA	NA	NA	NA	
420	0.75	4	NA	NA	NA	NA	
NA	NA	NA	420	0.75	1 4	60	
NA	NA	NA	420	0.75	1 4	60	
NA	NA	NA	420	0.75	1 4	60	(A) 500-pound bombs carried under wing stations 1 and 6 involve speed limitation of 360 kts and Mach 0.65. Avoid carrying out abrupt manoeuvers with the aileron control.
NA	NA	NA	420	0.75	1 4	60	
400	0.75	0.5 4	NA	NA	NA	40	• Avoid carrying out abrupt manoeuvers with the aileron control. • When installed in "single", symmetrical accelerations up to 6G are allowed.
400	0.75	0.5 4	NA	NA	NA	40	
400	0.75	0.5 4	NA	NA	NA	40	

18-040

Figure 5-3 (Sheet 2 of 4)

EXTERNAL STORES



STORE	SUSPENSION	CONDITION	STATION LOADING						CARRIAGE				JETTISON	
									AIRSPEED		ACCELERATION G.		AIRSPEED	
			1	2	3	4	5	6	KTS	M	SYM.	UNSYM.	KTS	M
Matra 122 Rocket pod	Pylon	Full Empty	●	●	●	●	●	●	420	0.75	6	4	300 200	0.65
Matra 155 Rocket pod	Pylon	Full Empty	⊙	●	●	●	●	⊙	420	0.75	6	4	300 200	0.65
Matra 181 Rocket pod	Pylon	Full Empty	⊙	●	●	●	●	⊙	420	0.75	6	4	300 200	0.65
Matra 361 Rocket pod	Pylon	Full Empty	⊙	●	●	●	●	⊙	420	0.75	6	4	300 200	0.65
LAU-3 A Rocket pod	Pylon	Full Empty	⊙	●	●	●	●	⊙	420	0.75	6	4	300 200	0.65
LAU-3B/A or LAU-32G Rocket pod	Pylon	Full Empty	●	●	●	●	●	●	420	0.75	6	4	300 200	0.65

18-041

Figure 5-3 (Sheet 3 of 4)

- Speeds or G quoted in the "employment" column are applicable to the firing limitations of the guns, the launching limitations of the rockets and missiles, etc.
- Speeds or G quoted in the "Release" column are applicable only to releasing the bombs or containers from its suspension equipment.
- Speeds quoted in the "Jettison" column are applicable to jettisoning the stores from its pylons.

NOTE

For mixed load configurations, base on the load that is subject to the most severe limitations.

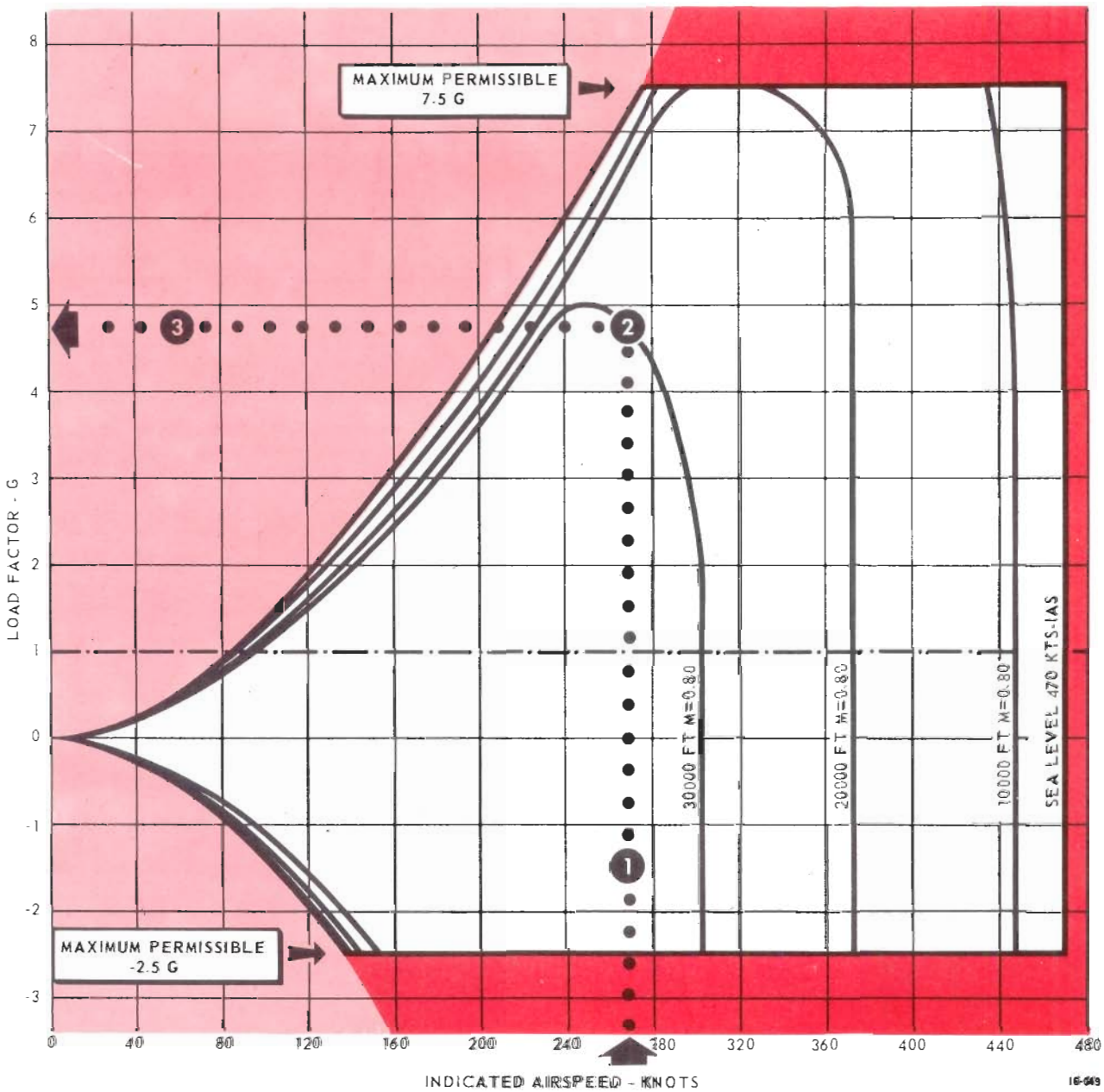
NA - NOT APPLICABLE

EMPLOYMENT			RELEASE			MAX. DELIVERY ANGLE	REMARKS
AIRSPEED		ACCELER.	AIRSPEED		ACCELER.		
KTS	M	G	KTS	M	G		
400	0.75	0.5 4	NA	NA	NA	40	
400	0.75	0.5 4	NA	NA	NA	40	
400	0.75	0.5 4	NA	NA	NA	40	Ⓑ Rocket containers carried under wing stations 1 and 6 involve speed limitation of 400 kts and Mach. 0.70. Avoid carrying out abrupt manoeuvers with the aileron control.
400	0.75	0.5 4	NA	NA	NA	40	
400	0.75	0.5 4	NA	NA	NA	40	
400	0.75	0.5 4	NA	NA	NA	40	

18-042

Figure 5-3 (Sheet 4 of 4)

MANEUVER ENVELOPE



DANGER AREA

SAFETY AREA

STALL AREA

AIRCRAFT CONFIGURATION

• no underwing stores

HOW TO USE CHART:

1. Enter chart at the desired airspeed.
2. Sight vertically to intersect the altitude line.
3. Sight horizontally to scale at left to read the load factor above which stall occurs.

Figure 5-4

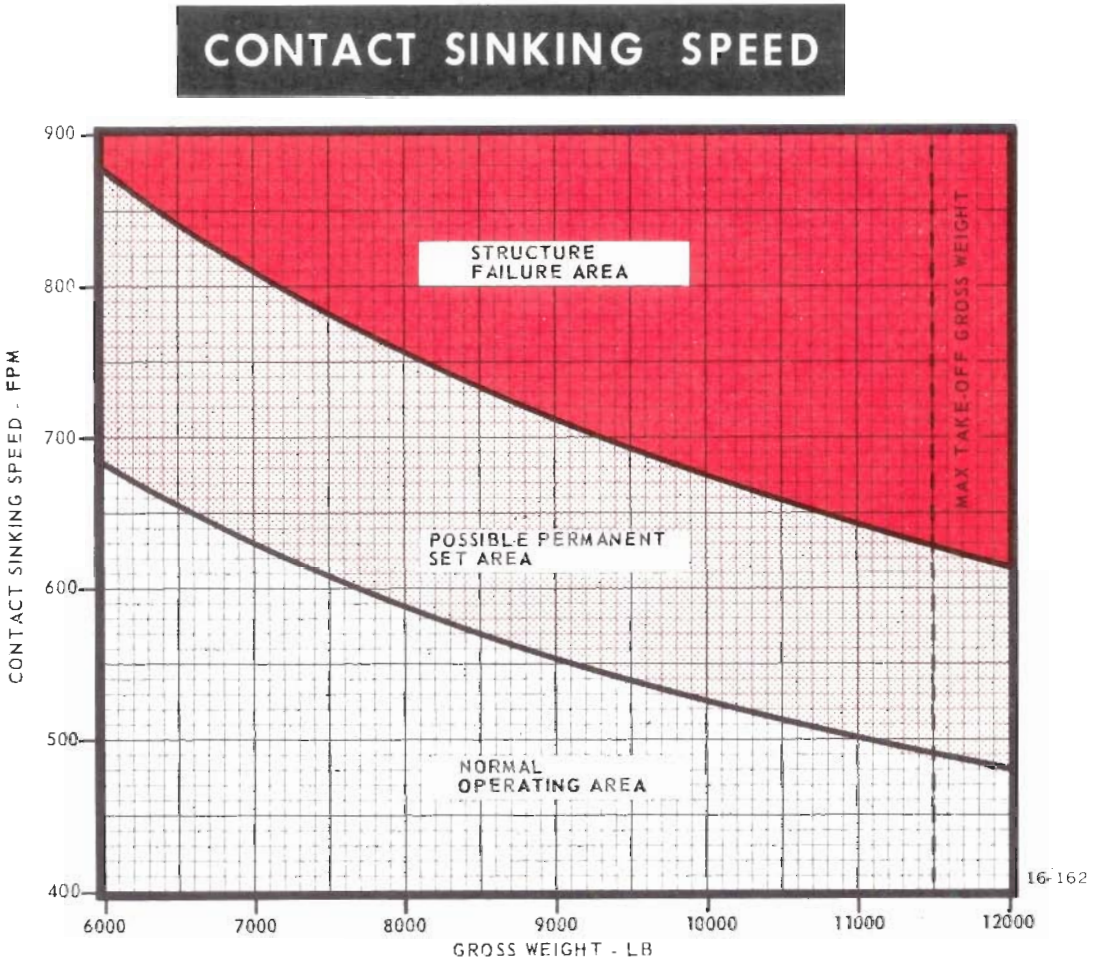


Figure 5-5

symmetrical (no-roll) pull-outs, see figure 5-1. The operating flight limit diagram in figure 5-4 graphically illustrates the symmetrical g-limits with no external load. The maximum entering acceleration for rolling pull-outs with no external load, is 5 g.

MAXIMUM ACCELERATION IN ARMED CONFIGURATION

The maximum allowable accelerations during symmetrical (no-roll) pull-outs with external loads are indicated in figure 5-3.
The maximum entering accelerations for rolling pull-outs with external load are indicated in figure 5-3.

Note

The above limitations are not applicable when the external stores are pods (photo-reconnaissance or machine gun pods), unloaded pylons or empty or half-empty underwing tanks.

WEIGHT LIMITATIONS

The normal take-off weight of the aircraft in the clean configuration is 8800 lb. External loads shall be installed in the aircraft only in accordance with the load configurations indicated in figure 5-3. In the armed version, the weight limitations are as follows:

- Maximum permissible at take-off . . . 11500 lb
- Maximum permissible at landing . . . . 9250 lb

CAUTION

In some of the approved configurations it will be necessary to limit the amount of fuel in the tip tanks so as to avoid exceeding the maximum take-off weight of 11500 lb.

CENTER OF GRAVITY LIMITATIONS

With any combination of standard external load items (figure 5-3), the center of gravity remains within limits. Any check that may be required shall be performed in accordance with the procedure indicated in publication P.I. 1T-MB326-GB-5 "Basic Weight Check List and Loading Data".

CONTACT SINKING SPEED

See figure 5-5.

SECTION VI

FLIGHT CHARACTERISTICS

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GENERAL

Note

The information in this section applies only to the aircraft with no external load, unless otherwise indicated

The stability and control characteristics of the aircraft are excellent throughout its entire speed range.

STALLING

During the stall and recovery there is no tendency to wing drop or yawing and aileron control remain effective during the whole maneuver. Stall warning in any flight configuration is good and is indicated by a general airframe buffeting. Stall characteristics and rudder and aileron effectiveness are very satisfactory, and lateral control can be maintained even beyond normal stall attitudes. Any wing drop tendency is easily controlled by use of aileron and/or rudder.

STALL IN LEVEL FLIGHT

Clean stall (landing gear and flaps retracted) in level flight is indicated by a moderate airframe vibration occurring about 8 knots above the stall speed. With landing gear and flaps extended the warning is less pronounced and starts at about 6 knots above the stall speed. Stalling speeds against aircraft weight and configuration are shown on the stall speed chart (fig. 6-1).

CAUTION

To avoid a possible flame-out during stall maneuvers, it is recommended that the following limits be observed:

- Min RPM: 60% rpm
- Min J.P.T.: 300°C

HIGH SPEED STALL UNDER LOAD FACTOR

High speed stalls are indicated by moderate to heavy buffeting, the intensity increasing with load factor. Recovery is effected by reducing the back pressure applied to the control stick. Refer to fig. 5-3 and 5-4 for structural limitations.

SPINNING

The vertical spin characteristics of the aircraft are quite good and the aircraft is reluctant to enter unintentional spins.

To enter the spin the control stick must be brought fully back and pro-spin rudder applied. The aircraft spins in a steep nose-down attitude as to the horizon. The angle between the aircraft longitudinal axis and the spin vertical path is approximately 20 degrees.

During the first three turns spin is clearly oscillatory with high amplitude oscillations around the three axes. From the fourth turn, the maneuver becomes stabilized and spin can be considered steady.

At 20,000 feet the aircraft loses about 700 feet per turn in 3.5 seconds while at 10,000 feet 600 feet per turn are lost.

SPIN RECOVERY

For normal spin recovery, apply full opposite rudder and maintain aileron neutral. One to two seconds after antispin rudder is applied, move the control stick forward to the center position.

The time taken from initiating the recovery to cessation of the spin is 2 to 3 seconds. Approximately 2000 feet are lost in the dive recovery.

STALL SPEEDS

	ANGLE OF BANK DEG.	LOAD FACTOR "G"	AIRCRAFT WEIGHT - LB											
			6000	6500	7000	7500	8000	8500	9000	9500	10000	10500	11000	11500
FLAPS 0° UP	0	1	82	85	88	91	94	97	100	103	106	109	112	115
	30	1.2	89	93	96	100	103	106	109	112	116	119	122	125
	45	1.4	96	100	104	108	111	115	119	122	126	130	134	138
	60	2	115	121	126	132	137	142	147	152	158	163	168	173
FLAPS 28° TAKE-OFF	0	1	75	78	81	84	87	90	92	95	98	101	104	107
	30	1.2	82	85	89	92	95	98	101	104	108	111	114	117
	45	1.4	89	92	96	99	103	106	109	112	116	119	122	125
	60	2	106	110	115	120	124	129	133	137	142	146	150	154
FLAPS 64° DOWN	0	1	73	76	79	82	84	87	89	92	95	97	100	103
	30	1.2	82	85	89	92	95	98	101	104	107	107	110	113
	45	1.4	86	90	93	97	100	103	106	109	113	116	119	122
	60	2	103	107	111	115	120	124	128	133	137	141	145	149

16-T002

NOTE

- THE VALUES ARE INDICATED IN I.A.S. KNOTS
- LANDING GEAR AND SPEED BRAKE POSITION AS WELL AS ENGINE RPM HAVE A NEGLIGIBLE EFFECT ON THE STALLING SPEED.

Figura 6-1

SIDESLIPS

The aircraft can be sideslipped throughout the allowed "Flight Envelope". As far as speed is concerned, the limit is given by the full limit of rudder travel (low speeds) or by the force on rudder (high speeds). Lateral and longitudinal stability and control are good in all configurations.

EFFECTS OF FLIGHT CONTROLS

SPEED BRAKE

The speed brake is very effective and can be used at any speed within the speed range of the aircraft. When the speed brake is selected out at high IAS and Mach numbers, it will produce a nose-up moment. The corresponding change in trim can be easily controlled by the pilot.

LEVEL FLIGHT CHARACTERISTICS

CRUISE

When setting up the cruise conditions given in the "Mission Profile Charts", approach the speed condition from the high side. At high altitudes the speed must be kept up to the values given in the Charts in order to attain the ranges listed. Best cruising performance is realized when the air is smooth. Rough air and turbulence will require more thrust to hold the desired airspeed. This results in increased fuel consumption and less range.

BAD VISIBILITY FLYING

For flights in conditions of bad visibility the flaps should be lowered to take-off position and power used to maintain speed around 140 to 150 knots IAS. Control and maneuvrability in this configuration are good and rapid engine response is available.

APPROACH AND LANDING

The base turn should be commenced as the leading edge is in line with the threshold. The airspeed should be 130 knots IAS, landing gear and take-off flap extended and approximately 65% rpm set. During the turn onto final reduce the airspeed so that the aircraft is aligned with the runway at a speed of 115 knots IAS and not less than 400 feet above ground level. Select full flap as required and aim to cross the runway threshold at 100 knots IAS. When landing at high all-up weights or in gusty conditions increase the threshold speed by 10 knots. A minimum rpm of 60% should be maintained until a landing is assured. As the threshold is crossed commence a gentle flare and reduce rpm to idle. The aircraft should not be held off but flown gently onto the runway. For landings in cross wind conditions either the wing down or crab technique may be used.

GO-ROUND

The importance of holding at least 60% rpm becomes apparent if the landing approach is incorrect (short, long) and it is necessary to go round. Under these circumstances, the throttle should immediately be advanced to full open and the landing gear raised as soon as possible. Flaps should be retracted at 110 knots IAS minimum. The prompt retraction of landing gear and flaps is necessary to eliminate their drag and enable the aircraft to accelerate more rapidly. If the engine speed is at approximately 60% rpm, it will require only about 5 seconds for acceleration to 100% rpm. However, if the engine is operating at idling speed, it will require approximately 10 seconds to accelerate and the thrust available will be small during the first five seconds of engine acceleration.

CLIMB

Optimum climb performance will be attained by following the climb speeds shown on the "Climb Charts" in the Appendix. Small variations from these recommended speeds will not seriously affect the climb performance at low altitudes.
At high altitudes it will be necessary to adhere more closely to the climb speeds shown on the charts in order to avoid a large reduction in rate of climb.
Also, if turns are required. it is best to make these at an altitude below 25,000 feet or at moderate angle of bank and, under all circumstances, at moderate angle of roll.

MANEUVERING FLIGHT

PERMISSIBLE AEROBATICS

All aerobatics are permissible. However, if inverted flight is maintained for more than 12 seconds (with the engine at maximum rpm), a flame-out will occur since fuel will not be fed to the engine. The control stick forces during aerobatics are moderate. The optimum indicated airspeeds to accomplish some aerobatic figures at medium altitudes are:

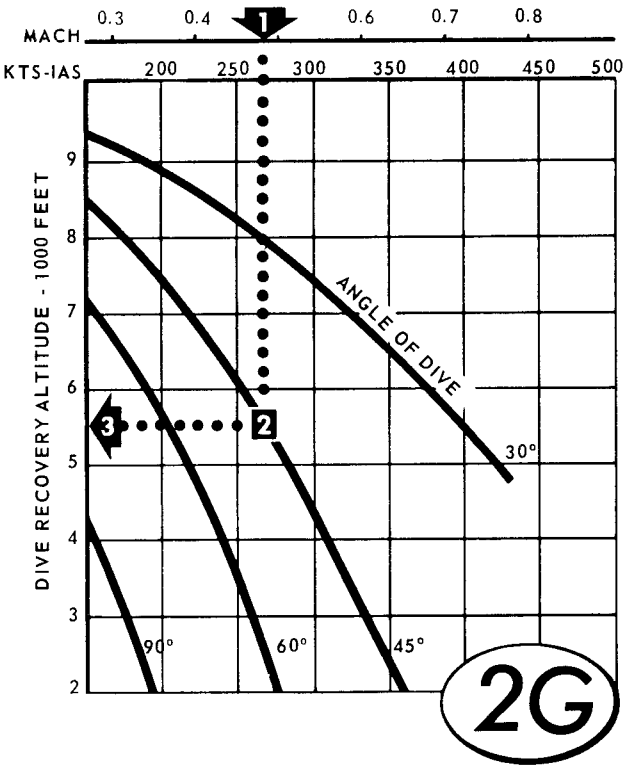
- 270 knots for looping
- 230 knots for roll
- 310 knots for roll off the top

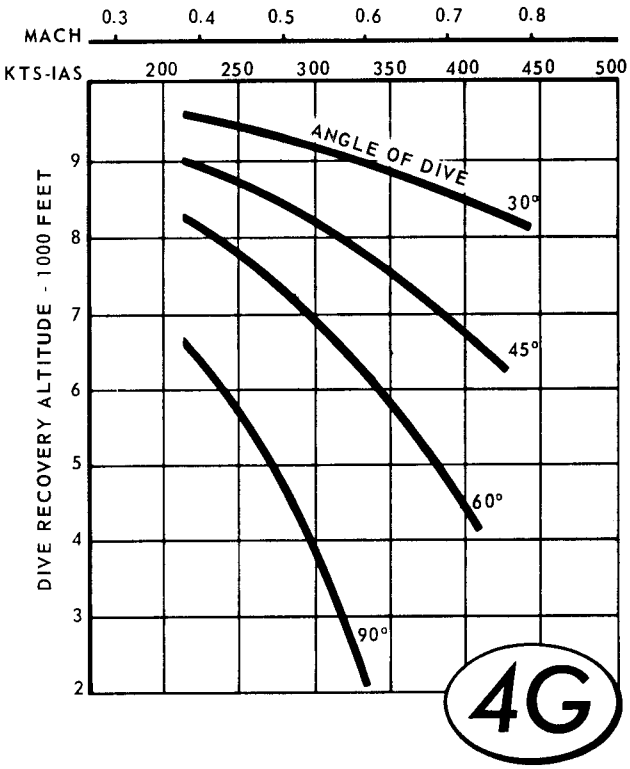
DIVES

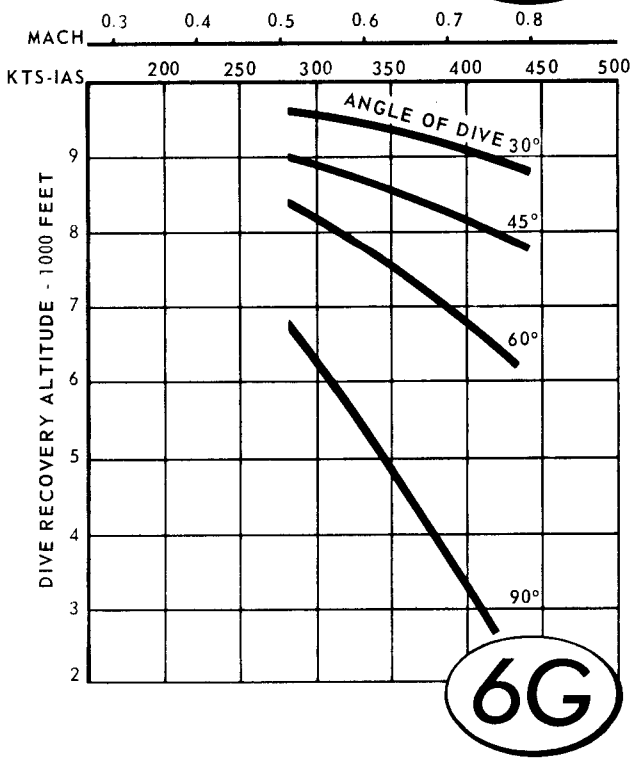
EFFECTS OF COMPRESSIBILITY

The aircraft speed limits are .80 Mach number or 470 knots IAS up to 6000 feet altitude.

DIVE RECOVERY ALTITUDE - FROM 10, 000 FT







HOW TO USE CHARTS

SELECT APPROPRIATE CHART, DEPENDING UPON ACCELERATION (2G, 4G OR 6G) TO BE HELD IN PULL OUT; THEN:

1 SELECT POINT NEAREST THE IAS AT WHICH PULL-OUT IS STARTED.

2 SIGHT VERTICALLY DOWN TO POINT ON CURVE OF DIVE ANGLE DIRECTLY BELOW AIRSPEED.

3 SIGHT BACK HORIZONTALLY TO SCALE AT LEFT TO READ THE DIVE RECOVERY ALTITUDE.

10-681

Figure 6-2

During dives and maneuvers up to Mach .76 with zero trim tab, the aircraft stability and control remain satisfactory. Beyond Mach .76 a slight nose-down change in trim occurs.
At Mach .78 compressibility effects are noticed; the aircraft is however fully controllable up to limit Mach number .80.
Altitude losses during dive recoveries are shown on the charts at fig. 6-2; these charts are based on recovery maneuvers from 10,000 feet with 2, 4 and 6 g load factor.

DIVE RECOVERY

For minimum loss of altitude during dive recovery it is recommended that the throttle be retarded to IDLE and the speed brake extended. All stick forces should be applied in such a manner that the g forces imposed do not exceed the limitations of the "Flight Envelope" (figure 5-4). Elevator stick forces are reasonable and well within pilot capabilities. Elevator trim should not be used during high speed dive recovery.

EFFECTS OF GUSTS

The gust load imposed on the aircraft increases directly with the speed; if the speed is doubled, the gust load will double. At high speeds in extremely turbulent air, gust loads may be as high as 4 g. If the gusts occur during high-speed maneuvering flight, they can cause the limit load factor of the aircraft to be exceeded. Therefore, if it is necessary to fly in turbulent air, reduce your speed to 200 knots, and refrain from intentionally pulling more than 2 g.

ASYMMETRIC LOAD

This paragraph furnishes the information as necessary to check the aircraft with the wing pylons loaded with asymmetric loads. Within well defined asymmetric limits and under particular operating conditions, planning missions with an asymmetric distribution of the underwing loads is allowed.
The instructions, as given hereafter, refer to the most general instance of asymmetric load arising from an emergency.

FLIGHT WITH ASYMMETRIC LOAD

An asymmetric load produces a deterioration of available lateral and directional aircraft controls.
The first one is the unbalance moment effect, due to the weight of the asymmetric load, which acts about the aircraft roll axis. This unbalance rolling moment must be counteracted by the application of ailerons to produce an opposite moment and to prevent continuous rolling in the direction of the heavy wing. As normal load factor increases, more aileron is necessary to counteract the increasing rolling moment due to increased weight of the load.
In the case of asymmetry of underwing stores there is an unbalance drag effect about the aircraft yaw axis which must be counteracted by the application of rudder trim. The directional trim is easily obtained for all asymmetrical configurations.

TRIM EFFECTS AND MINIMUM CONTROL SPEED WITH ASYMMETRIC LOAD

Flight with asymmetric load imposes a requirement for aileron and rudder trim tab or for pilot held control forces if coordinated flight is to be maintained for a given asymmetric load. As airspeed changes, the amount of lateral and directional trim required changes continuously.
As airspeed decreases, for a given asymmetric load, a continuous increasing amount of aileron trim tab is required and when full aileron trim tab is used, the minimum aileron trim tab control speed is reached (see figure 6-3).
A further reduction of airspeed will require the pilot to hold lateral stick force with further aileron deflection to maintain wings level
When an airspeed is reached at which full aileron deflection has been applied, the minimum aileron control speed is reached (see figure 6-3).
A further decrease in airspeed below the minimum aileron control speed will result in an uncontrollable roll in the direction of the heavy wing and the pilot must add power and/or reduce aircraft pitch attitude to increase airspeed above minimum aileron control speed.

WARNING

Minimum control speeds given in fig. 6-3 were determined for one G flight and do not include any allowance for gusts, crosswind, wake turbolence, or G loads imposed by longitudinal maneuvering.

FLIGHT CHARACTERISTICS WITH ASYMMETRIC LOAD

Take-off

Take-off with an unbalanced moment of more than

35000 inch-pounds is not recommended. For all asymmetric take-offs, nosewheel lift-off and take-off speeds should not be lower than minimum aileron trim tab control speed (see figure 6-3).

CAUTION

Take-offs with asymmetric load may impose a requirement for large directional control inputs during the high acceleration phase of the take-off roll. Differential braking and rudder may be required to maintain directional control.
The pilot should promptly act on thesstick in the lift-off phase, so as to compensate the unbalanced moment and subsequently use the aileron trim tab as necessary.

Flight

Flight control can be maintained with one unbalanced store on any station within the loading spectrum certified for the MB-326GB aircraft.
At airspeed above 180 KIAS small aileron and rudder trim tab deflections are required to maintain level flight. At airspeed below 180 KIAS until minimum aileron trim tab control speed (see figure 6-3) sufficient aileron and rudder trim tabs are available to permit trimming off all control forces for level flight.

CAUTION

The requirements to provide large aileron control inputs should be anticipated on all store deliveries with weight of 500 pounds or more in the event that an asymmetric load should intentionally or inadvertently result. If possible, make all turns away from the heavy wing, especially at low airspeed.

Landing

Intentional landings should not be made with asymmetric load unless the differential moment is less than 35000 inch-pounds. In the event of an asymmetric load due to tip tank fuel, the fuel must be dumped (see Section III, "Faulty Transfer of Fuel From Tip Tanks"). In the event an asymmetric load results from inability to expend a particular store, proceed as follows:

1. Make every effort to reduce the asymmetric load prior to landing. This may be accomplished by attempting to selectively drop other stores on the heavy wing.
2. At a safe altitude, determine the minimum aileron control speed with landing-gear down and take-off flaps.
   There are three events:

WARNING

If at anytime during the flight near minimum control speed, insufficient aileron control is available to prevent a roll in the direction of the heavy wing, or if stall is approached, recovery can only be accomplished by reducing pitch attitude and adding power to increase airspeed above minimum aileron control speed.

   a. The minimum aileron control speed is above 120 knots IAS: use emergency jettison system to balance the asymmetric load. If the amount of asymmetry cannot be reduced, maintain airspeed above and abandon the aircraft in a safe area.
   b. The minimum aileron control speed is between 110 and 120 knots IAS: use emergency jettison system to balance the asymmetric load. If the amount of asymmetry cannot be reduced, landing should only be made with take-off flaps at a touch-down speed of 120 knots IAS. The approach speed must be in any case approximately 10 knots above the minimum aileron control speed.
   c. The minimum aileron control speed is 110 knots IAS or less:
      if judged necessary, use the emergency jettison system to balance the asymmetric load.
      Landing should be made with take-off flaps with an approach speed approximately 10 knots IAS and a touch-down speed approximately 5 knots IAS above the minimum control speed.

WARNING

Do not permit the aircraft to contact the runway nose wheel first, or an uncontrollable porpoise will result.

For events b. and c. it is recommended that the pilot, at a safe altitude, perform a simulated landing approach at the planned airspeed to become familiar with the aircraft flight characteristics under this loading configuration.

A very flat, power on, straight-in approach, with very little flare, should be made to accomplish a smooth touch-down. The approach and landing should be carefully planned and executed, considering the runway length and the increased approach speed. Consideration should be given to pilot proficiency, runway length, width and surface conditions, weather conditions, visibility, crosswind, gust, etc.

SAMPLE PROBLEM

Example based on figure 6-3.

Given: 2 X 250 lb bombs MK-81 on pylons 1 and 2 of left wing.
1 X 500 lb bomb MK-82 on pylon 2 of right wing.

Find:
1. Asymmetric load.
2. Minimum aileron control speed.
3. Minimum aileron trim tab control speed.
4. Take-off speed for a T.O.W. of 9000 pounds (only internal fuel).

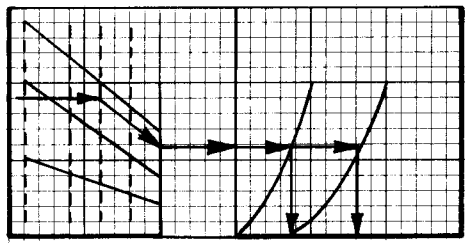
Procedure:

1. Left wing moment: entry point for 260 pounds (260 pounds is the actual weight of MK-81 bomb); read and add moments for pylons 1 and 2: 27.000 + 36.000 = 63.000 inch-pounds.
   Right wing moment: entry point for 530 pounds (530 pounds is the actual weight of MK-82 bomb) and read moment for pylon 2: 73.000 inch-pounds.
   Asymmetric moment is: 73.000 – 63.000 = 10.000 inch-pounds applied on right wing.
2. Minimum aileron control speed is 86 knots IAS.
3. Minimum aileron trim tab control speed is 102 knots IAS.
4. For a take-off weight of 9000 pounds, take-off speed is 102 knots IAS instead of 92 knots IAS for symmetrical load (see figure A2-2).

MINIMUM AILERON CONTROL AND AILERON TRIM CONTROL SPEEDS FOR ASYMMETRICAL LOAD

NOTES: TAKE-OFFS AND LANDING SHOULD NOT BE MADE INTENTIONALLY WITH DIFFERENTIAL MOMENT ABOVE THAN 35000 INCH-POUNDS.

FOR MULTIPLE STORE, ADD MOMENTS FOR ALL STORES BEFORE DETERMINING MINIMUM AILERON AND AILERON TRIM CONTROL SPEEDS.
(SEE SAMPLE PROBLEM)



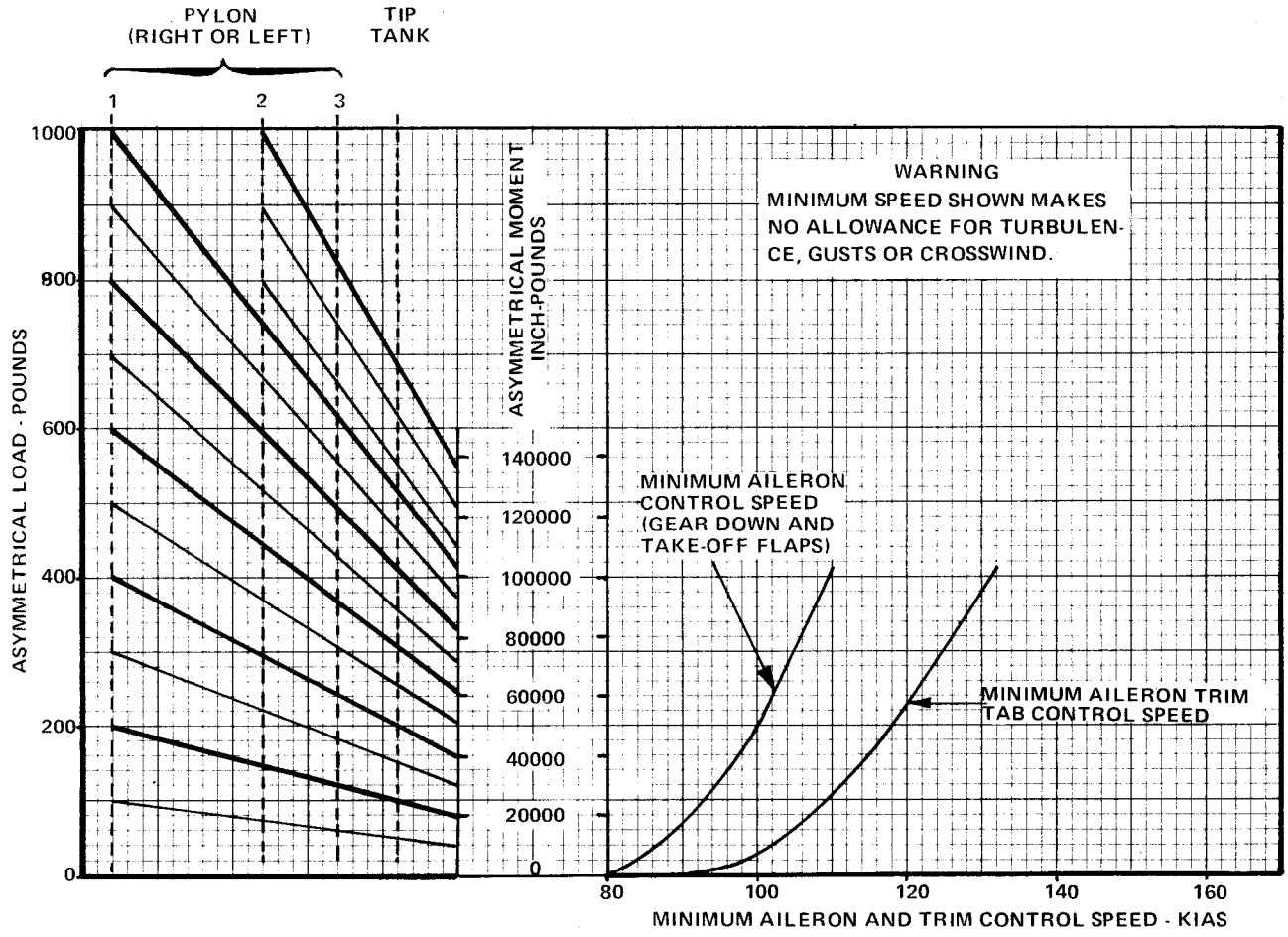


Figure 6-3

SECTION VII

SYSTEMS OPERATION

ALL INFORMATION FORMERLY CONTAINED IN THIS SECTION IS NOW CONTAINED IN SECTION I

SECTION VIII
CREW DUTIES

NOT APPLICABLE TO THIS AIRCRAFT

SECTION IX

ALL WEATHER OPERATION

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INTRODUCTION

This section covers those procedures which only differ from or supplement the procedures for normal operation included in Section II.

INSTRUMENT FLIGHT PROCEDURES

The endurance and range factors are especially critical during IFR flights. Special care should therefore be given to the preparation of the flight plan under IFR conditions, especially as far as fuel required and alternate airfields are concerned.

BEFORE ENTERING THE COCKPIT

Follow the normal procedures as described in Section II.

AFTER ENTERING THE COCKPIT

1. Check in the aircraft map case that the radio frequency list and all publications required for flight are available.
2. Synchronize the clock with the time given by the control tower.
3. Set altimeter to the QNH. If a difference of ± 75 feet with the barometric pressure given by the control tower is noted, do not fly the aircraft.
4. Observe the RMI and CI heading indications and check the standby compass for consistent readings.
5. Check to ascertain that the "OFF" flag is not in view on the attitude indicator dial.
6. "PITOT HTG" switch — ON to test, then OFF.
7. Check the ADF operation, frequency alignment and antenna reception by tuning on the NDB of the departure field.
8. Check the operation of the radio sets by contacting the control tower.
9. Turn on the "INTERIOR LIGHTS" and "EXTERIOR LIGHTS" rheostats.

TAXIING

1. Turn on the windshield demisting system, if required.
2. Check the turn indicator incorporated in the attitude indicator for correct operation during turns while taxiing.
3. Check the RMI for direction deviations while taxiing.
4. Check the ADF for correct bearing on the selected station during turns while taxiing.

BEFORE INSTRUMENT TAKE–OFF

1. Align the aircraft with the runway axis. If required, press the "GYRO COMPASS FAST SLAVE" push-button.
2. "PITOT HTG" switch — ON.
3. Wing flap control lever at TAKE–OFF.
4. Set the heading and course markers aligned with Course Indicator centerline.
5. Observe the Attitude Indicator: the horizon bar will show a two degrees nose down attitude approximate.
6. Keep the aircraft braked and advance the throttle progressively until 100% rpm is attained.
7. Check all instruments again and ascertain that all caution and warning lights are extinguished.

INSTRUMENT TAKE–OFF

1. Release the brakes.
2. Maintain direction by braking until 50 kts are attained. Whenever visibility permits, runway features and light should be used as an aid to maintain proper heading.
3. At 70 kts, apply gently aft stick pressure to raise the nose visualizing on the attitude gyro by the aircraft symbol upper edge tangent to the 5° mark. Maintain heading by use of the Course Indicator.

4. As the airspeed reaches 100 kts with a nose-high 5° pitch attitude, the aircraft will spontaneously fly off the ground. Maintain a wing level attitude by use of the Course Indicator.
5. When the vertical speed indicator indicates climb and the altimeter an altitude gain, retract the landing gear. At 110 kts retract the flaps.
6. Maintain a 5° nose-up attitude until a positive climb of 1000 to 1500 ft/min is reached on the vertical speed indicator.
7. Maintain a rate of climb of 1000 to 1500 ft/min and allow the aircraft to accelerate up to 230 kts. During the acceleration phase, standard turns may be performed provided airspeed is higher than 150 kts.

INSTRUMENT CLIMB

Instrument climbs are normally made at 100% rpm and at airspeed as given in Appendix I.

INSTRUMENT CRUISING FLIGHT

After reaching the desired cruising altitude, maintain high power to attain the optimum cruising speed, then reduce to level off from climb and until the optimum cruising speed is established (refer to Appendix I).

INSTRUMENT DESCENT

Instrument descents can be accomplished with the speed brake extended or retracted; use of the speed brake is however advisable to limit airspeed and covered distance, though maintaining a high descent airspeed.
High speed descents, accomplished with the speed brake open and the engine idling are very fast and recovery from this attitude involves a loss of altitude; such descents are therefore not advisable below 10,000 feet under bad weather conditions. (See fig. 9-1 for typical approach conditions).

A few minutes before starting descent

1. Check fuel level (refer to fig. 1-11).
2. Oxygen – As required.
3. Cabin air conditioning selector switch in HOT position. Observe the related instrument, then release the selector switch.
4. "WSHLD DEMIST" control – Open (Handle horizontal).
5. "WSHLD ANTI–ICE" control – Open (Handle horizontal).
6. "PITOT HTG" switch – ON.
7. Check the RMI against the reading of the magnetic compass.

STARTING INSTRUMENT DESCENT

1. Reduce RPM to 76%.
2. Slowly lower the aircraft nose checking that the horizon bar on the attitude indicator moves to the 10° marks.
3. With IAS = 220 kts, speed brake OUT. Maintain 220 kts throughout the descent.
4. Adjust the altimeter to the QNH. Perform a radio call.

At 7000 feet

1. Check the navigation altimeter against the reading of the cabin altimeter.
2. Check hydraulic pressures.

Note

Avoid accomplishing turns at a high angle of bank. Turns at high rates of descent become progressively more difficult with increase in the angle of bank.

RADAR DESCENT

Fuel and time required for GCA descents depend on the altitude where descent is started, on the procedure selected for descent and on the type of approach being used. Should the aircraft be short of fuel, ask for an emergency GCA with short circuit.

ICE AND RAIN

During instrument flights, under special conditions, icing may be encountered on the aircraft or engine. Ice will normally adhere to the wing leading edge, empennage and to the front portion of the tip tanks. Accumulation of ice, when it becomes heavy, can make the aircraft control very sluggish under instrument flight. At cruise rating, speed may be lost and will not be regained with power as long as the ice formation remains on the aircraft: therefore it is necessary to lose altitude to regain lost speed. Icing on the wing leading edge causes the stalling speed to increase considerably.

ICING OF AIRCRAFT

Icing conditions may be encountered when flying through fog with a high percentage of water, clouds or rain. The heaviest ice formation may be encountered when flying through cumuli with strong vertical currents, whereas in stratus type clouds the ice forma-

tions are usually light or moderate. During prolonged flights under moderate icing conditions, the ice accumulation can become as thick as during short flights under heavy icing conditions. The optimum conditions for ice formation are normally encountered between + 1 and −10°C.When the ice accumulation on the aircraft tends to decrease speed, it is advisable to fly out of the dangerous icing altitude immediately.

ICING ON ENGINE

If icing conditions are encountered, including cloud at ambient temperatures of + 1°C or below, which cannot be avoided by flying clear of them, reduce the rpm to below 85%. Throttle movements must be made slowly.

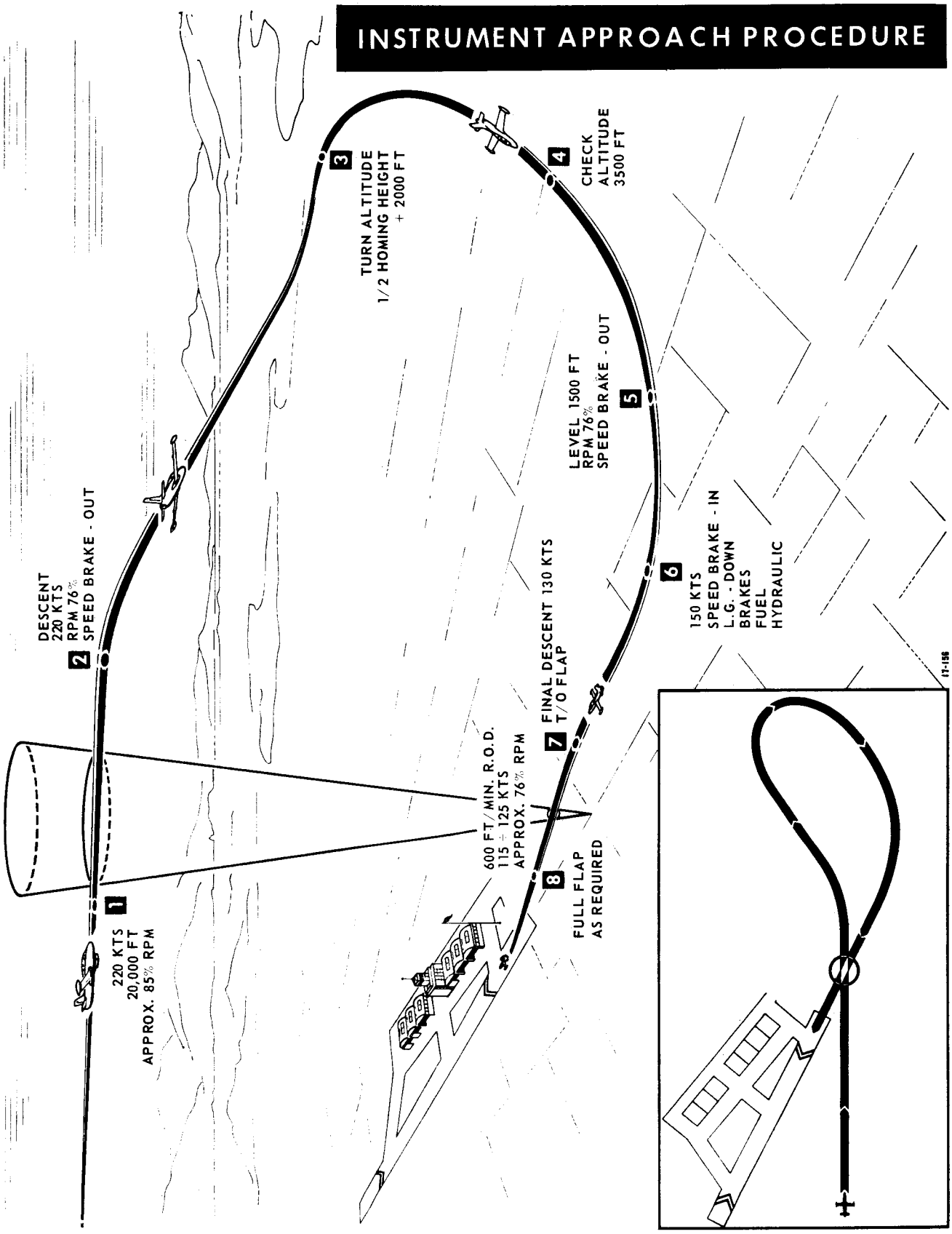

INSTRUMENT APPROACH PROCEDURE
1
220 KTS
20,000 FT
APPROX. 85% RPM
2
DESCENT
220 KTS
RPM 76%
SPEED BRAKE - OUT
3
TURN ALTITUDE
1/2 HOMING HEIGHT
+ 2000 FT
4
CHECK
ALTITUDE
3500 FT
5
LEVEL 1500 FT
RPM 76%
SPEED BRAKE - OUT
6
150 KTS
SPEED BRAKE - IN
L.G. - DOWN
BRAKES
FUEL
HYDRAULIC
7
FINAL DESCENT 130 KTS
T/O FLAP
8
FULL FLAP
AS REQUIRED
600 FT/MIN. R.O.D.
115 - 125 KTS
APPROX. 76% RPM
17-156

Figure 9-1

If engine surge occurs, throttle back and make a maximum rate descent to below the icing level. Open the throttle slowly to 70% rpm and let de-icing take place for five minutes. Should the J.P.T. increase rapidly with further throttle opening, again throttle back to 70% and allow a further five minutes before attempting to increase power.
Report the occurrence and extent of symptoms. Engine flight safety and overhaul life are affected.

TURBULENCE AND THUNDERSTORMS

BEFORE TAKE–OFF

When flight through turbulent air areas or thunderstorms is anticipated, operate as follows:

1. Analyse the general weather situation thoroughly, then prepare the flight plan, so that the aircraft avoids regions of thunderstorms as far as possible.

CAUTION

Flights in turbulent air areas or thunderstorms should be avoided as far as possible; many operational flights may however require penetration of these regions or also night weather flying, when it is even more difficult to locate the thunderstorms. In such cases a pilot who has sufficient training and experience in instrument flight, can safely fly through heavy turbulence or thunderstorms.

2. Check for correct operation of all flight instruments, navigation equipment, Pitot heater and instrument panel lights.

APPROACHING A THUNDERSTORM

If the storm cannot be seen, its proximity may be detected by strong crash static of the radio. Before entering the turbulence it is necessary to adjust power as necessary to obtain a safe penetration airspeed.

CAUTION

The recommended penetration airspeed under heavy turbulence conditions is 200 knots IAS.

The power setting and attitude of the aircraft will give a fairly constant average speed, regardless of the readings of the airspeed and Mach number indicator which, due to the different pressures existing from one storm to another, may give false indications.

Indications given by the altimeter in a thunderstorm may be false, therefore maintain altitude constant by reference to the attitude indicator.
Specific instructions for flying in thunderstorms are given in the following paragraphs:

1. Pitot heater — ON.
2. Windshield defrost cock — OPEN.
3. Check that the safety belt and shoulder harness are tight.
4. Properly adjust the volume of the radio equipment when crash static is too strong.
5. By night, turn cockpit lights full bright to minimize the blinding effect of lighting.

IN THE STORM

While in the storm, operate as follows:

1. Maintain power setting and pitch attitude of the aircraft as prepared prior to entering the thunderstorm.
2. Turbulence, precipitation and lightning are expected in a thunderstorm and must not be a reason for unjustified concern.
3. Concentrate principally on holding a level attitude by reference to the attitude indicator.
4. Maintain a constant heading. Avoid turns, unless strictly necessary.
5. The indications given by the airspeed indicator in a storm may be false. Possible maneuvers to correct the airspeed indications may result in extreme aircraft attitudes. Should a sudden gust strike the aircraft while in a nose-up attitude, a stall might occur.
6. It is advisable to use as little elevator as possible to maintain aircraft attitude in order to minimize the stresses imposed on the aircraft. Use trim tab as required.
7. The altimeter indications in a storm may be unreliable due to the change of barometric pressure existing inside the storm. Take care to maintain the minimum safe altitude since, in the storms, altitude losses or gains of many thousands of feet may be expected. This latter consideration must be borne in mind when preparing the flight plan.

Note

In temperate weather regions the most turbulent areas in a thunderstorm occur usually between 10,000 and 20,000 feet, while the least turbulent areas are encountered below 6,000 feet and above 30,000 feet.

NIGHT FLIGHTS

A pilot who is preparing for night flying must be fully familiar with the location of all switches in the cockpit. The procedures and information given hereafter supplement the procedures to be followed for the preparation of normal flights.

BEFORE TAKE–OFF

1. Check all cockpit lights.
2. Check the navigation lights, position lights and rotating beacons.
3. Check the landing light.
4. The pilot's personal equipment for night flying must include an electrical torch.
5. Check the operation of the rheostats for cockpit light dimming.

DURING FLIGHT

1. Dim the cockpit lights to the desired intensity.
2. Set the navigation lights switch to STEADY under any weather condition. Should this switch be on FLASH, the intermittent light reflected on the clouds could cause eye annoyance.
3. When flying in storm areas, turn the cockpit lights full bright to reduce the blinding effect of lightning.

BEFORE LANDING

Lower the landing lamp as necessary.

COLD WEATHER OPERATION

The dangers which may be involved by ice formation on the aircraft have already been considered in this section. This paragraph lists the procedures to be followed in order to obtain safe operation of the aircraft under cold weather conditions. An important factor to ensure satisfactory operation of the aircraft at low temperatures is the post-flight inspection to be accomplished in anticipation of the requirements for operating the aircraft the following day.

BEFORE ENTERING THE COCKPIT

1. Remove all covers and plugs.
2. Check the aircraft for freedom from frost, snow and ice; brush off all light snow and frost. Remove heavy ice formations with a direct flow of hot air.

WARNING

Always ensure that water from melted ice is sponged away so that it will not drain to some critical area and freeze again. Do not attempt to chip or scrape ice from the aircraft surfaces as this action may cause damage to the aircraft. Inadequate cleaning of the aircraft may result in dangerous loss of lift and sudden stalls during flight.

3. At temperatures below $-20°C$, heating of the cockpit and canopy seal is necessary.
4. Check that vents and fuel filters are free from ice.
5. Check shock absorbers and actuating cylinders for dirt or ice. Clean with a rag soaked in hydraulic fluid.
   Check shock absorbers for correct inflation.
6. No pre-heating of the engine oil or oil dilution is required to ensure satisfactory lubrication down to $-26°C$.

AFTER ENTERING THE COCKPIT

1. Check the flight controls for correct operation.
2. Make sure that the canopy is closed and locked.
3. Check the electrical and radio equipment using an external power source.

BEFORE STARTING THE ENGINE

To start the engine, use an adequate power source. If the minimum starting rpm cannot be obtained, it is advisable to pre-heat the air ducts before attempting another start.

ENGINE STARTING

Start the engine using the procedure outlined in Section II.

GROUND HEATING AND ISPECTION

1. Turn on the cabin heat and windshield anti-ice and defrosting systems immediately after engine start.

2. Check control surfaces, speed brake and trim tabs for correct operation.
3. Check wing flap and flap indicator operation.

WARNING

Make sure that air in the cabin is sufficiently warm to ensure normal operation of the instruments.

TAXIING

1. Avoid taxiing in deep snow as aircraft maneuvrability is difficult under these conditions and frozen brakes may result.
2. When taxiing behind other aircraft, especially under extreme external temperature conditions, keep a safe interval to ensure adequate stopping distance and to prevent icing of the aircraft surfaces by melted snow and ice thrown back in the jet blast of preceding aircraft.

BEFORE TAKE-OFF

1. Pitot heating switch — ON.
2. Check the instruments with the engine running at full power if runway conditions permit; otherwise check the instruments during the initial part of the take-off run.

TAKE-OFF

At ambient air temperatures below 0°C with the throttle opened to "FULL", max. rpm is not obtained but full thrust is available. The 100% rpm take-off charts contained in the Appendix are therefore fully applicable.

AFTER TAKE-OFF

After take-off from snow covered runways, actuate the brakes several times to remove the snow and operate the landing gear and wing flaps several times to prevent their freezing in the retracted position. (Under extreme temperature conditions retraction and extension of the landing gear will be much slower).

CAUTION

During these maneuvers, speed must not exceed the specified limits.

CLIMBING

The climbing characteristics of the aircraft are improved under cold weather and at low altitude. For climbing speeds, refer to Appendix I.

CRUISE

1. Under extreme temperature conditions, adjust the power setting in accordance with the normal procedures.
2. Keep the windshield defrosting and anti-ice systems operating.
3. Adjust the cabin temperature to a comfortable setting.

DESCENT

1. Make sure that the defrosting control is fully open to prevent formation of fog or frost on the windshield during rapid descents from higher altitudes.

CAUTION

To obtain satisfactory operation of the defrosting system, turn the handle to open some minutes prior to starting the descent.

2. During descent check that engine temperature is at any time within the specified limits.

APPROACH

1. Make the normal pattern and landing.
2. During approach, pump the brakes several times to check operation.

LANDING

Landing speed and technique are normal. For the characteristics, refer to Appendix I.

AFTER LANDING

1. Use the brakes lightly and intermittently to avoid the tire tread being filled with snow and ice.

Note

Abrupt braking on icy or wet runway may result in dangerous yaw moments or skidding.

2. Pitot heating switch — OFF.

ENGINE SHUT-DOWN

Shut-down the engine in the normal manner.

BEFORE LEAVING THE AIRCRAFT

1. Close the canopy.

2. Make sure that protective covers are installed over the Pitot tubes and the aircraft. Allow the engine to cool prior to installing covers over the air intake ducts and jet nozzle orifice.
3. Whenever possible leave the aircraft parked with full fuel tanks. Every effort should be made during servicing to prevent moisture from entering the fuel system.
4. When the aircraft is to be parked at temperatures below −29°C for more than four hours, remove the batteries.

HOT WEATHER AND DESERT OPERATION

BEFORE ENTERING THE COCKPIT

1. Inspect the air intake ducts for the presence of sand.

CAUTION

If sand is found in the air intake ducts, do not start the engine.

2. Inspect tires for proper inflation and for the presence of cracks or other deteriorations.
3. Check for hydraulic system leaks due to the heat.
4. Check electrical wiring and equipment for evidence of corrosion and cracks.

CAUTION

The canopy transparent panel is very easily damaged in hot weather. Take care to avoid any impact with the canopy when entering the cockpit.

ENGINE STARTING

Normal starting procedures are used in hot weather.

BEFORE TAXIING

Ground testing should be completed as rapidly as possible.

TAXIING

1. If possible, taxi with reduced power to minimize the entry of dust or sand into the engine.
2. Maintain adequate distance from aircraft taxiing ahead.
3. Brakes should be used as little as possible to prevent overheating.

TAKE-OFF

1. At ambient air temperatures above 15°C, full thrust will not be obtainable even with the engine running at 100% rpm.
2. At ambient air temperatures above 35°C it will be necessary to reduce engine speed to prevent maximum permissible J.P.T. being exceeded.

Note

- If the "JPT LIM" switch is on, a reduction in rpm will be automatically obtained at ambient air temperatures above 30°C.
- When a take-off is required from a short runway at temperatures higher than 15°C, it will be advisable to refer to Appendix I for take-off performance plotted against temperature, to ascertain that the runway length is sufficient for take-off. The aircraft will accelerate slowly because of the less thrust available, the take-off ground run will therefore be longer. Ground speed will be increased for the same indicated airspeed.

CLIMB

Follow the normal procedures.

CRUISE

Engine operation at cruise altitude shall be in accordance with the normal procedures. At low altitudes, take care that the engine temperature limits are not exceeded.

DESCENT

Turn on the windshield defrosting system during descent to prevent formation of fog or frost.

BEFORE LANDING

Follow normal procedures.

LANDING

Expect gusts and windshifts near the ground. Landing ground run will be longer.

ENGINE SHUT–DOWN

Shut-down the engine in the normal manner.

BEFORE LEAVING THE AIRCRAFT

1. The canopy may be left partially open if the aircraft is to be parked in a location not subject to blowing sand or dust.

2. Leave the canopy partially open if the aircraft is to be parked in locations with high humidity or excessive temperature changes from day to night.

3. In desert localities, cover all ducts and air intakes of the aircraft to prevent entrance of blowing sand or dust.

APPENDIX I PERFORMANCE DATA

The appendix is divided into parts, as outlined below, to present the performance data in proper sequence for preflight planning. Each part contains descriptive text and sample problems for the applicable charts.

PART 1 INTRODUCTION A1-1

PART 2 TAKEOFF A2-1

PART 3 CLIMB A3-1

PART 4 RANGE A4-1

PART 5 ENDURANCE A5-1

PART 6 DESCENT A6-1

PART 7 LANDING A7-1

NOTE

In the heading of the charts contained in this Appendix, the wordings:

DATE: 1 OCTOBER 1968
DATA BASIS: ESTIMATED FLIGHT TEST

are to be read as indicated below (where not already changed by revision of the affected page):

DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

PART I - INTRODUCTION

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Airspeed and Altimeter Position Error Correction	A1-2
Compressibility Correction to Calibrated Airspeed	A1-3
Airspeed Mach Number Conversion	A1-3
Standard Altitude Table	A1-3
Standard Unit Conversion Table	A1-3
Flight Performance Charts for the Aircraft in the Different Configurations	A1-12
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GENERAL

This appendix contains all the performance data which are necessary for accurate pre-flight planning. Charts are supplemented with descriptive text and examples to facilitate their use.

All information shown in this appendix is based on manufacturer's flight test data and, unless specifically stated, are consistent with the recommended operating procedures and techniques set forth in the concerned sections of this Manual.

All data presented are for standard atmospheric conditions as defined by the Standard Altitude Table, however, corrections for non-standard temperature conditions have been included on the charts where possible.

FUEL

All performance and operating weight ranges included in this appendix are based on operation with fuel having an average density of 7.8 lb/imp gal (6.5 lb/US gal).

SYMBOLS AND DEFINITIONS

SYMBOLS	DEFINITIONS	REMARKS
c	Sound speed (kts)	
CAS	Calibrated airspeed: indicated airspeed corrected for position error: CAS = IAS + ΔV_i	
C_D	Aircraft drag coefficient	
C_h	Fuel flow in lb/h	
C_L	Aircraft lift coefficient	
C_t	Specific fuel consumption in lb/lb.h	
EAS	Equivalent airspeed: calibrated airspeed corrected for compressibility: EAS = CAS + ΔV_c	
ft	Feet	1 ft = 0.3048 m
GS	Ground speed: TAS corrected for the wind component velocity: GS = TAS + V_W	

SYMBOLS	DEFINITIONS	REMARKS
H_p	Pressure altitude	
IAS	Indicated airspeed, airspeed indicator reading uncorrected	Where this symbol is used on the performance charts, mechanical error in the instrument is assumed to be zero.
kts	Knots	1 kts = 1.853 km/h
lb	Pounds	1 lb = 0.4536 kg
M	Mach number: M = TAS/sound speed	
min	Minutes	
N.Mi	Nautical miles	1 N.Mi = 1.853 km
N.Mi/lb	Nautical miles per pound of fuel	
S	Aircraft wing area	
T	Engine thrust (lb)	
t_o	Outside air temperature	
TAS	True airspeed, equivalent airspeed corrected for atmosphere density: TAS = EAS × $1/\sqrt{\sigma}$	
V	True airspeed (TAS)	
V_W	Wind velocity component	
W	Aircraft weight	
%RPM	Engine rating (RPM/13.760) < 100%	
ΔH	Altimeter position error correction	
ΔV_c	Airspeed compressibility correction	
ΔV_i	Airspeed position error correction	
ΔW	Aircraft weight variation	
ρ	Atmospheric density for a given altitude	
ρ_o	Atmospheric density for standard atmospheric conditions at sea level	
σ	ρ/ρ_o	

AIRSPEED AND ALTIMETER POSITION ERROR CORRECTION

The static sources of the aircraft do not provide the correct ambient static pressure for a given altitude of flight.The value of the static pressure at the static sources is subject to an error generated by the aircraft speed.
The static source position error is not affected by the presence of underwing stores.
In the aircraft, in all configurations (take-off, cruise with speed brake, cruise without speed brake) except landing, pressure at the static sources is higher than the actual static pressure of the altitude at which the aircraft is flying: This means that:

1. In all configurations except landing, the airspeed indicator reading is below the actual value: the calibrated airspeed CAS is therefore obtained by adding the position error correction ΔV_i to the indicated airspeed IAS (Refer to figure A1-1).
2. The corrected pressure altitude is obtained, for all configurations except take-off and landing, by adding the altimeter position error correction ΔH (figure A1-2) to the reading obtained from the altimeter.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

The position error is produced, for a given type of installation, by the aircraft speed.

At low speeds (up to approximately 200 knots IAS) the position error is in fact proportional to airspeed. Apart from the static source position on the aircraft, a new error in the measurement of static pressure and airspeed is involved by the compressibility of the air which does not allow pressure to be considered simply proportional to airspeed. This error has such a sign as to give an airspeed reading higher than the correct value.

The compressibility correction to apply, ΔV_C, will therefore be a magnitude to be subtracted from the calibrated airspeed value (figure A1-3).

AIRSPEED-MACH NUMBER CONVERSION

True Mach number, true airspeed or calibrated airspeed can be obtained from the Airspeed-Mach Number curves (see figure A1-4).

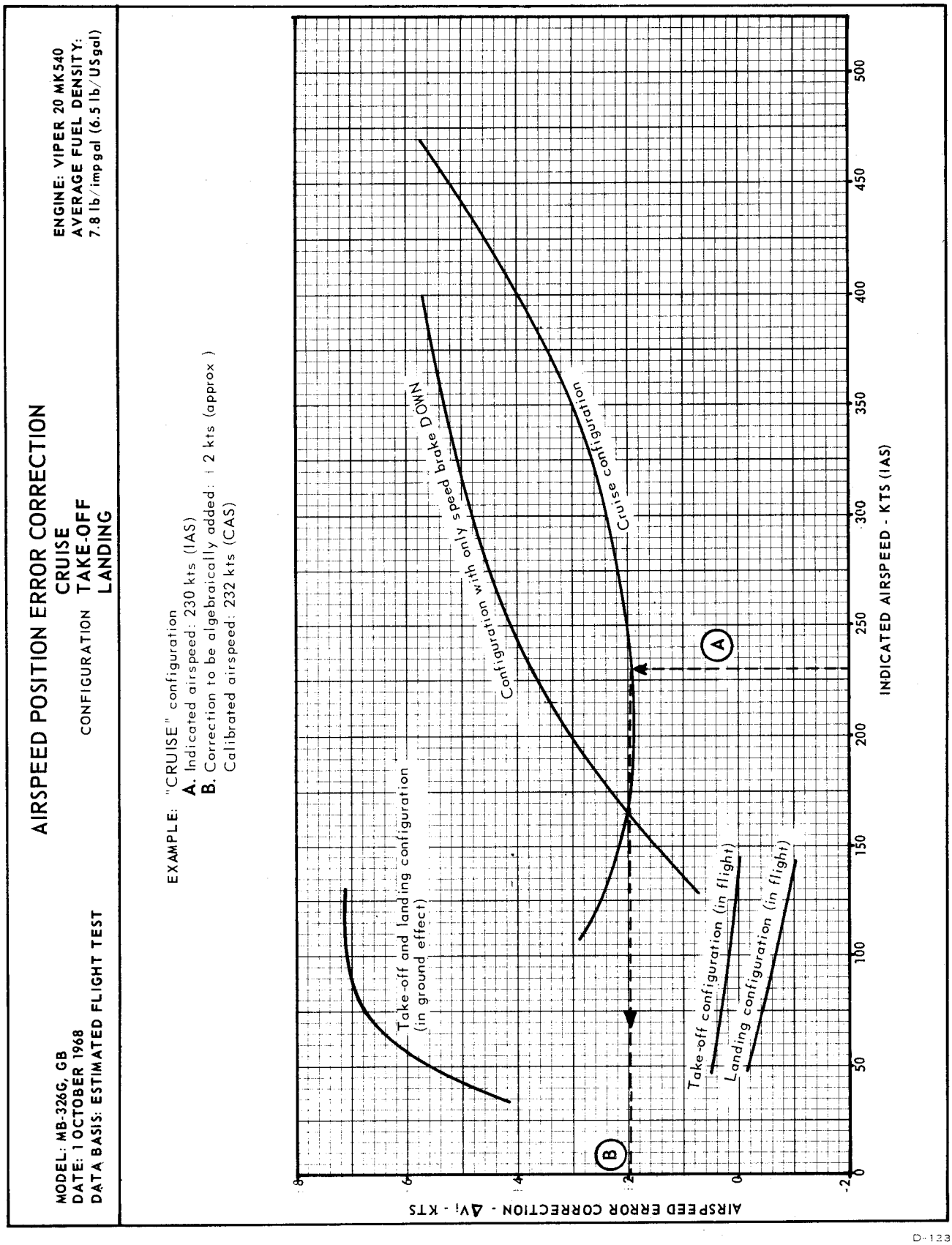
The use of these charts is illustrated by the sample problem given at page A1-8.

STANDARD ALTITUDE TABLE

The standard altitude table (figure A1-5) provides reference temperature, pressure, air density, and sonic speed information which may be of assistance in overall flight planning.

STANDARD UNIT CONVERSION TABLE

The standard unit conversion table (figure A1-6) provides a means for direct conversion of temperature from degrees centigrade to degrees Fahrenheit, and of distance and speed from feet, nautical miles, feet per second, and feet per minute to metric equivalents of meters, kilometers, meters per second, and meters per minute, respectively.



D-123

Figure A1-1

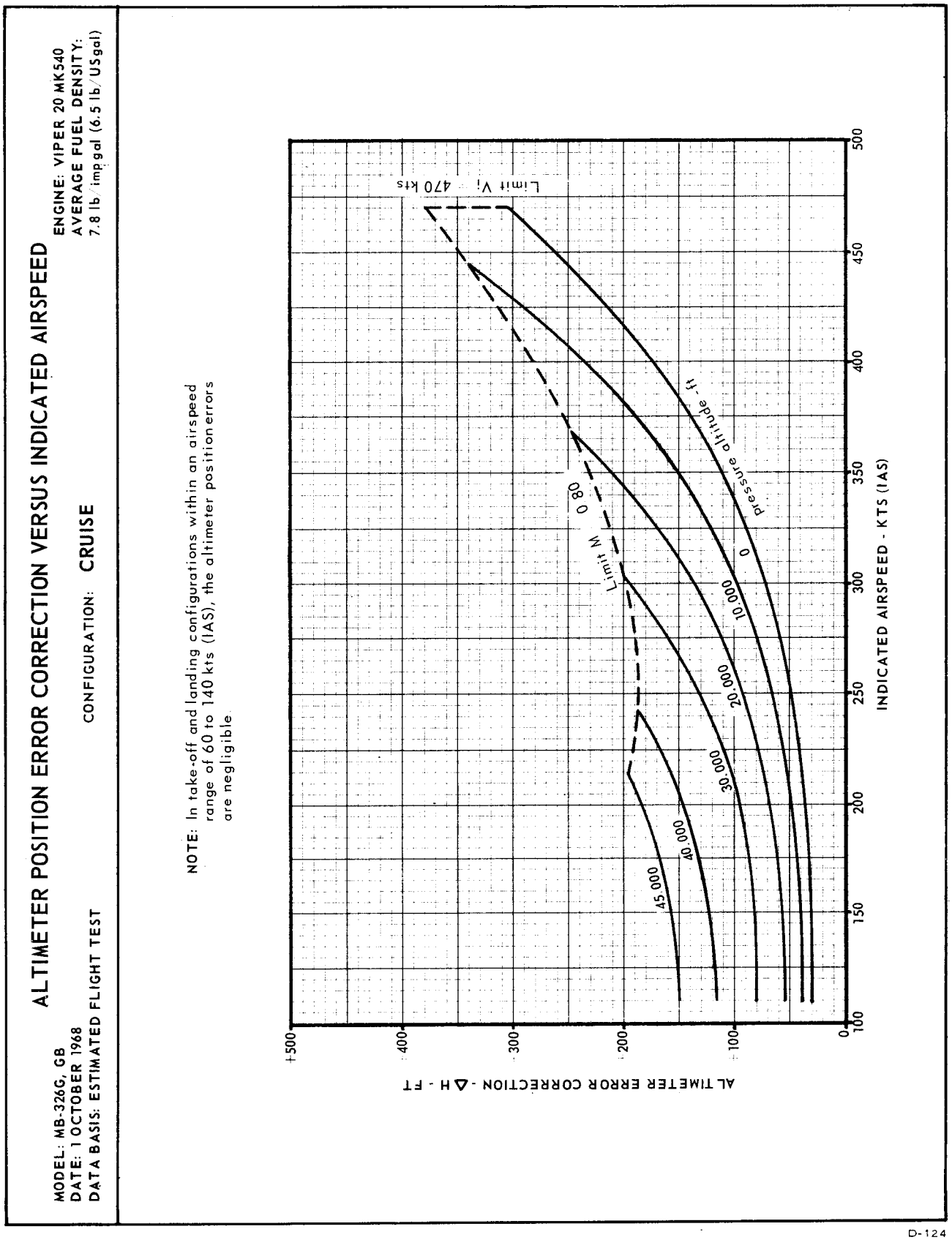


Figure A1-2 (Sheet 1 of 2)

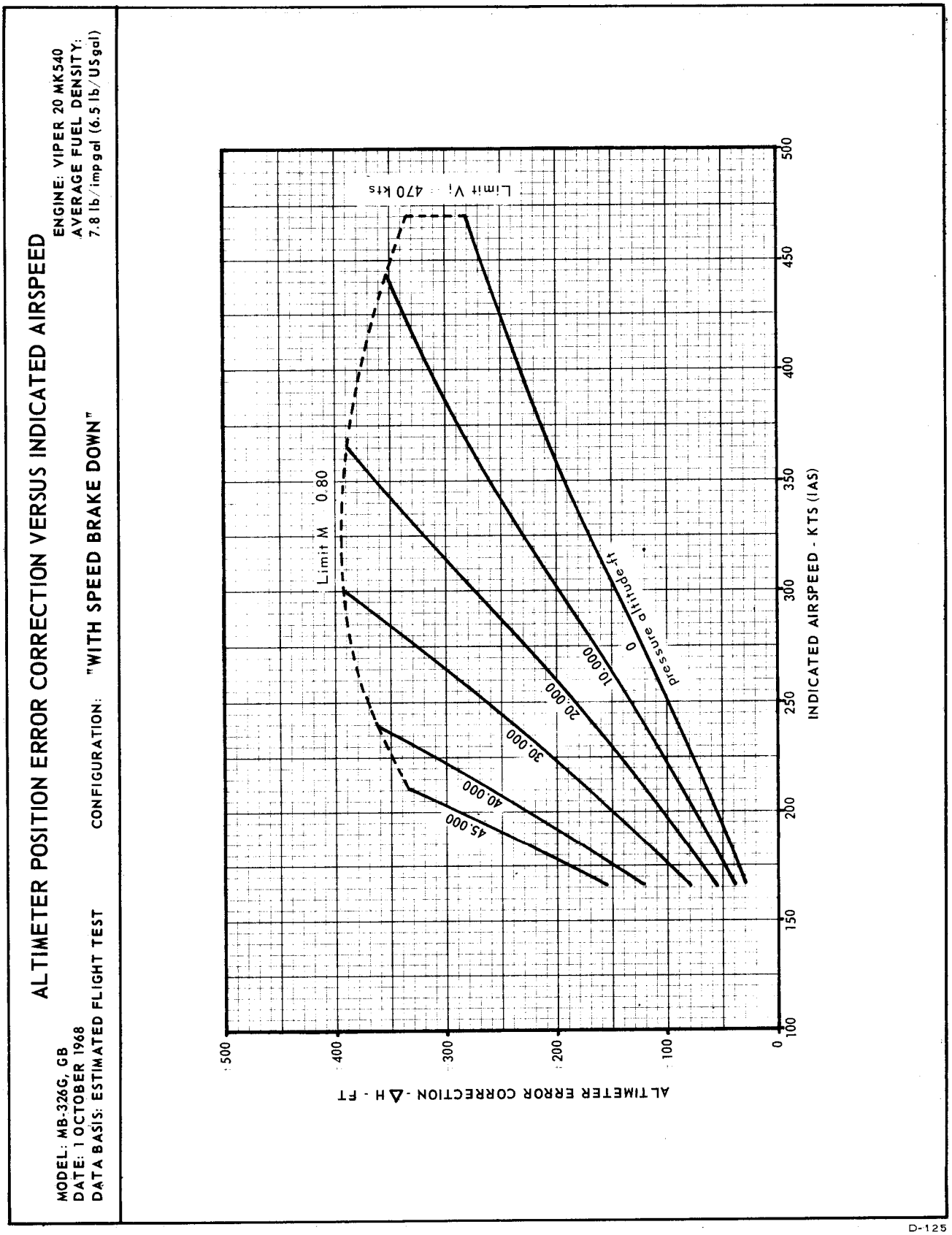
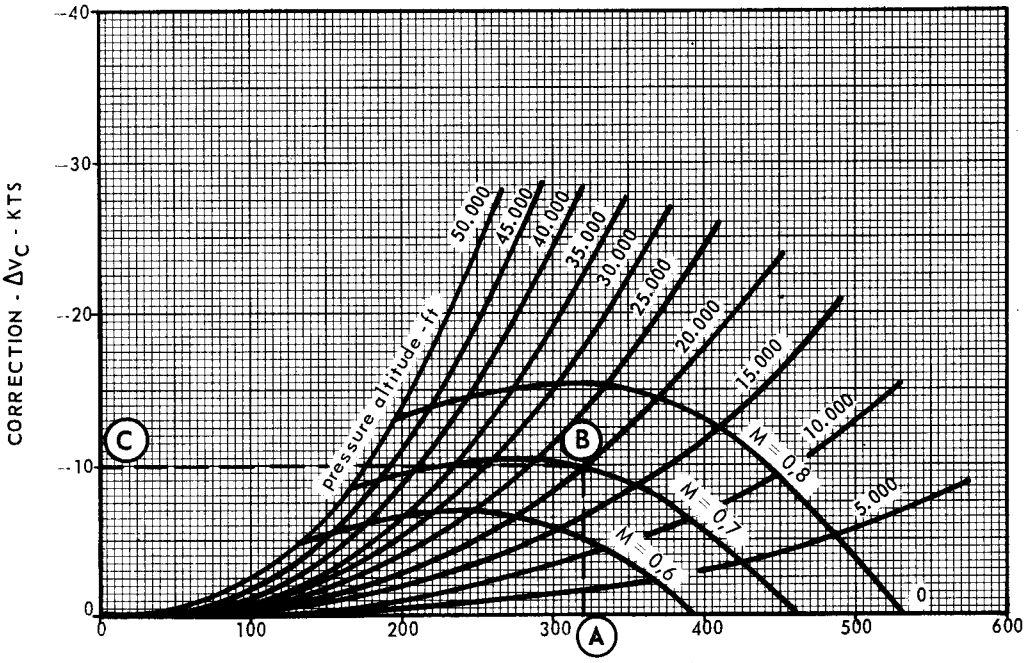


Figure A1-2 (Sheet 2 of 2)

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)



Algebraically add compressibility correction to calibrated airspeed to obtain equivalent airspeed

$$EAS = CAS + \Delta V_C$$

EXAMPLE:
A = Calibrated airspeed = 320 kts CAS
B = Pressure altitude = 20.000 ft
C = Compressibility correction = 10 kts
A+C = Equivalent airspeed = 310 kts EAS

D-004

Figure A1-3

AIRSPEED-MACH NUMBER CONVERSION

EXAMPLE BASED ON FIGURE A1-4

DATA:

- True Mach number: M = 0,47
- Pressure altitude: 200,000 ft
- Ambient temperature: −40°C

FIND:

- Calibrated airspeed and True airspeed

PROCEDURE:

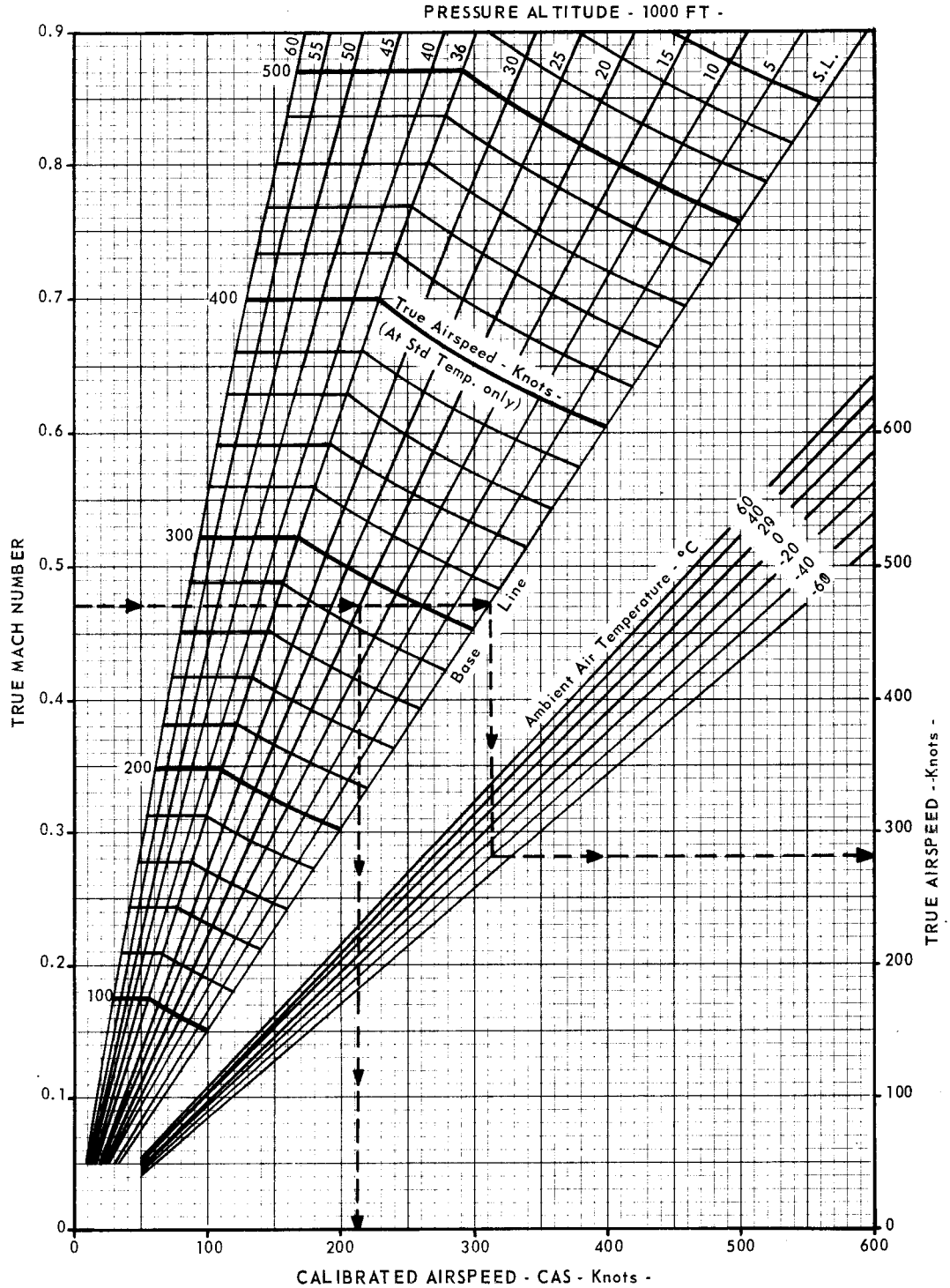
1. With true Mach number known, (M = 0,47) enter the chart on the left and proceed horizontally to the altitude 20,000 ft.
2. If standard temperature exists at that altitude read the true airspeed from the speed line provided: TAS = 288 kts.
   Drop vertically to read the calibrated airspeed: CAS =213 kts.
3. If non-standard free air temperature exists, proceed horizontally to the base line, then drop vertically to the desired temperature (−40°C) and read the true airspeed from the right-hand scale: TAS = 280 kts.

AIRSPEED-MACH NUMBER CURVES

MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

0 TO 0.9 MACH NUMBER

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)



D-005

Figure A1-4

STANDARD ALTITUDE TABLE

STANDARD SEA LEVEL AIR:
T = 59° F
P = 29.921 IN. OF HG

ρ_o = .076475 LB/CU FT ρ_o = .0023769 SLUGS/CU FT
1" OF HG. = 70.732 LB/SQ FT = 0.4912 LB/SQ IN.
c_o = 1116.89 FT/SEC

BASED ON INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) STANDARD ATMOSPHERE
(NACA TECHNICAL REPORT NO. 1235)

ALTITUDE FEET	DENSITY RATIO $\sigma = \rho/\rho_o$	$1/\sqrt{\sigma}$	TEMPERATURE DEG F	TEMPERATURE DEG C	SPEED OF SOUND RATIO c/c_o	PRESSURE IN. OF HG	PRESSURE RATIO $\delta = p/p_o$
-2000	1.0598	0.9714	66.132	18.962	1.0064	32.15	1.0294
-1000	1.0296	0.9855	62.566	16.981	1.0039	31.02	1.0147
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1000	.9711	1.0148	55.434	13.019	.9966	28.86	.9644
2000	.9428	1.0299	51.868	11.038	.9931	27.82	.9298
3000	.9151	1.0454	48.302	9.057	.9896	26.82	.8962
4000	.8881	1.0611	44.735	7.075	.9862	25.84	.8637
5000	.8617	1.0773	41.169	5.094	.9827	24.90	.8320
6000	.8359	1.0938	37.603	3.113	.9792	23.98	.8014
7000	.8106	1.1107	34.037	1.132	.9756	23.09	.7716
8000	.7860	1.1279	30.471	- 0.849	.9721	22.22	.7428
9000	.7620	1.1456	26.905	- 2.831	.9686	21.39	.7148
10000	.7385	1.1637	23.338	- 4.812	.9650	20.58	.6877
11000	.7156	1.1822	19.772	- 6.793	.9614	19.79	.6614
12000	.6932	1.2011	16.206	- 8.774	.9579	19.03	.6360
13000	.6713	1.2205	12.640	-10.756	.9543	18.29	.6113
14000	.6500	1.2403	9.074	-12.737	.9507	17.58	.5875
15000	.6292	1.2606	5.508	-14.718	.9470	16.89	.5643
16000	.6090	1.2815	1.941	-16.699	.9434	16.22	.5420
17000	.5892	1.3028	- 1.625	-18.681	.9397	15.57	.5203
18000	.5699	1.3246	- 5.191	-20.662	.9361	14.94	.4994
19000	.5511	1.3470	- 8.757	-22.643	.9324	14.34	.4791
20000	.5328	1.3700	-12.323	-24.624	.9287	13.75	.4595
21000	.5150	1.3935	-15.889	-26.605	.9250	13.18	.4406
22000	.4976	1.4176	-19.456	-28.587	.9213	12.64	.4223
23000	.4807	1.4424	-23.022	-30.568	.9175	12.11	.4046
24000	.4642	1.4678	-26.588	-32.549	.9138	11.60	.3876
25000	.4481	1.4938	-30.154	-34.530	.9100	11.10	.3711
26000	.4325	1.5206	-33.720	-36.511	.9062	10.63	.3552
27000	.4173	1.5480	-37.286	-38.492	.9024	10.17	.3398
28000	.4025	1.5762	-40.852	-40.473	.8986	9.725	.3250
29000	.3881	1.6052	-44.419	-42.455	.8948	9.297	.3107
30000	.3741	1.6349	-47.985	-44.436	.8909	8.885	.2970
31000	.3605	1.6654	-51.551	-46.417	.8871	8.488	.2837
32000	.3473	1.6968	-55.117	-48.398	.8832	8.106	.2709
33000	.3345	1.7291	-58.683	-50.379	.8793	7.737	.2586
34000	.3220	1.7623	-62.249	-52.361	.8754	7.382	.2467
35000	.3099	1.7964	-65.816	-54.342	.8714	7.041	.2353
36000	.2981	1.8315	-69.382	-56.323	.8675	6.712	.2243
37000	.2844	1.8753	-69.700	-56.500	.8671	6.397	.2138
38000	.2710	1.9209	-69.700	-56.500	.8671	6.097	.2038
39000	.2583	1.9677	-69.700	-56.500	.8671	5.811	.1942
40000	.2462	2.0155	-69.700	-56.500	.8671	5.538	.1851
41000	.2346	2.0645	-69.700	-56.500	.8671	5.278	.1764
42000	.2236	2.1148	-69.700	-56.500	.8671	5.030	.1681
43000	.2131	2.1662	-69.700	-56.500	.8671	4.794	.1602
44000	.2031	2.2189	-69.700	-56.500	.8671	4.569	.1527
45000	.1936	2.2728	-69.700	-56.500	.8671	4.355	.1455
46000	.1845	2.3281	-69.700	-56.500	.8671	4.151	.1387
47000	.1758	2.3848	-69.700	-56.500	.8671	3.956	.1322
48000	.1676	2.4428	-69.700	-56.500	.8671	3.770	.1260
49000	.1597	2.5022	-69.700	-56.500	.8671	3.593	.1201
50000	.1522	2.5630	-69.700	-56.500	.8671	3.425	.1145
51000	.1451	2.6254	-69.700	-56.500	.8671	3.264	.1091
52000	.1383	2.6892	-69.700	-56.500	.8671	3.111	.1040
53000	.1318	2.7546	-69.700	-56.500	.8671	2.965	.09909
54000	.1256	2.8216	-69.700	-56.500	.8671	2.826	.09444
55000	.1197	2.8903	-69.700	-56.500	.8671	2.693	.09001
56000	.1141	2.9606	-69.700	-56.500	.8671	2.567	.08578
57000	.1087	3.0326	-69.700	-56.500	.8671	2.446	.08176
58000	.1036	3.1063	-69.700	-56.500	.8671	2.331	.07792
59000	.09877	3.1819	-69.700	-56.500	.8671	2.222	.07426
60000	.09414	3.2593	-69.700	-56.500	.8671	2.118	.07078
61000	.08972	3.3386	-69.700	-56.500	.8671	2.018	.06746
62000	.08551	3.4198	-69.700	-56.500	.8671	1.924	.06429
63000	.08150	3.5029	-69.700	-56.500	.8671	1.833	.06127
64000	.07767	3.5881	-69.700	-56.500	.8671	1.747	.05840
65000	.07403	3.6754	-69.700	-56.500	.8671	1.665	.05566

Figure A1-5

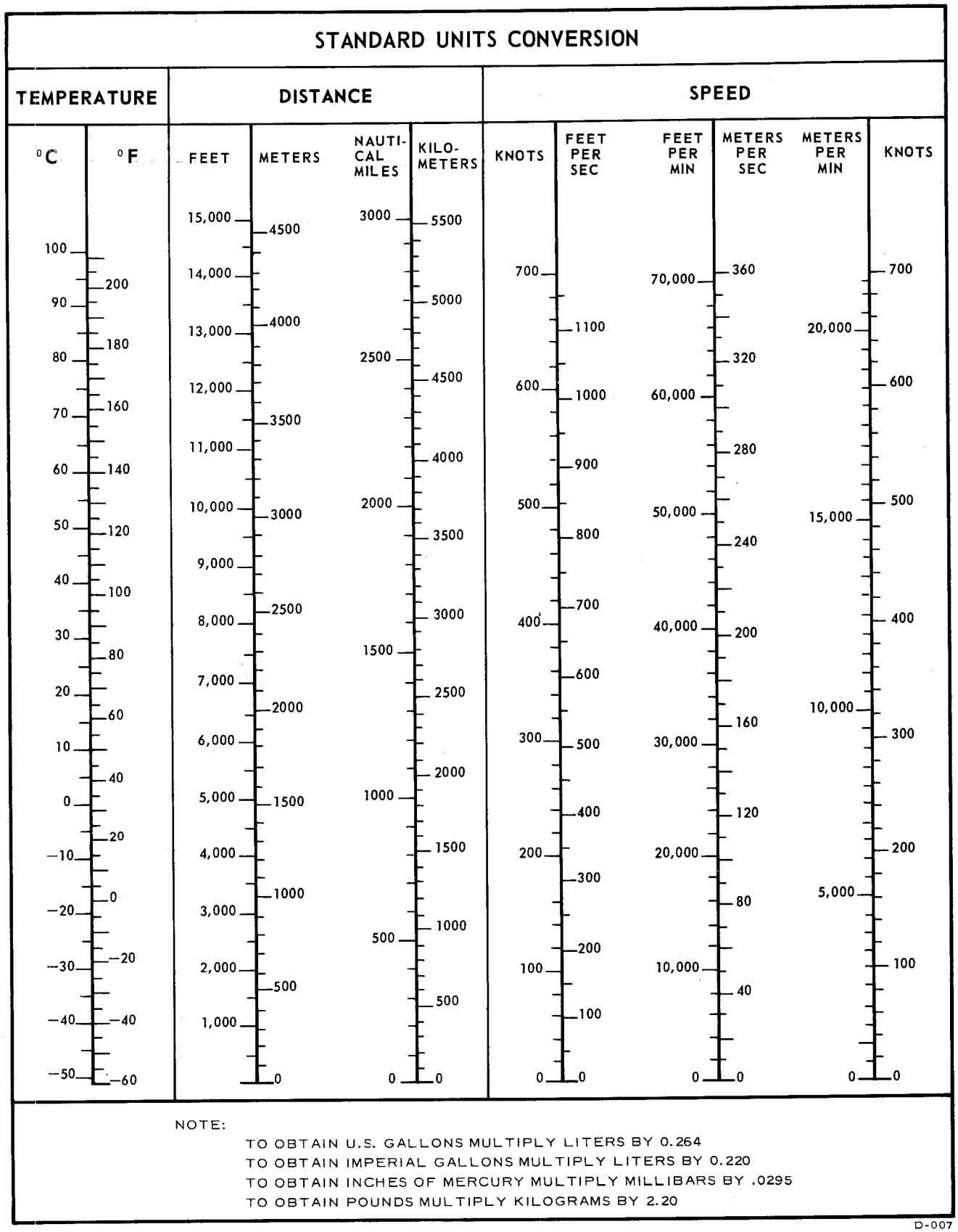

STANDARD UNITS CONVERSION
TEMPERATURE
DISTANCE
SPEED
°C
°F
FEET
METERS
NAUTI-CAL MILES
KILO-METERS
KNOTS
FEET PER SEC
FEET PER MIN
METERS PER SEC
METERS PER MIN
KNOTS
NOTE:
TO OBTAIN U.S. GALLONS MULTIPLY LITERS BY 0.264
TO OBTAIN IMPERIAL GALLONS MULTIPLY LITERS BY 0.220
TO OBTAIN INCHES OF MERCURY MULTIPLY MILLIBARS BY .0295
TO OBTAIN POUNDS MULTIPLY KILOGRAMS BY 2.20
D-007

Figure A1-6

FLIGHT PERFORMANCE CHARTS FOR THE AIRCRAFT IN THE DIFFERENT CONFIGURATIONS

This appendix contains the performance charts for the aircraft in the basic trainer configuration and in the various armed configurations with underwing stores.

The performance data shown in the charts are based on the results of flight tests.

The various configurations of the aircraft, corresponding to the different combinations of underwing stores, have been grouped in nine families in order to facilitate the use of this appendix.

The families of configurations are identified in the performance charts with capital letters from A to I. Each family comprises those configurations, i.e. those combinations of underwing stores, which approximately show the same characteristics of aerodynamic drag, thence the same flight performance. The choice of the configurations for group assignment has been the result of extensive flight testing. In general, the configurations to be grouped in the same aerodynamic family have been chosen on the basis of a rather large principle. The adopted principle, however, permits mission profiles to be planned with the fairly good approximation that is normally required in practice.

The cruise performance data (nautical miles per pound of fuel, range profiles, endurance) embody a 5% general worsening of the values obtained from flight testing. This provides a conservative margin which allows for the engine performance deterioration and the tolerances on the guaranteed acceptance conditions set forth in the Rolls-Royce Contract Specification.

The climb data shown in this appendix are instead based on climbs performed in accordance with the climb flight nominal correct conditions. In particular, these are values that can be obtained under the following conditions:

- Strict adherence to the climb schedule.
- Absence of turbulent air conditions (gusts, turbulence).
- Absence of an unfavourable wind gradient during climb.
- Engine calibration at altitude such as to provide the correct performance of a standard engine as set forth in the Performance Brochure of Rolls-Royce.
- Possible deviation of the ambient air temperature standard conditions, at the different altitudes, being correctly evaluated on the basis of a recent meteorological data.

If the above requirements are not complied with, a reduction as large as 10% of the climb performance data shown in the charts may be expected during the aircraft normal operation.

However, in consideration of the relatively lower degree of accuracy that is required for climb planning with respect to cruise flight, and in view of the difficulty for the effect of the indicated values to be calculated every time, it has been throught convenient to leave the climb performance basis nominal values unaltered and assume these values as the best results obtainable under correct climb conditions and with the best engine calibration at altitude.

The charts providing the take-off ground run and the distance to clear the 50-foot obstacle, are valid for all the aircraft configurations.

Flight tests have confirmed that the take-off runs are affected, further than, of course, by the ambient conditions, by the take-off weight only, the aerodynamic effect of underwing stores of any type practically having no influence on the take-off performance.

FAMILIES OF REFERENCE CONFIGURATIONS FOR THE USE OF THE PERFORMANCE CHARTS

NOTE: Each figure in this appendix is identified by the reference letter of the family to which it pertains

Family of configurations	AIRCRAFT CONFIGURATIONS IN THE SAME FAMILY
A	Basic trainer
B	A + two Macchi 12.7 mm machine gun pods A + one Macchi 12.7 mm machine gun pod and one photo-reconnaissance pod
C	A + two underwing tanks A + two AN-M30A1 bombs A + two AN-M57A1 bombs A + two AN-M64A1 bombs A + two minigun pods A + two LAU-32B/A or LAU-32G rocket pods
D	B + 2 or 4 underwing pylons unloaded
E	B + two underwing tanks B + two AN-M30A1 bombs B + two AN-M57A1 bombs B + two AN-M64A1 bombs B + two minigun pods B + two LAU-32B/A or LAU-32G rocket pods
F	B + two SCAR rocket racks unloaded
G	B + two Matra 122 rocket pods B + two SCAR rocket launchers with 2×2 SCAR rockets B + two Matra 181 rocket pods
H	A + six AN-M30A1 bombs A + six AN-M57A1 bombs A + six AN-M64A1 bombs B + two Matra 361 rocket pods B + four Matra 122 rocket pods B + 2×4 HVAR rockets B + four Matra 181 rocket pods B + two Matra 155 rocket pods B + two LAU-3/A rocket pods
I	B + four AN-M30A1 bombs B + four AN-M57A1 bombs B + four AN-M64A1 bombs B + four minigun pods B + four LAU-32B/A or LAU-32G rocket pods

AIRCRAFT LOADED GROSS WEIGHT

— Zero Fuel Weight with 360 lb Crew	6390 lb

USABLE FUEL WEIGHT

(Average fuel density: 7.8 lb/imp gal corresponding to 6.5 lb/US gal)

— Fuselage Tank	1342 lb
— Fuselage Tank plus 70 imp gal Tip Tanks	2388 lb
— Fuselage Tank plus 70 imp gal Tip Tanks, plus two Underwing Tanks	3524 lb

EXTERNAL STORES LOADING DATA

(Single item in all cases)

— Machine Gun Pod (Macchi) with 300 rounds	250 lb
— Camera Pod (Macchi)	154 lb
— Underwing Pylon (Macchi	48.5 lb
— 7.62 mm cal SUU—11A/A Minigun Pod with 1500 rounds	324 lb
— Underwing Tank { empty	116 lb
full	685 lb
— SCAR Rocket Launcher (Macchi)	13 lb
— SCAR Rocket	12 lb
— HVAR Rocket	143 lb
— Matra 122 Rocket Container { empty	47.5 lb
loaded	110.5 lb
— Matra 155 Rocket Container { empty	196 lb
loaded	446.2 lb
— Matra 181 Rocket Container { empty	37.5 lb
loaded	78.5 lb
— Matra 361 Rocket Container { empty	75 lb
loaded	158 lb
— Type LAU—3A Rocket Launcher { empty	78 lb
loaded	415 lb
— Type LAU—32B/A or LAU—32G Rocket Launcher { empty	60 lb
loaded	183 lb
— Type AN—M30A1 Bomb	107 lb
— Type AN—M57A1 Bomb	270 lb
— Type AN—M57A1 Bomb with High Velocity Fin	290 lb
— Type AN—M64A1 Bomb with T12671 (M 128) Tail	590 lb
— Aero —2B Practice Bombs Container { empty	30 lb
loaded	54 lb

PART II - TAKE-OFF

TABLE OF CONTENTS

Title	Page
Take-off and landing crosswind	A2-1
Take-off ground run distance	A2-1
Total take-off distance to clear 50 ft obstacle	A2-1
Take-off gross weight limitation due to tire limit speed	A2-1

TAKE–OFF AND LANDING CROSSWIND

The take-off and landing crosswind chart (figure A2-1) is used to resolve the prevailing wind into headwind and crosswind components and to determine the minimum nose wheel lift-off and main gear touchdown speed for the crosswind component.
The recommended nose wheel lift-off speed or main gear touchdown speed is determined from the take-off speed chart or landing speed chart and the crosswind chart, whichever is greater.

TAKE–OFF GROUND RUN DISTANCE

The take-off distance chart (figure A2-2) is used to determine the ground run distance. The ground run is defined as the distance along the runway from the start of the take-off run to the point where the aircraft leaves the ground. Corrections are provided in the chart for variable conditions of weight, pressure altitude, air temperature, wind velocity and runway slope, at maximum thrust. The ground run for the different configurations is only affected by the aircraft weight. The aerodynamic drag differences due to the various types of underwing store do not involve variations in the ground run distances.

TOTAL TAKE–OFF DISTANCE TO CLEAR 50 FT OBSTACLE

The total distance to clear 50 ft obstacle chart (figure A2-3) is the distance along the runway from the start of the take-off run to the point where the obstacle height is reached.
The aerodynamic drag differences due to the various types of underwing store do not involve variations in the total take-off distance.

TAKE–OFF GROSS WEIGHT LIMITATION DUE TO TIRE LIMIT SPEED

The take-off gross weight limitation due to the tire limit speed (figure A2-4) is obtained as a function of runway temperature, pressure altitude and wind velocity.

TAKE-OFF AND LANDING CROSSWIND

EXAMPLE BASED ON FIGURE A2-1

DATA

- Take-off gross weight: 8000 lb
- Wind from: 50°
- Average wind velocity: 30 kts
- Gust wind velocity: 40 kts
- Active runway: 01

FIND

- The headwind and the crosswind components.
- The recommended take-off speed.

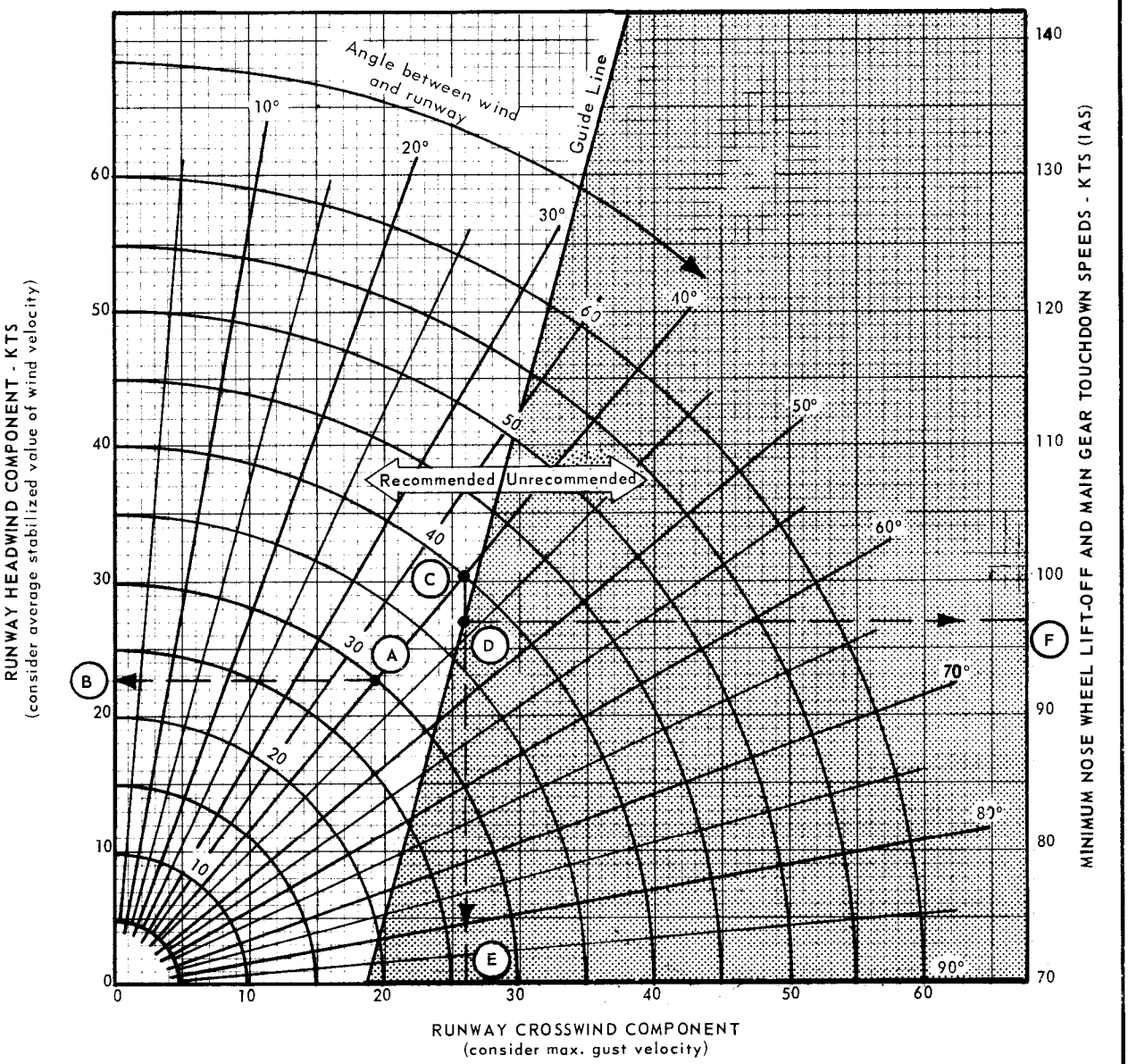
PROCEDURE:

1. Wind direction from runway $50^\circ - 10^\circ = 40^\circ$
2. Enter figure at average wind velocity of 30 kts and wind direction of 40° (A). Move horizontally to headwind component scale and read: 22.5 kts (B).
3. At gust wind velocity of 40 kts and wind direction of 40° drop vertically from (C) to guide line (D).
4. Drop vertically from (D) to runway crosswind component scale and read: 26 kts (E)
5. Move horizontally from (D) to minimum nose wheel lift-off and main gear touchdown speed scale and read the minimum nose wheel lift-off speed: 97 kts IAS (F).
6. From "Take-off speed schedule" of figure A2-2, at take-off gross weight of 8000 lb there corresponds a take-off speed of 85 kts IAS (zero wind).
7. The recommended take-off speed is: 97 kts IAS (this speed is the greater between the nose wheel lift-off and the zero wind take-off speed).

TAKE-OFF AND LANDING CROSSWIND COMPONENTS

MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb impgal (6.5 lb USgal)



NOTES:

1 Check the minimum permissible take-off and landing speed in case gusts should exceed 20 kts

2 Enter chart with steady wind to determine headwind component and with maximum gust velocity to determine crosswind component

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Figure A2-1

TAKE-OFF GROUND RUN DISTANCE CHART

EXAMPLE BASED ON FIGURE A2-2

DATA:

- Engine setting: Maximum thrust
- Flaps setting: Take-off
- Gross weight: 9000 lb
- Runway air temperature: 43°C
- Pressure altitude: 1000 ft
- Runway headwind component: 16 kts
- Runway slope: 1% down hill

FIND:

- Ground run distance.

PROCEDURE:

1. Enter figure A2-2 at runway air temperature: 43°C (A).
2. Move vertically up to altitude: 1000 ft (B).
3. Move horizontally to gross weight: 9000 lb (C).
4. Drop vertically to wind base line (D).
5. Move parallel to "Headwind" guide lines to wind: 16 kts (E).
6. Drop vertically to slope base line (F).
7. Move parallel to "Down hill" guide lines to slope: 1% (G).
8. Drop vertically to ground run distance scale and read distance: 1750 ft (H).

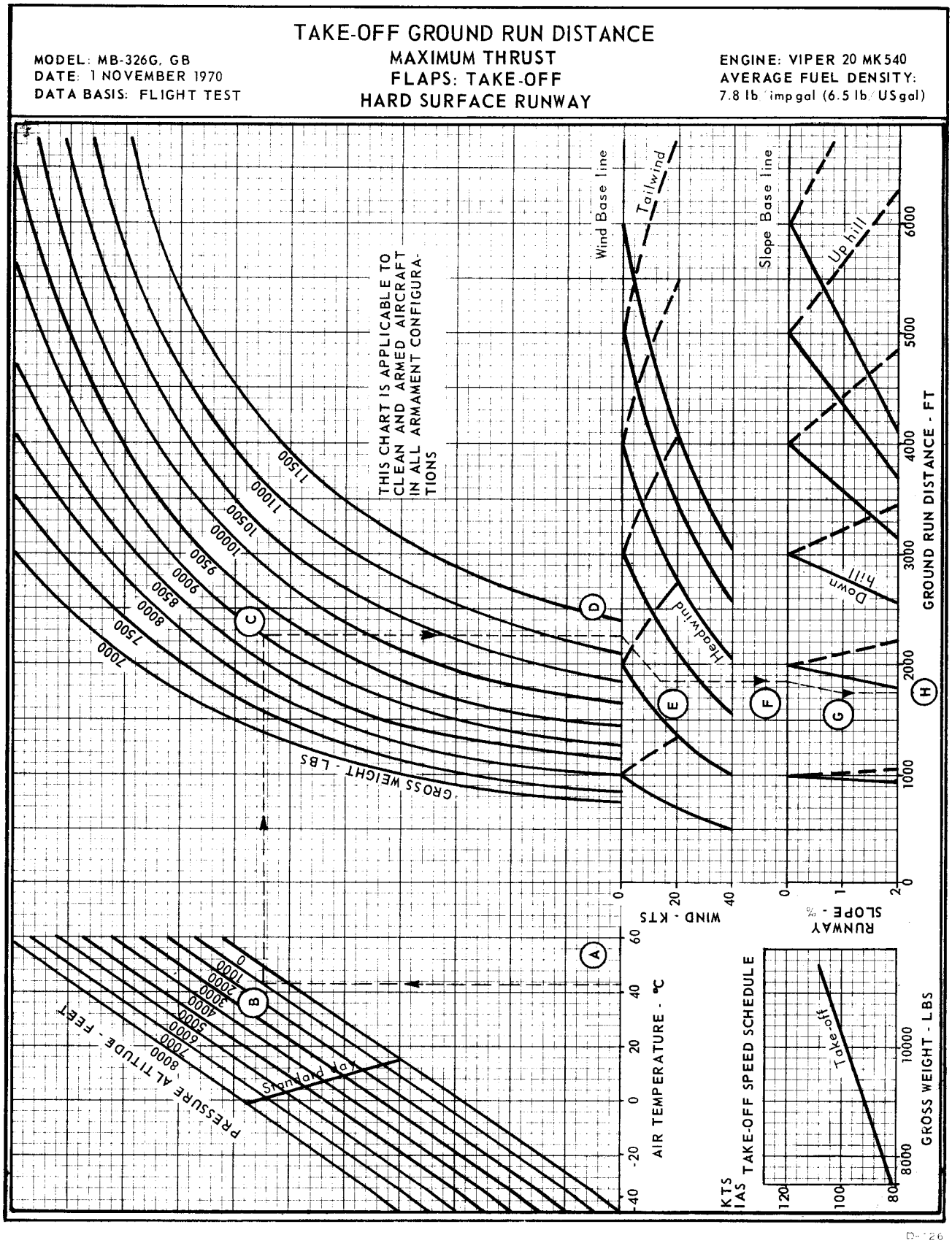

TAKE-OFF GROUND RUN DISTANCE
MAXIMUM THRUST
FLAPS: TAKE-OFF
HARD SURFACE RUNWAY
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/impgal (6.5 lb/USgal)
THIS CHART IS APPLICABLE TO CLEAN AND ARMED AIRCRAFT IN ALL ARMAMENT CONFIGURATIONS
GROSS WEIGHT - LBS
11500
11000
10500
10000
9500
9000
8500
8000
7500
7000
PRESSURE ALTITUDE - FEET
0
1000
2000
3000
4000
5000
6000
7000
8000
Standard Day
AIR TEMPERATURE - °C
60
40
20
0
-20
-40
A
B
C
D
E
F
G
H
Wind Base line
Tailwind
Headwind
WIND - KTS
0
20
40
Slope Base line
Up hill
Down hill
RUNWAY SLOPE - %
0
1
2
GROUND RUN DISTANCE - FT
6000
5000
4000
3000
2000
1000
0
KTS IAS TAKE-OFF SPEED SCHEDULE
Take-off
120
100
80
GROSS WEIGHT - LBS
10000
8000

Figure A2-2

TOTAL TAKE-OFF DISTANCE TO CLEAR 50 FT OBSTACLE

EXAMPLE BASED ON FIGURE A2-3

DATA:

- Engine setting: Maximum thrust
- Flaps setting: Take-off
- Gross weight: 9000 lb
- Runway air temperature: 43°C
- Pressure altitude: 1000 ft
- Runway headwind component: 16 kts
- Runway slope: 1% down hill

FIND:

– Ground run distance for given conditions:

PROCEDURE:

1. Enter figure A2-3 at runway air temperature: 43°C (A).
2. Move vertically up to altitude: 1000 ft (B).
3. Move horizontally to gross weight: 9000 lb (C).
4. Drop vertically to wind base line (D).
5. Move parallel to "Headwind" guide lines to wind: 16 kts (E).
6. Drop vertically to slope base line (F).
7. Move parallel to "Down hill" guide lines to slope: 1% (G).
8. Drop vertically to total take-off distance scale and read distance: 2600 ft (H).

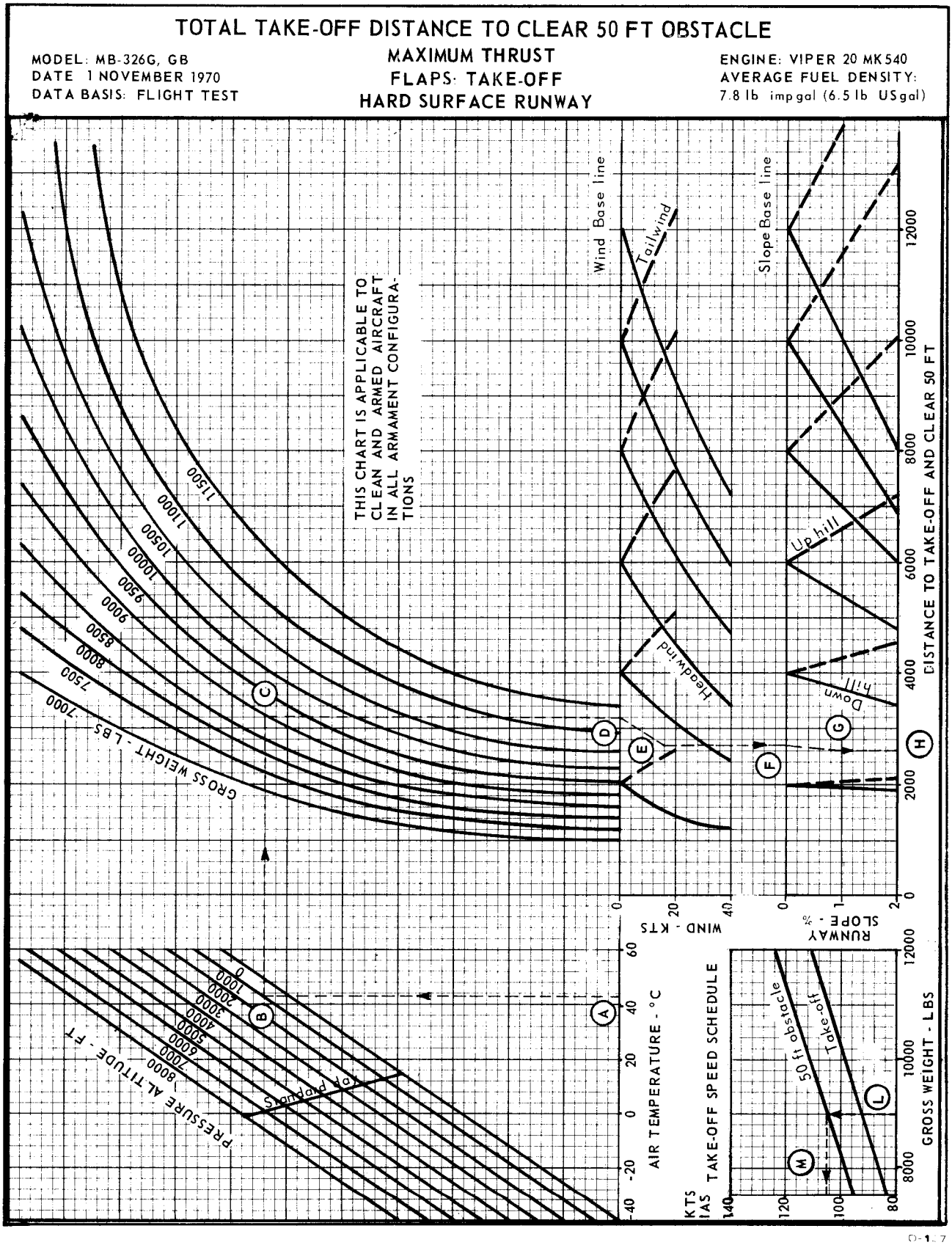

TOTAL TAKE-OFF DISTANCE TO CLEAR 50 FT OBSTACLE
MODEL: MB-326G, GB
DATE 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
MAXIMUM THRUST
FLAPS: TAKE-OFF
HARD SURFACE RUNWAY
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb impgal (6.5 lb USgal)
THIS CHART IS APPLICABLE TO CLEAN AND ARMED AIRCRAFT IN ALL ARMAMENT CONFIGURATIONS
GROSS WEIGHT - LBS
11500
11000
10500
10000
9500
9000
8500
8000
7500
7000
PRESSURE ALTITUDE - FT
0
1000
2000
3000
4000
5000
6000
7000
8000
Std Day
AIR TEMPERATURE - °C
WIND - KTS
Wind Base line
Tailwind
Headwind
RUNWAY SLOPE - %
Slope Base line
Uphill
Downhill
DISTANCE TO TAKE-OFF AND CLEAR 50 FT
KTS IAS TAKE-OFF SPEED SCHEDULE
50 ft obstacle
Take-off
GROSS WEIGHT - LBS
A
B
C
D
E
F
G
H
L
M

Figure A2-3

TAKE-OFF GROSS WEIGHT LIMITATIONS DUE TO TIRE LIMIT SPEED

EXAMPLE BASED ON FIGURE A2-4

DATA:

- Runway temperature of 38°C
- Runway pressure altitude of 6,000 ft.

FIND:

The take-off gross weight limit with 0, 5 and 10 knots headwing.

PROCEDURE:

1. Enter the chart at the runway temperature = 38°C (A).
2. Proceed vertically up to the pressure altitude = 6000 ft (B).
3. Move horizontally to the headwind speed = 0 knots (C), 5 knots (D), 10 knots (E).
4. Drop vertically and read the limit take-off gross weight: 9,700, 10,500 and 11,300 lb.

NOTE. With headwind above 10 kts the take-off gross weight is not limited by the tire limit speed.

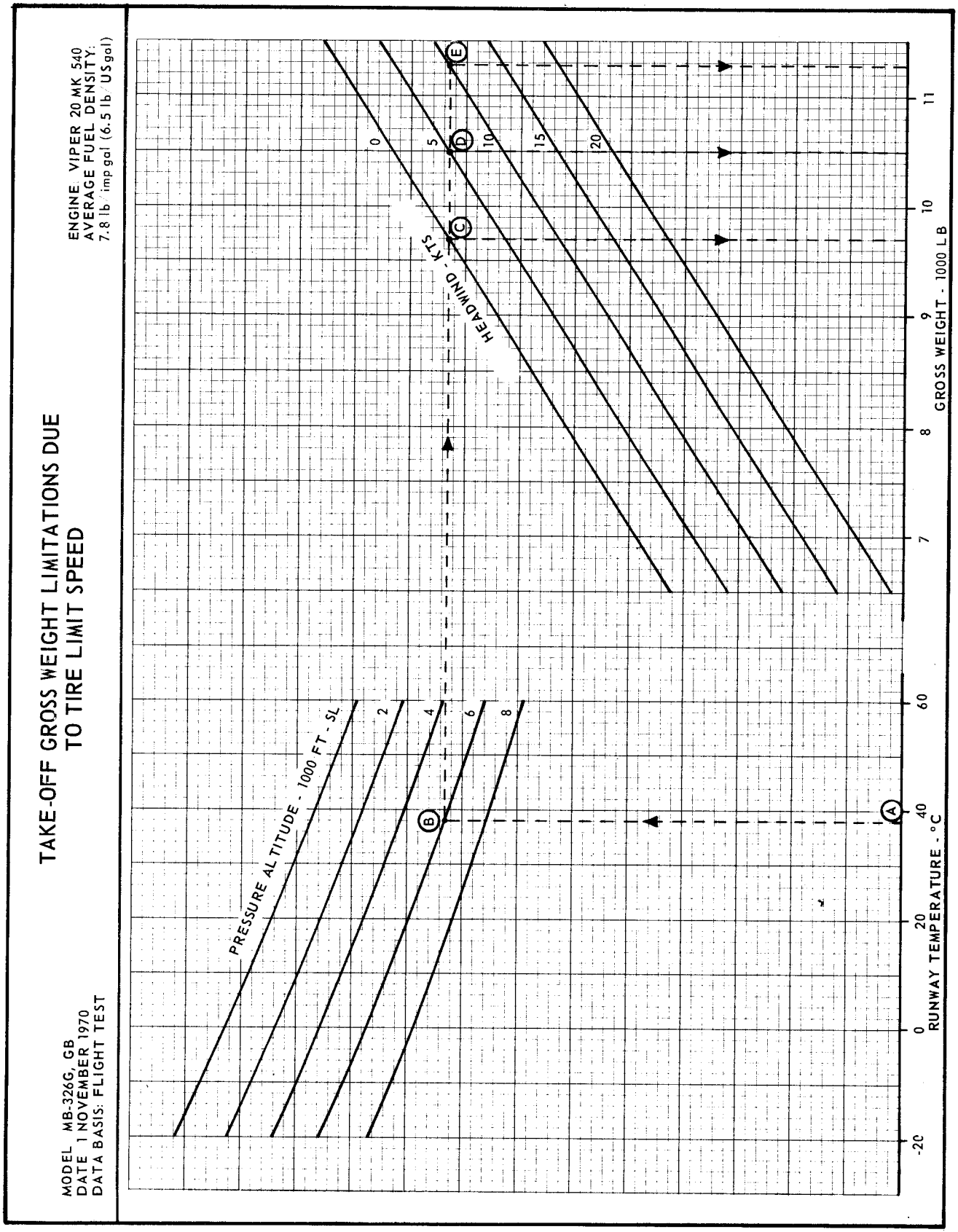

TAKE-OFF GROSS WEIGHT LIMITATIONS DUE TO TIRE LIMIT SPEED
MODEL MB-326G, GB
DATE 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
ENGINE VIPER 20 MK 540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)
PRESSURE ALTITUDE - 1000 FT - SL
0
2
4
6
8
HEADWIND - KTS
0
5
10
15
20
A
B
C
D
E
-20
0
20
40
60
RUNWAY TEMPERATURE - °C
7
8
9
10
11
GROSS WEIGHT - 1000 LB

Figure A2-4

PART III - CLIMB

TABLE OF CONTENTS

Title	Page
General	A3-1
Climb Performance Sample Problem	A3-2

PART III – CLIMB

GENERAL

The following information:

- Rate of climb
- Calibrated airspeed for optimum climb
- Distance travelled in climb
- Time to climb
- Fuel to climb

is presented in the charts:

- for standard day conditions
- versus gross weight
- at maximum thrust

Note

- The fuel consumption provided by these charts does not allow for the fuel consumed in the stages preceding climb, such as engine starting, taxi, take-off, acceleration to optimum climb speed. The corresponding value is 250 lb. This value includes an exuberant margin for long taxiing on the ground.
- The optimum climb schedule has resulted to be, both from flight tests and subsequent extensive research, the best compromise for gross weight variations. It is evident that, during a climb, the following basic limitations should be kept in mind by the pilot: 20 minutes allowed at max. thrust and max. JPT (730°C) per flying hour.
- The climb charts can be read directly to obtain performance data for standard-day conditions. When the free air temperature is higher than standard (a hot day) the aircraft will perform as though the weight is greater than actual. When the free air temperature is lower than standard (a cold day) the aircraft will perform as though the weight is less than actual. A Δ temperature equivalence is included on each climb chart for the determination of non standard-day climb performance. The Δ temperature for the climb is determined as follows:

  1. Determine the average OAT (ambient air temperature) excpected during the climb to desired altitude.
  2. Enter the standard altitude table (Figure A1-5) at the average pressure altitude during the climb and obtain the standard-day temperature.
  3. The difference between the standard--day temperature (step 2) and the average OAT (step 1) is the Δ temperature.

- An example of calculation of the climb performance is developed at page A3-2.

CLIMB PERFORMANCE

EXAMPLE BASED ON FIGURES A3-1, A3-2 AND A3-3.

DATA:

- Engine: maximum thrust
- Initial altitude: 5000 ft
- Final altitude: 36,000 ft
- Weight at initial altitude: 8300 lb
- Aircraft configuration: G
- From meteorologic research, the temperature at the different altitudes results to be as follows:

Altitude ft	Ambient Air Temperature °C	ΔT from Standard (using Standard Altitude Table)
10000	+8.8	+12°C
20000	−2.3	+10°C
30000	−36.4	+ 8°C

FIND:

The fuel to climb, the time to climb and the horizontal distance traveled during climb.

PROCEDURE:

1. Difference between standard-day temperature and actual OAT (ambient air temperature) at the average altitude of 20,000 ft: +10°C (hot day).
2. Enter figure A3-1 "Fuel used to climb"
   a. At initial gross weight = 8300 lb (A) move parallel to "Hotter" guide lines to ΔTemp. = 10°C (B)
   b. Move horizontally to altitude = 36000 ft (C).
   c. Drop vertically to family of configurations line = G (C).
   d. Move horizontally to the fuel used scale and read fuel used = 620 lb (E).
3. Enter figure A3-2 "Time to climb".
   a. At initial gross weight = 8300 lb (F) move parallel to "Hotter" guide lines to ΔTemp. = 10°C (G).
   b. Move horizontally to altitude = 36000 ft (H).
   c. Drop vertically to family of configuration line = G (I).
   d. Move horizontally to the time scale and read time = 20.1 min (J).
4. Enter figure A3-3 "Horizontal distance travelled during climb"

a. At initial gross weight = 8300 lb (K) move parallel to "Hotter" guide lines to ΔTemp. = 10°C (L).

b. Move horizontally to altitude = 36000 ft (M).

c. Drop vertically to family of configuration line = G (N).

d. Move horizontally to the distance scale and read distance = 77 Naut. Mi. (O)

5. Re-enter figures A3-1, A3-2, A3-3 and repeat steps (A) through (O) using altitude = 5000 ft.

   Read:

   Fuel used = 70 lb

   Time = 1.3 min

   Distance = 4 Naut. Mi.

6. Determine fuel used from 5000 ft to 36000 ft:

   Fuel used from sea level to 36000 ft : 620 lb

   Fuel used from sea level to 5000 ft : 70 lb

   Fuel used : 550 lb

7. Determine time to climb from 5000 ft to 36000 ft :

   Time from sea level to 36000 ft : 20.1 min

   Time from sea level to 5000 ft : 1.3 min

   Time to climb : 18.8 min

8. Determine horizontal distance travelled in climb from 5000 ft to 36000 ft:

   Distance to climb from sea level to 36000 ft : 77 Naut. Mi.

   Distance to climb from sea level to 5000 ft : 3 Naut. Mi.

   Horizontal distance travelled in climb: 73 Naut.Mi.

Note. The climb speed schedule to be followed is taken from figure A3-4.

FUEL USED TO CLIMB
MAXIMUM THRUST
STANDARD DAY

MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)

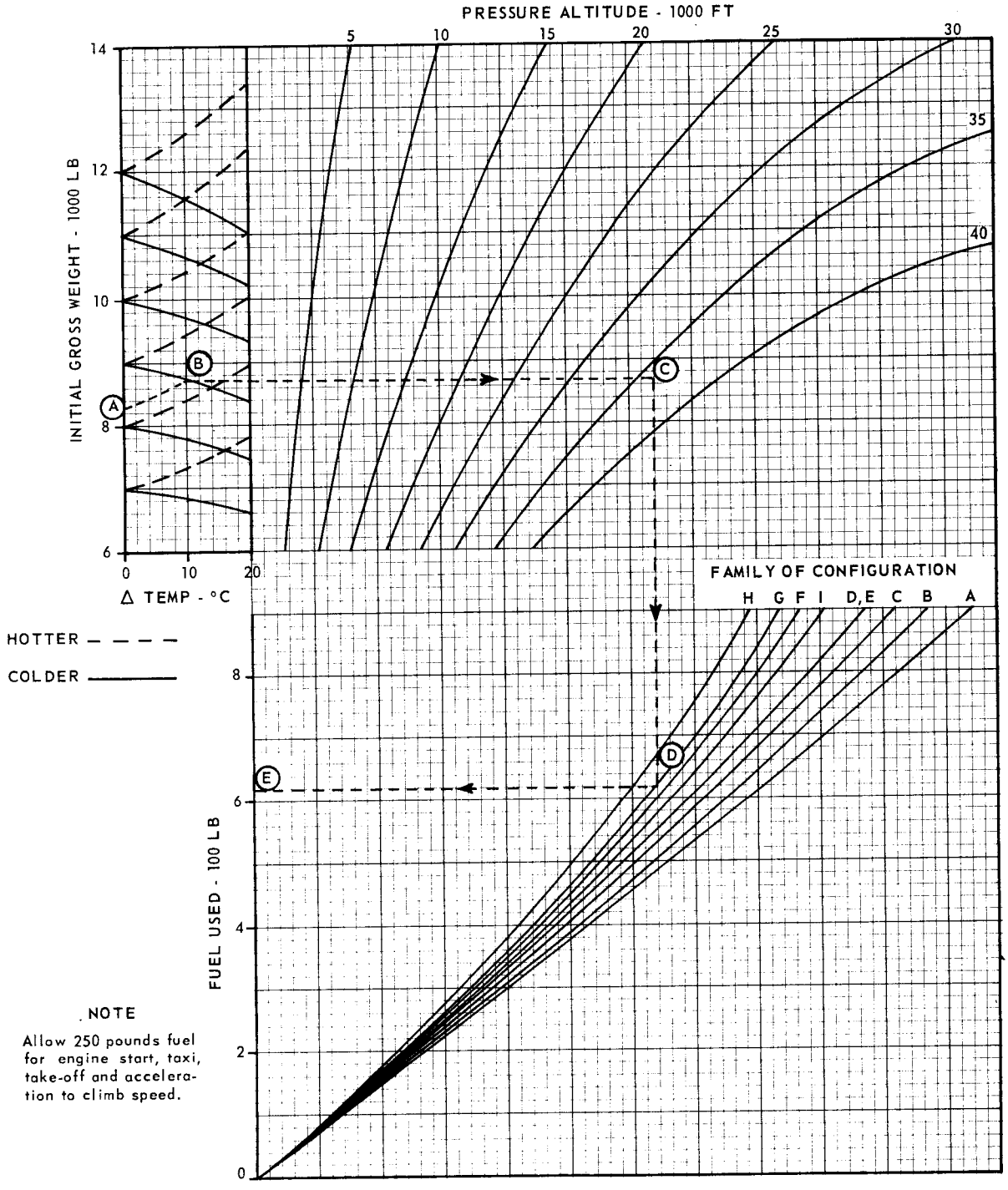


Figure A3-1

MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

TIME TO CLIMB
MAXIMUM THRUST
STANDARD DAY

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb impgal (6.5 lb USgal)

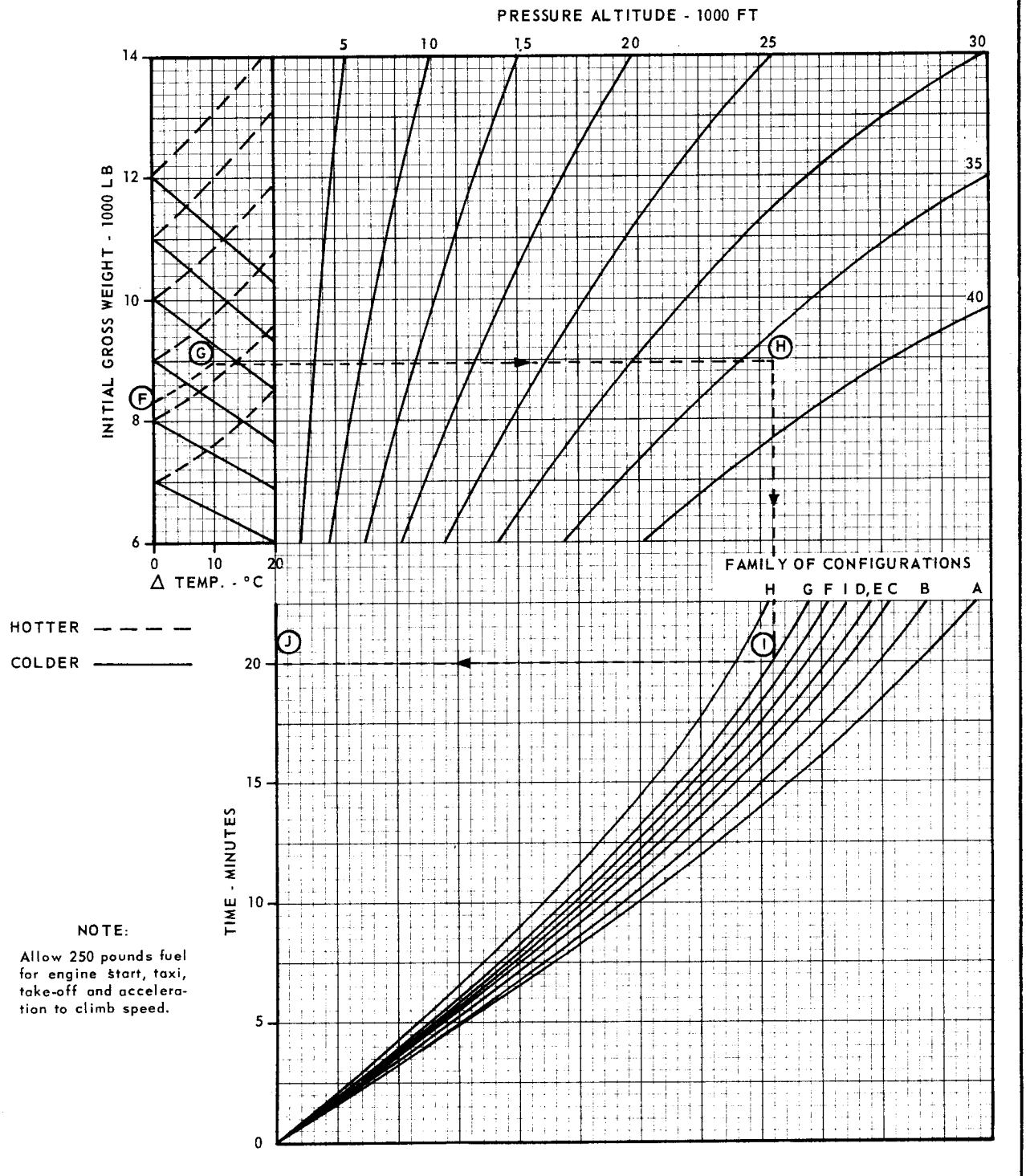


Figure A3-2

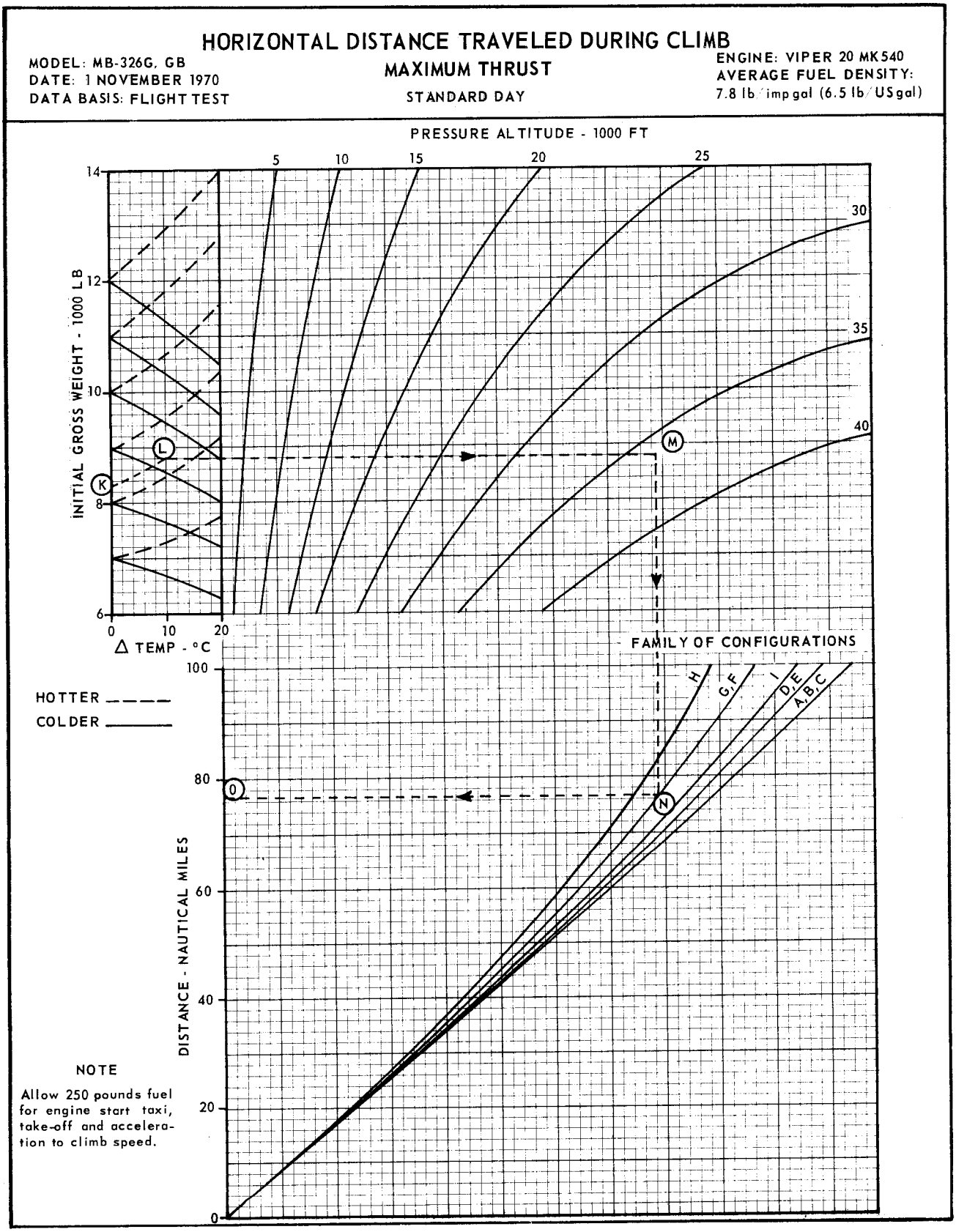

HORIZONTAL DISTANCE TRAVELED DURING CLIMB
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
MAXIMUM THRUST
STANDARD DAY
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)
PRESSURE ALTITUDE - 1000 FT
5
10
15
20
25
30
35
40
INITIAL GROSS WEIGHT - 1000 LB
14
12
10
8
6
K
L
M
N
O
0
10
20
Δ TEMP - °C
HOTTER
COLDER
FAMILY OF CONFIGURATIONS
H
G,F
I
D,E
A,B,C
100
80
60
40
20
0
DISTANCE - NAUTICAL MILES
NOTE
Allow 250 pounds fuel for engine start taxi, take-off and acceleration to climb speed.

Figure A3-3

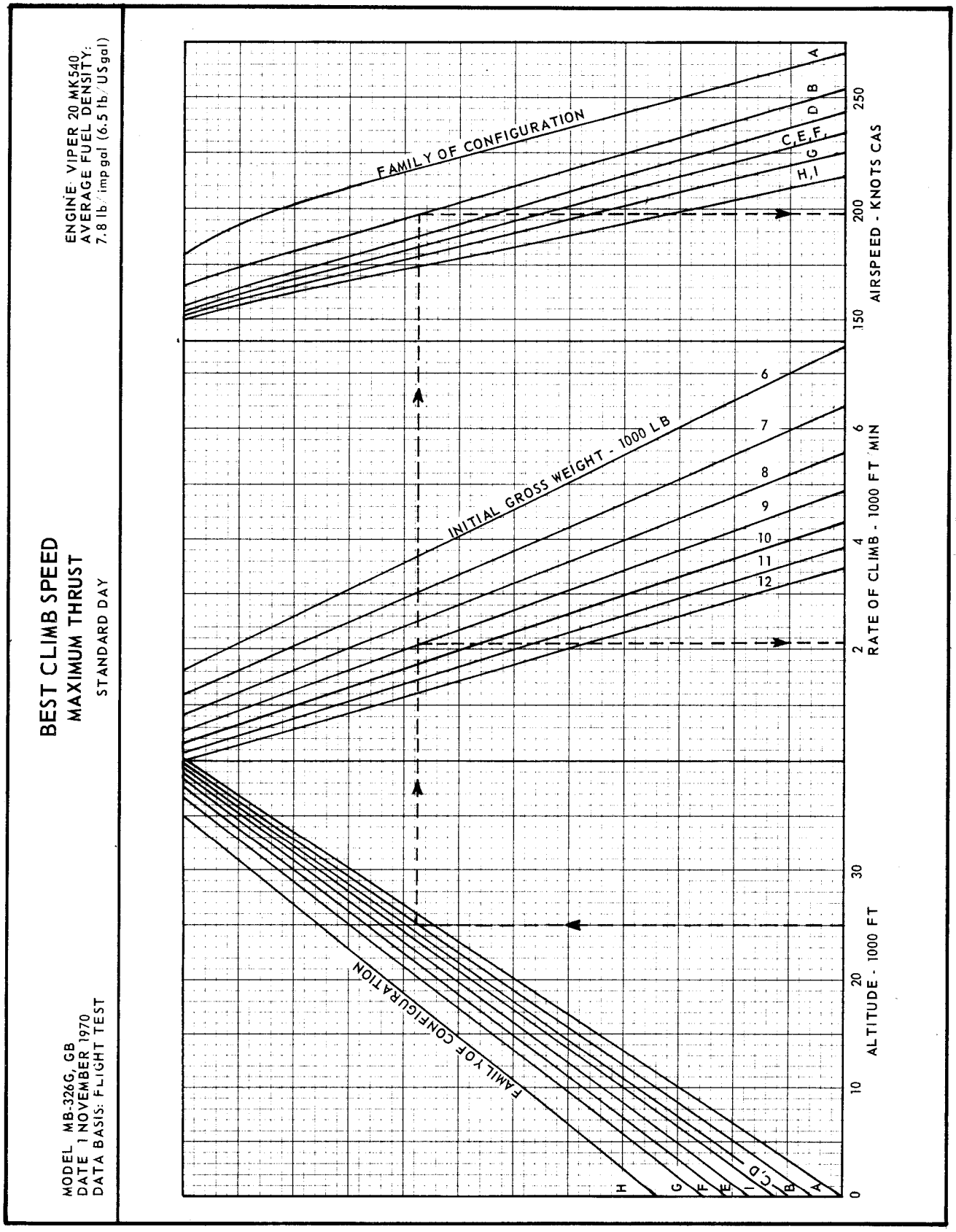

BEST CLIMB SPEED
MAXIMUM THRUST
STANDARD DAY
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
FAMILY OF CONFIGURATION
A
B
D
C, E, F,
G
H, I
AIRSPEED - KNOTS CAS
150
200
250
INITIAL GROSS WEIGHT - 1000 LB
6
7
8
9
10
11
12
RATE OF CLIMB - 1000 FT/MIN
2
4
6
FAMILY OF CONFIGURATION
H
G
F
E
I
C,D
B
A
ALTITUDE - 1000 FT
0
10
20
30

Figure A3-4

PART IV – RANGE

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General Information on Maximum Range	A4-1
Purpose of Charts	A4-5
Miles per Pound Charts	A4-5
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Constant Altitude Cruise 99% Maximum Range	A4-89
Constant Altitude Cruise 99% Maximum Range-Sample Problem	A4-90

GENERAL INFORMATION ON MAXIMUM RANGE

The maximum range condition is obtained at the flight point allowing the maximum distance to be flown with the minimum fuel consumption, in the unity of time.
The distance travelled and fuel consumed in the unity of time are respectively the aircraft speed and the engine fuel flow.
The relevant equation therefore is:

(1) $\frac{V}{C_h} = \max$

V = True airspeed (kts)

C_h = Fuel flow (lb/h)

From the equation of lift in level flight the true airspeed V can be expressed as:

$$V = \sqrt{\frac{2 \cdot W}{\rho \cdot S \cdot C_L}}$$

V = Aircraft weight that, due to the level flight equilibrium is equal to the aerodynamic lift.

ρ = Air density

S = Wing surface area

C_L = Lift coefficient

The fuel flow is given by:

(2) $C_h = C_t \cdot T$ C_t = Engine specific fuel consumption in lb/lb.h; it is a function of the engine overall efficiency (product of the compressor, combustion, turbine etc. efficiences).

T = Engine thrust (lb).

The thrust required in level flight, T, can be expressed as a function of the aircraft weight by dividing, term by term, the two level flight equations:

$$\frac{T = \frac{1}{2} \rho S V^2 C_D}{W = \frac{1}{2} \rho S V^2 C_L}$$

$$\frac{T}{W} = \frac{C_D}{C_L}$$ C_D = Aerodynamic drag coefficient

(3) $T = W \cdot \frac{C_D}{C_L}$

Substitution of this equation into equation (1) gives:

$$\text{Specific range} = \frac{\text{Naut.Mi}}{\text{lb}} = \frac{V}{c_t \cdot T} = \frac{\sqrt{\frac{2W}{\rho S C_L}}}{c_t \cdot W \frac{C_D}{C_L}} =$$

(4) $$= \boxed{1.41 \; \frac{\sqrt{C_L}}{C_D} \cdot \frac{1}{c_t} \cdot \frac{1}{\sqrt{\rho S W}}}$$

The maximum range is therefore obtained at the maximum value of V/C_h defined from expression (4), in $\frac{\text{Naut.Mi}}{\text{lb}}$

Thus, for a given aircraft, at a given gross weight

(W) and assigned altitude (ρ), the maximum distance travelled per pound of fuel (Naut.Mi/lb) is obtained when the following product is at maximum

$$\frac{\sqrt{C_L}}{C_D} \qquad \frac{1}{c_t}$$

If the engine specific fuel consumption c_t (lb/lb.h) remained constant with varying airspeed and engine setting required to provide a thrust corresponding to the different speeds, the maximum range would be obtained exactly at the angle of attack corresponding to ($\sqrt{C_L}/C_D$) max.

In practice, the specific fuel consumption undergoes a remarkable variation with respect to the above parameters, as follows:

a) Starting from a certain engine setting which, as far as the Viper 20 is concerned, varies from 95% RPM at sea level to 85% RPM at 40,000 ft, the specific fuel consumption (lb/lb.h) increases as the RPM percent is reduced, for a given true airspeed.

b) At all altitudes and at any assigned constant value of RPM percent, the specific fuel consumption decreases as the aircraft true speed decreases.

The influence of these flight parameters on the specific fuel consumption is shown in charts **A** and **B** for exemplification purposes.

These charts in fact represent the typical curve of the specific fuel consumption as a function of the RPM and airspeed variations, for an average cruise condition.

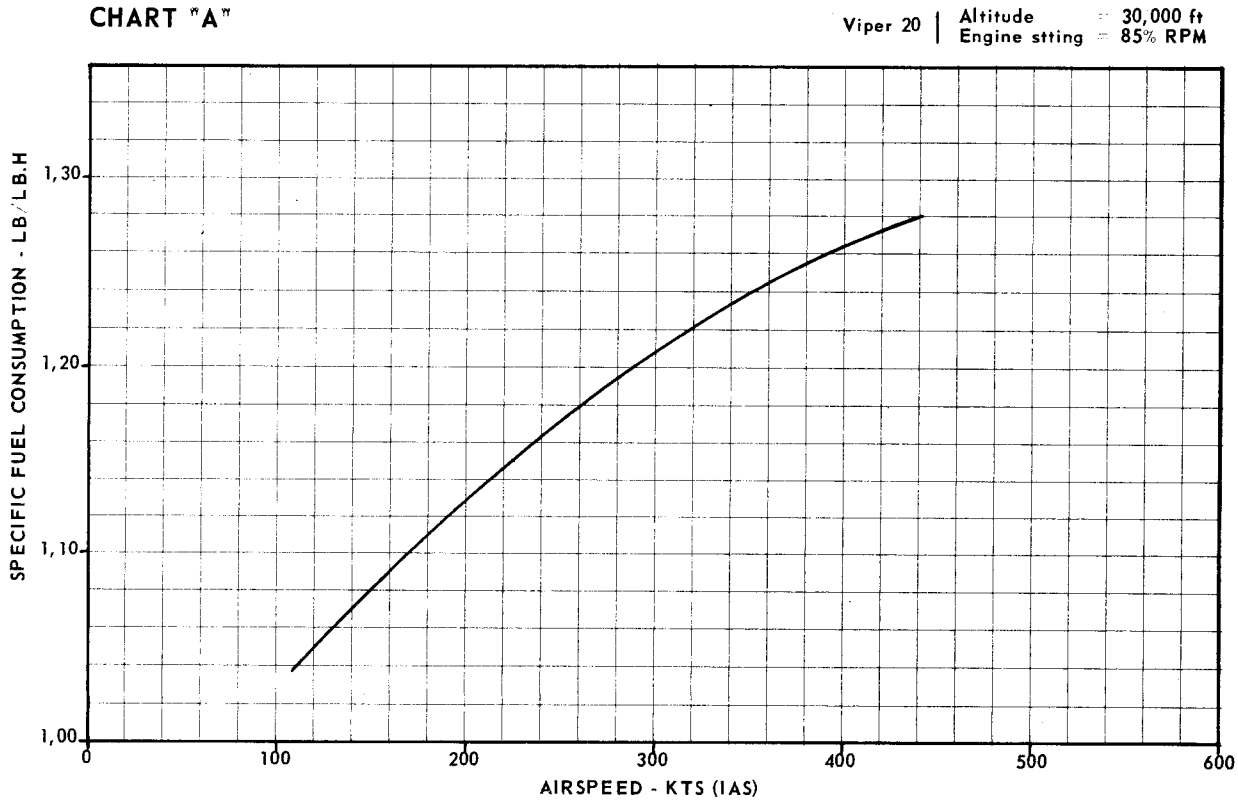
By assuming the RPM percent as constant, it is noted that to an increase in the selected cruise speed there corresponds an **increase** of specific fuel consumption (Chart **A**).

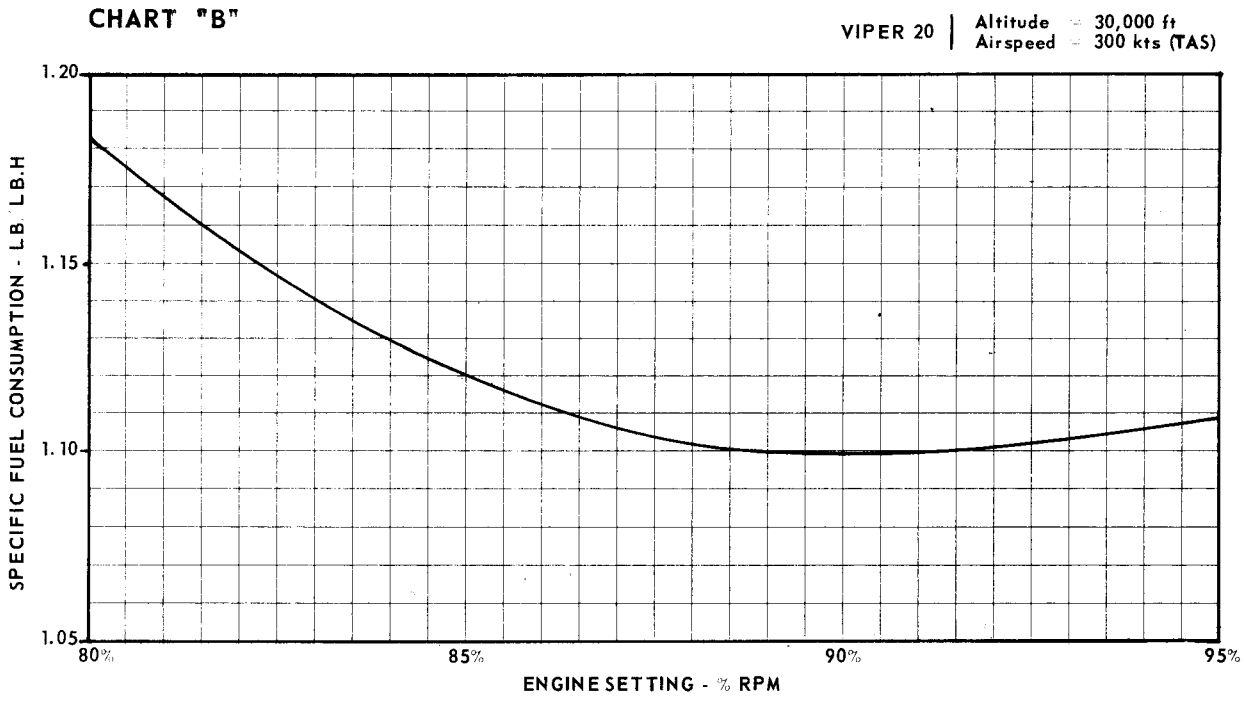
On the other hand, an increase in cruise speed involves an increase in the thrust required and therefore an increase in the RPM percent, to which there corresponds a **decrease** of fuel specific consumption (Chart **B**).

This dual effect of airspeed and engine setting on the specific fuel consumption gives the reason why for any assigned condition of weight and altitude, the aircraft angle of attack corresponding in the graphs of this manual to the recommended speed for maximum range is not actually the theoretical value at which ($\sqrt{C_L}/C_D$) max is obtained.

The variation of specific range ($\frac{\text{Naut.Mi}}{\text{lb}}$), as a function of the altitude, is determined by the influence of the following parameters:

a) **Air density**: as appears from equation (4) in this





page, the specific range value $\frac{V}{c_t \cdot T} = \frac{\text{Naut.Mi}}{\text{lb}}$ increases, all other conditions remaining the same, with the increase of altitude in accordance with the law of variation of the square root of the absolute density.

b) **Specific fuel consumption**: for a given calibrated airspeed (CAS), a given gross weight and on the assumption that the compressibility effects on the aerodynamic coefficients are negligible, there corresponds, regardless of the altitude:

- an angle of attack of the aircraft.
- a value of $\sqrt{C_L}/C_D$:
- a value of $\frac{C_D}{C_L}$ and therefore of the thrust required for level flight $T = W \cdot \frac{C_D}{C_L}$

If it is assumed to fly in cruise at the calibrated airspeed and therefore at the angle of attack for maximum range $(\frac{\sqrt{C_L}}{C_D}$ max.), it follows that, at least theoretically, the corresponding thrust required for the level flight remains constant with the variation of altitude.

At a calibrated airspeed and engine thrust reciprocally determined and constant, the specific fuel consumption remarkably decreases with increasing altitude.

In chart **C** the curve of the specific fuel consumption variation as a function of the altitude is represented for a condition of flight included within the aircraft cruise speed range.

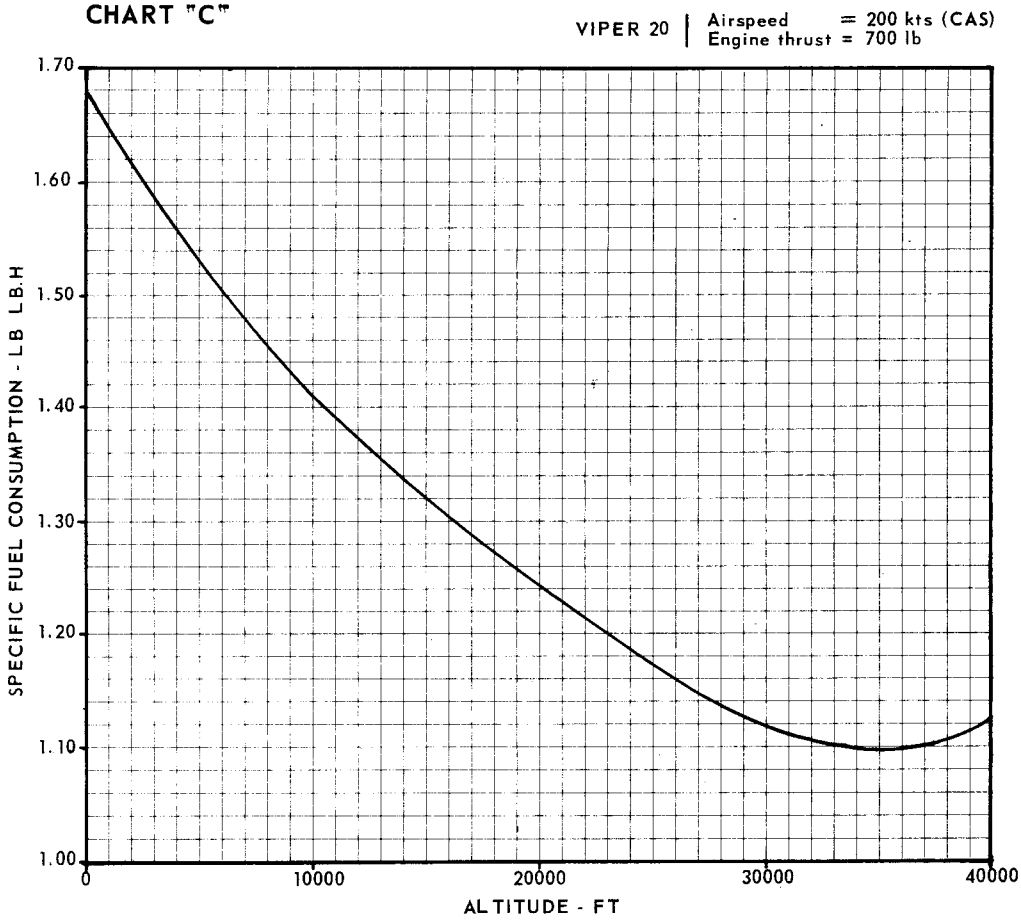
This chart, like the previous ones, is drawn from the sets of Viper 20 jet engine performance curves supplied by Rolls-Royce.

It is evident that to achieve low values of specific fuel consumption, c_t, and therefore very high specific ranges $(\frac{\text{Naut.Mi}}{\text{lb}})$ (as per equation (4) at page A4-2), the pilot must fly at altitudes as high as possible.

Finally, it is noted from chart **C** that at altitudes above 35,000 ft, the specific fuel consumption curve, after passing through the lowest consumption point, shows a tendency to increase again. This increase in the specific fuel consumption at high altitude is due, for the engine installed in the aircraft, to a reduction of the compression efficiency involved by the change of the Reynolds number in the compressor blades.

This small increase of specific consumption, c_t, is however compensated for by the decreased density (factor $1/\sqrt{\rho}$ in equation (4) at page A4-2). Therefore, in order to obtain the maximum specific range, it will be in any case convenient for the pilot to fly at an altitude as high as possible.

c) **Mach number**: Although the compressibility effects



are more evident in the aircraft at values of Mach number above 0.75, some changes in the aerodynamic coefficients are already present at cruise M values.

Precisely, an increase in the Mach number will involve:

1) Increase in lift coefficient, C_L, for a given angle of attack.

2) Increase in aerodynamic drag coefficient, C_D.

The variation law of the optimum Mach number for the maximum cruise range as a function of the altitude recommended in the graphs of this manual, has been experimentally obtained and therefore also allows for the aforementioned compressibility effects.

PURPOSE OF CHARTS

The purpose of the charts is to supply flight planning data applicable to the cruise portion of any type of flight plan. The parametric miles-per-pound charts show level flight performance for operations between maximum endurance speeds and speeds resulting from use of max thrust.

MILES PER POUND CHARTS

The nautical miles per pound of fuel charts present cruise data for the speed range from maximum endurance to max thrust. The chart parameters are basic plots of nautical miles per pounds of fuel versus Mach number for various gross weights. Each chart includes the specific range available that will result from various engine settings and fuel flows. Engine speeds are purely indicative, because non-standard air conditions and the operating characteristics of individual engines have a decided effect on the RPM setting required to maintain cruise airspeeds. The recommended procedure is to cruise at the Mach number recommended and monitor the fuel flow to compare the actual miles per pound with that predicted.

USE OF MILES PER POUND CHARTS

The miles-per-pound charts can be used to determine range when the speed schedules shown on the range charts are not satisfactory for mission requirements. The charts provide the following data:

- Specific range in N.Mi/lb
- Fuel flow in lb/h
- Indicative engine setting in RPM (percent of max.) for the following reference conditions.

- Flight altitudes in 5000 ft increments from S.L. to 40,000 for the A, B, C, D, E, F, G configurations, from S.L. to 36,000 ft for the H and I configurations.
- Standard day
- Gross weight: all weight values, for every 1000 lb increment, concerning all configurations.
- Airspeed range: from the speed for maximum endurance to maximum level speed.

Compution of the fuel quantity and time required to fly a given distance at a desired altitude and speed should be normally considered in flight planning.
The essential condition to obtain the cruise performance for optimum range is that the calibrated airspeed (or Mach number) be in conformity with the values progressively corresponding to the reduced gross weight.
To this end, the pilot should correct the assigned RPM accordingly or, within the limits allowed by navigation, will slightly increase the altitude while maintaining the optimum Mach number assigned at the beginning of cruise throughout the cruising. Effect of non-standard air temperature: in practice, the N.Mi/lb value will not undergo appreciable changes for non-standard air temperatures. On the contrary, the required RPM setting and lb/h consumption will vary, but their change is compensated for by the different value of TAS. Flight time, between the check points, will also be different, while the attainable distance will practically remain unchanged. Effect of wind: when a very accurate flight planning for maximum range is required, the wind component on the aircraft course should be considered when assigning the optimum cruise speed.Recommended cruise speed lines for maximum range operations are presented on the charts for 100 knot headwind conditions.
In the condition of flight with wind, the specific range (N.Mi/lb) is corrected with respect to the zero wind condition by use of the following formula:

$$\text{Ground specific range} = \text{Specific range} \times \frac{\text{Average ground speed (GS)}}{\text{Average true airspeed (TAS)}}$$

Note

At page A4-32 there is given an example of mission planning with reference to the concerned chart.

CONSTANT ALTITUDE CRUISE 99% MAXIMUM RANGE

For constant altitude cruise 99% maximum range, see page A4-89.

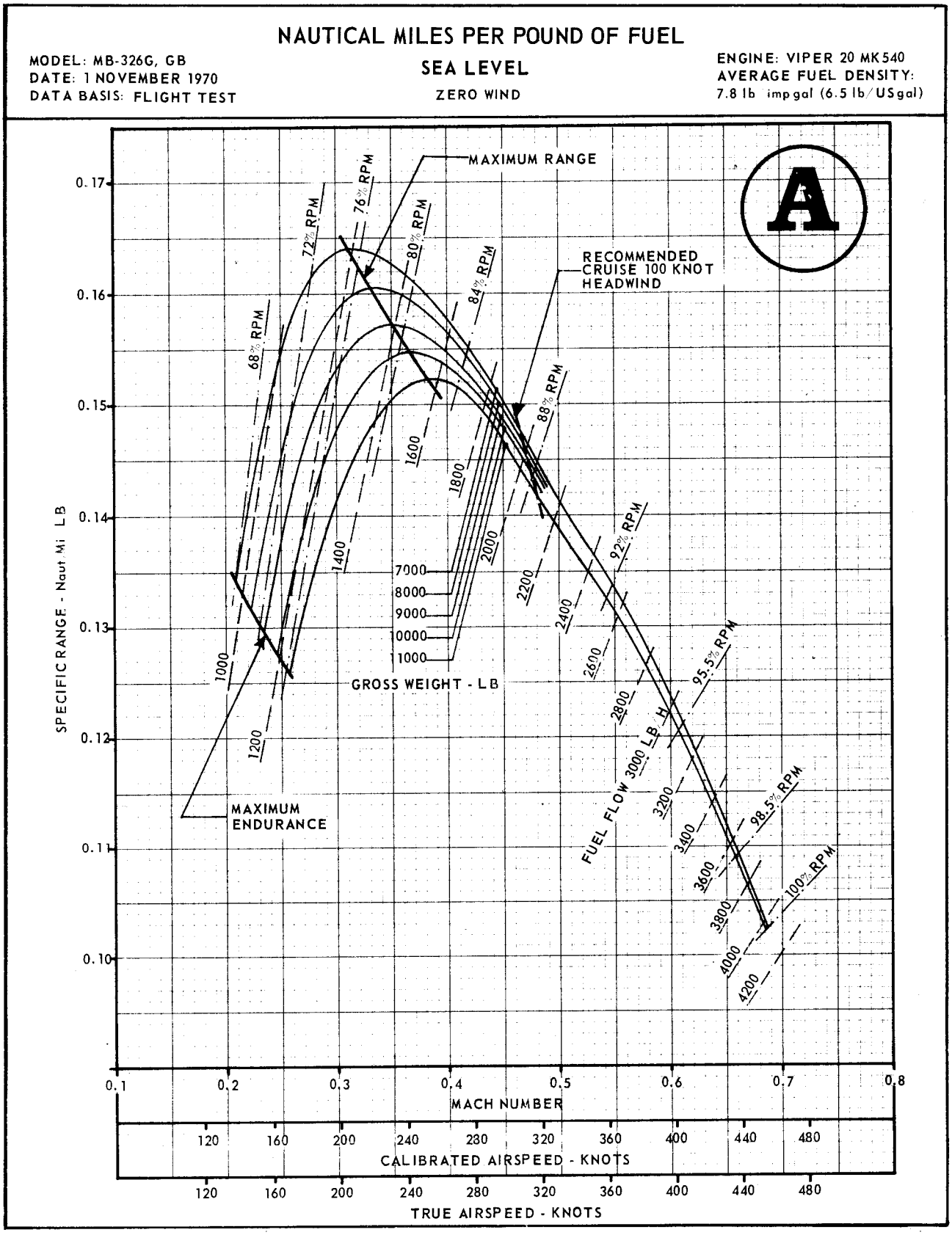


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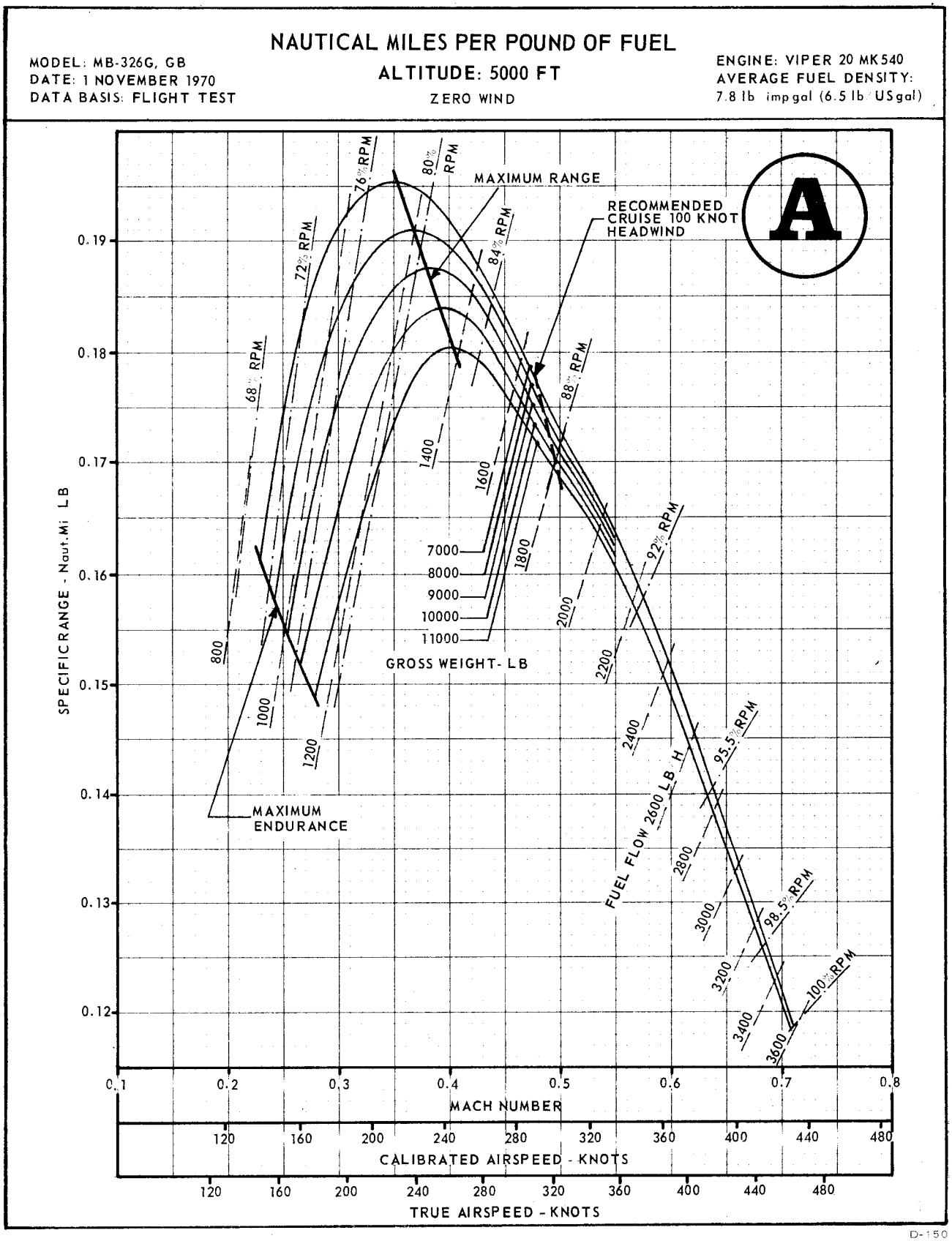


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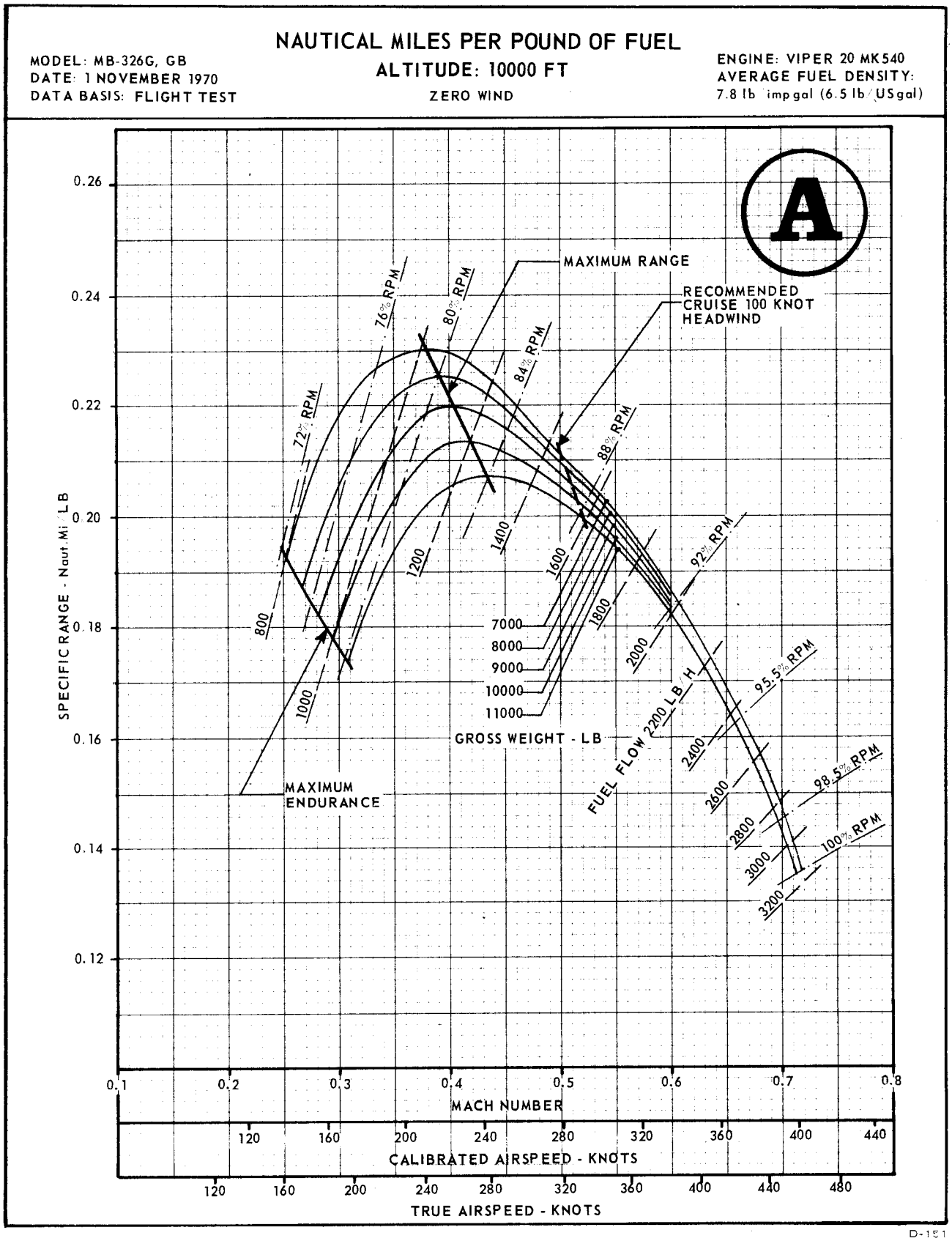


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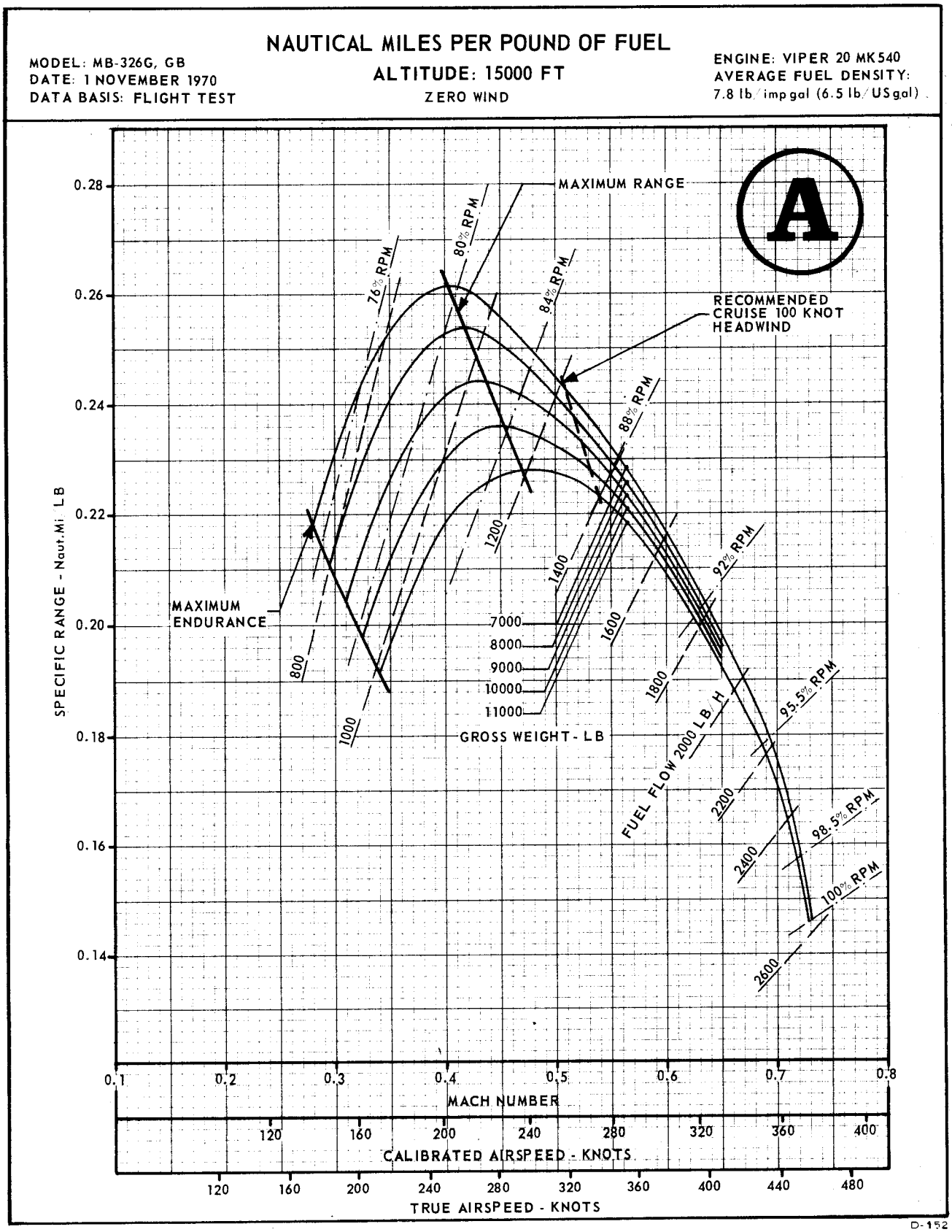


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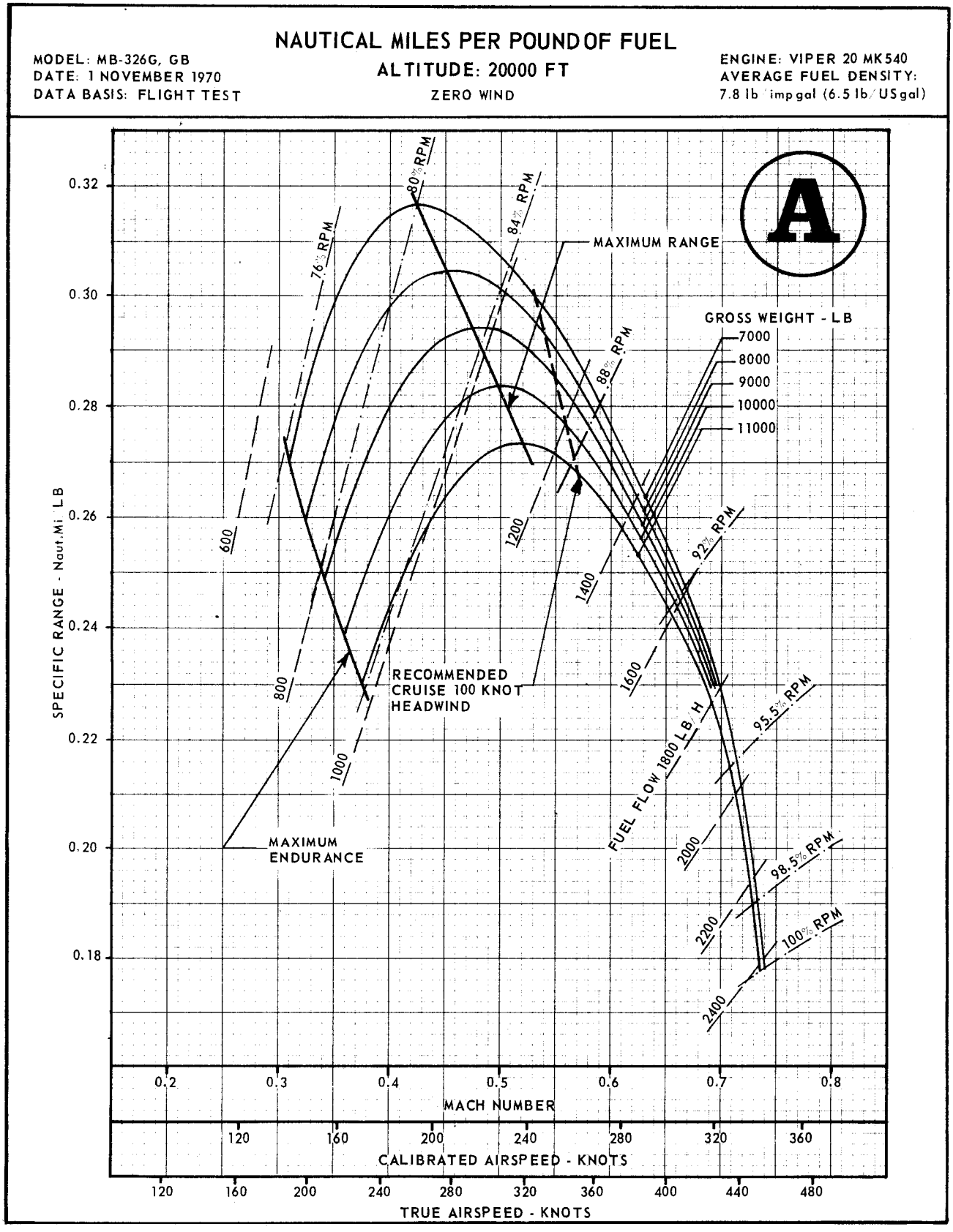


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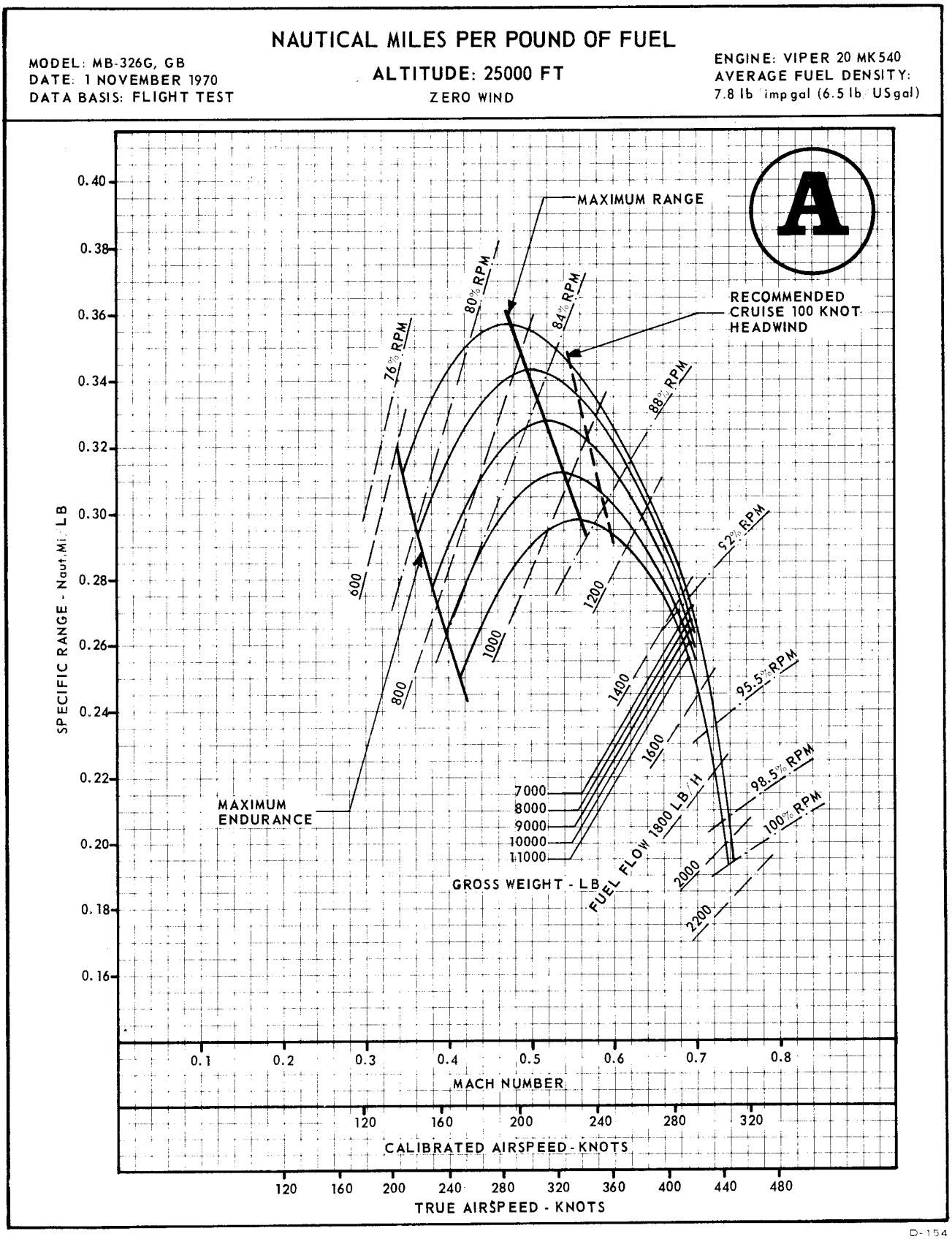


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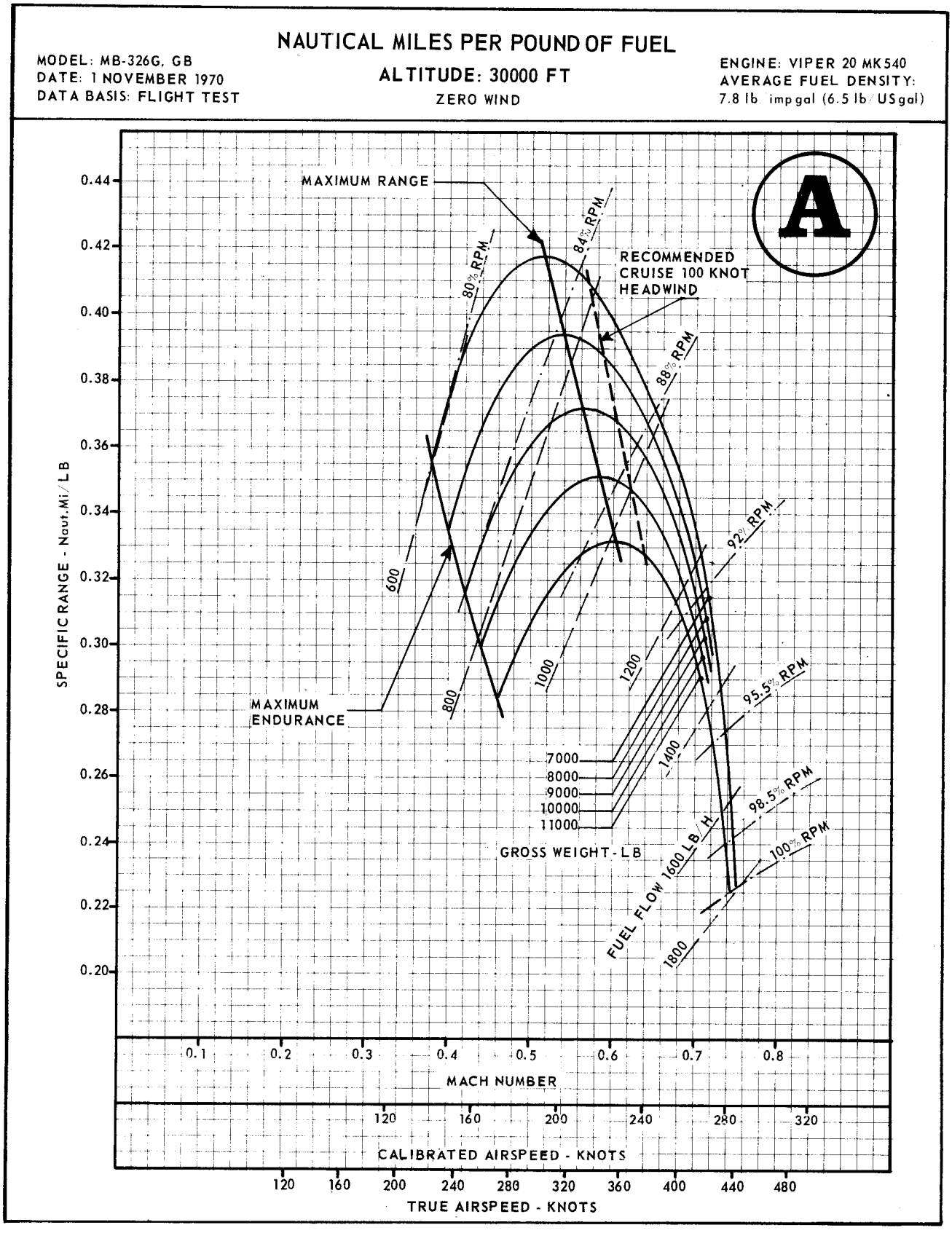


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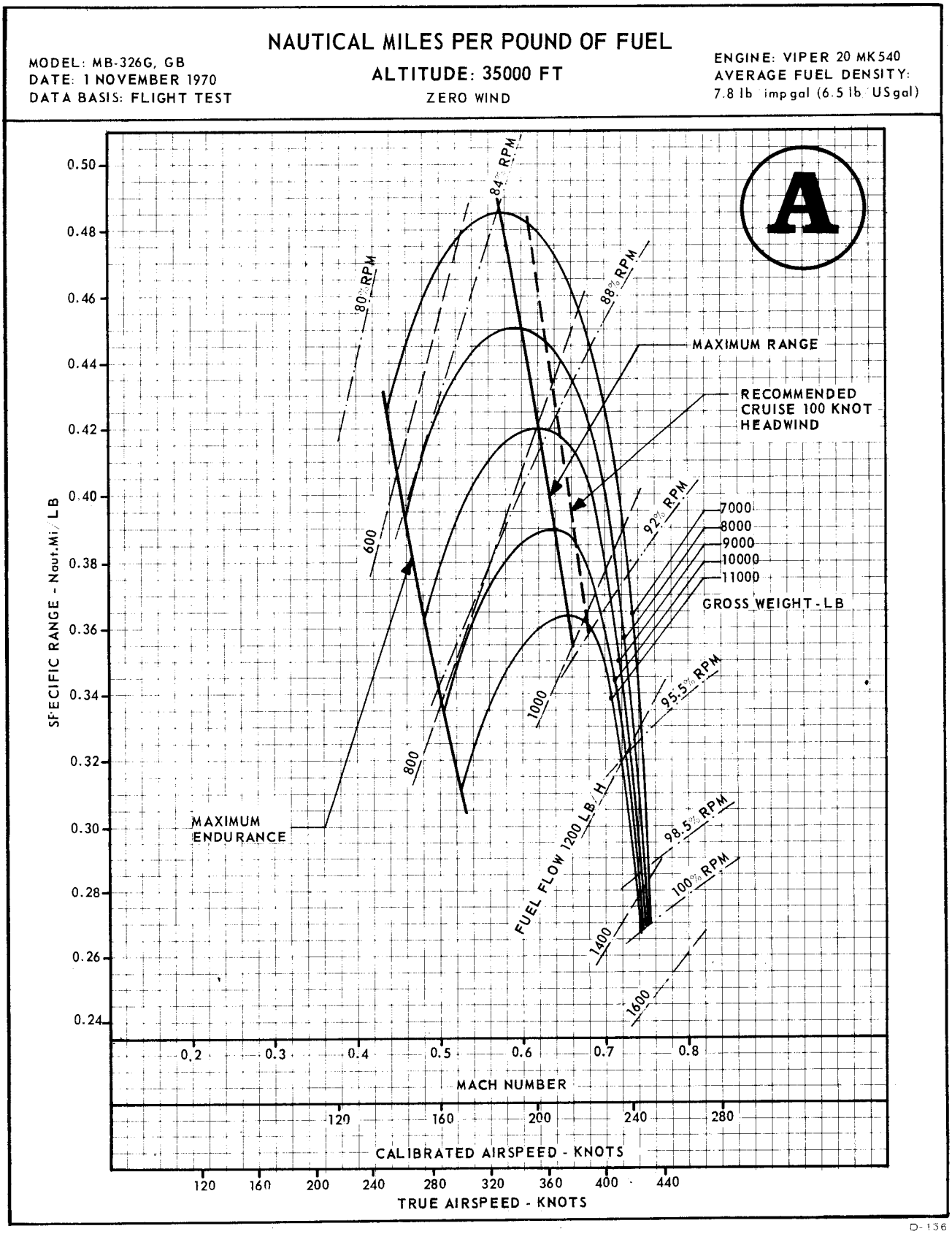


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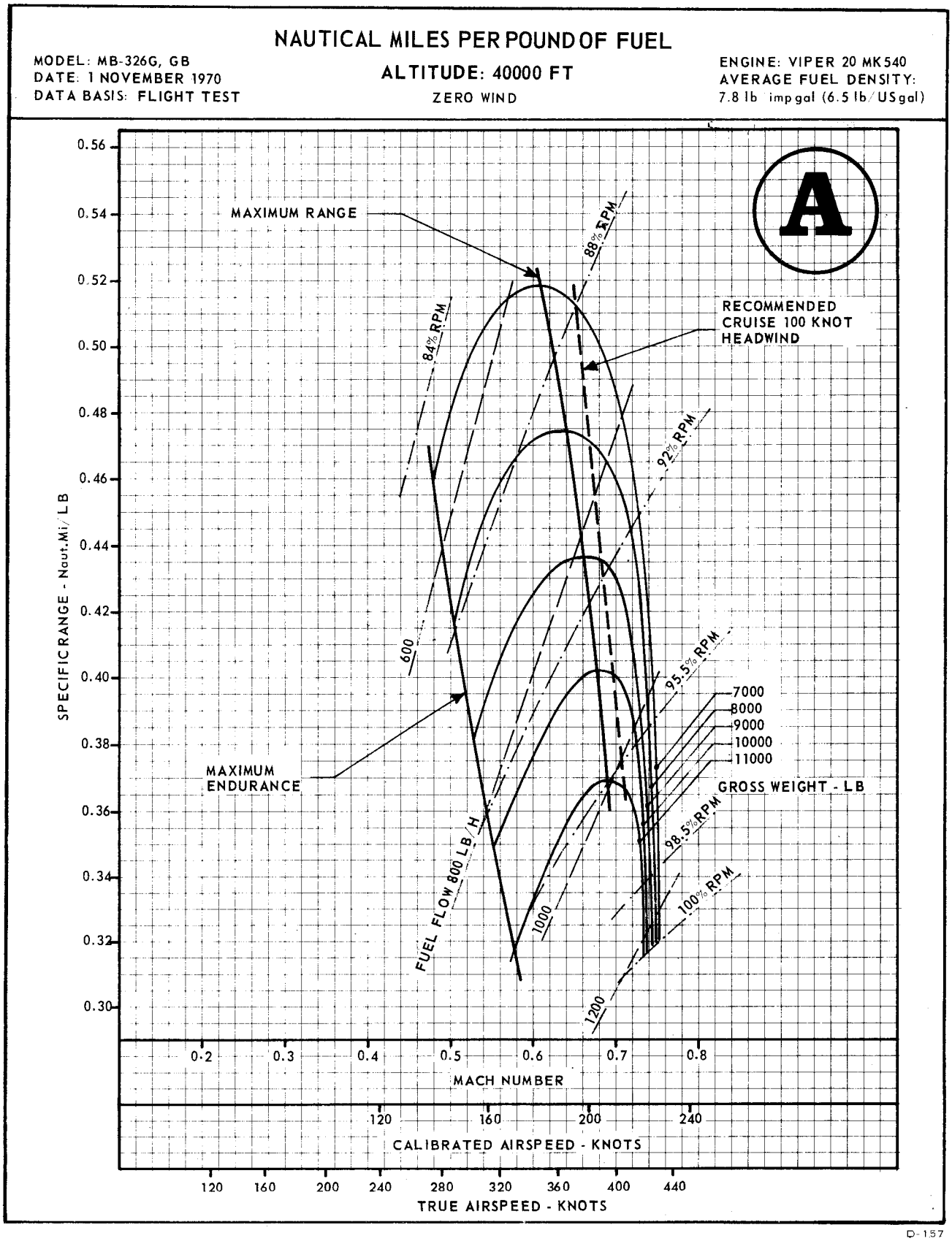


Figure A4-1 (Sheet 9 of 9)

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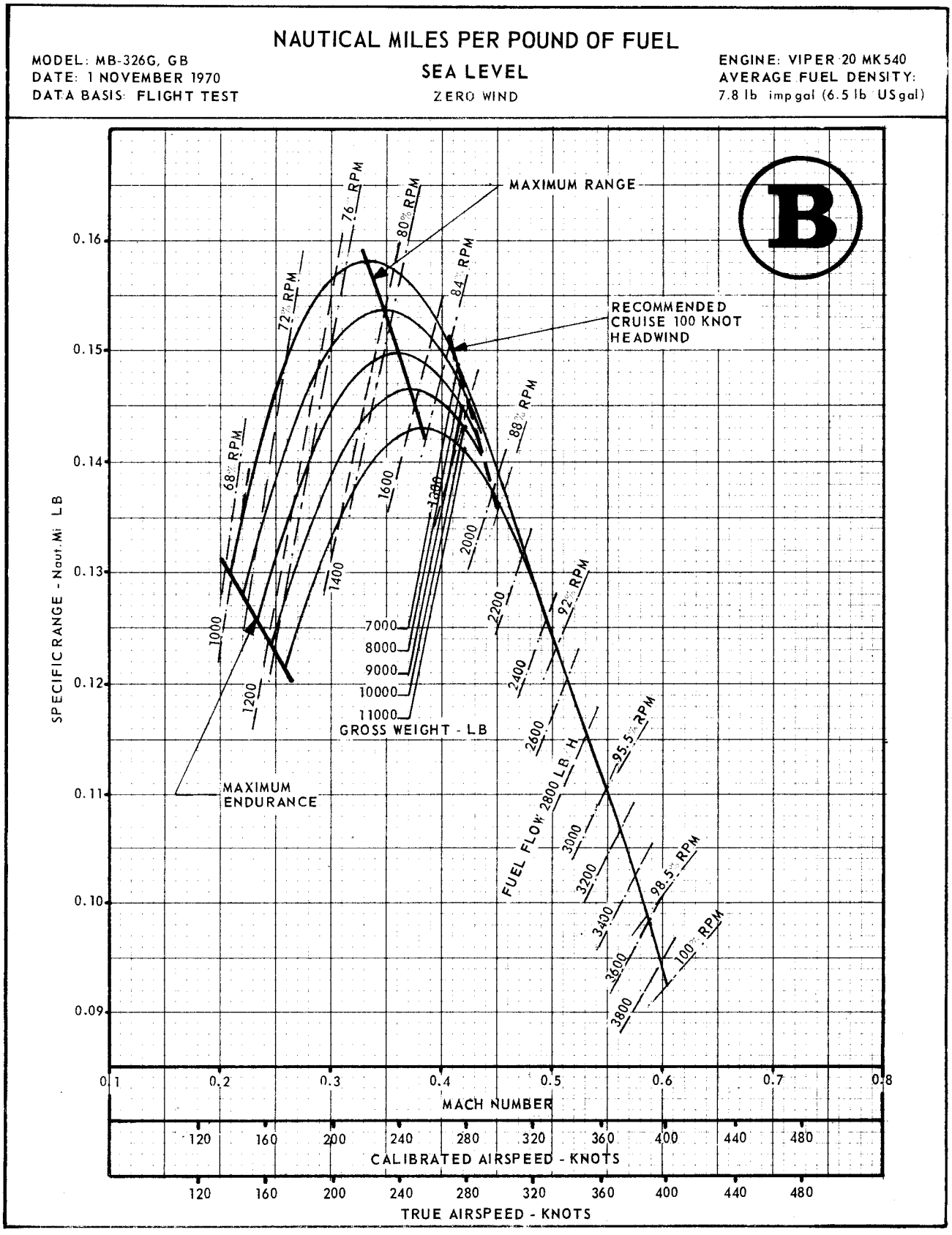


Figure A4-2 (Sheet 1 of 9)

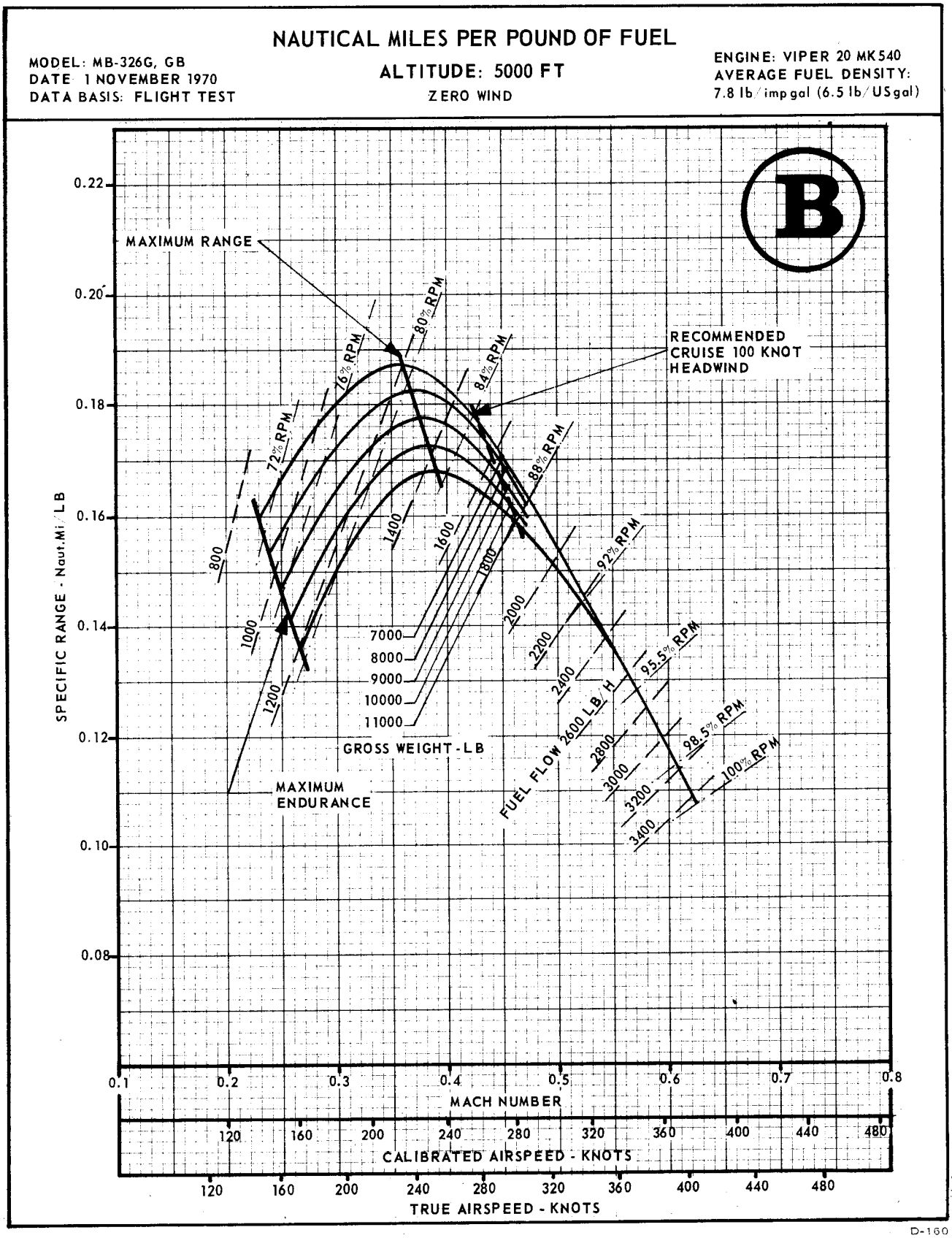


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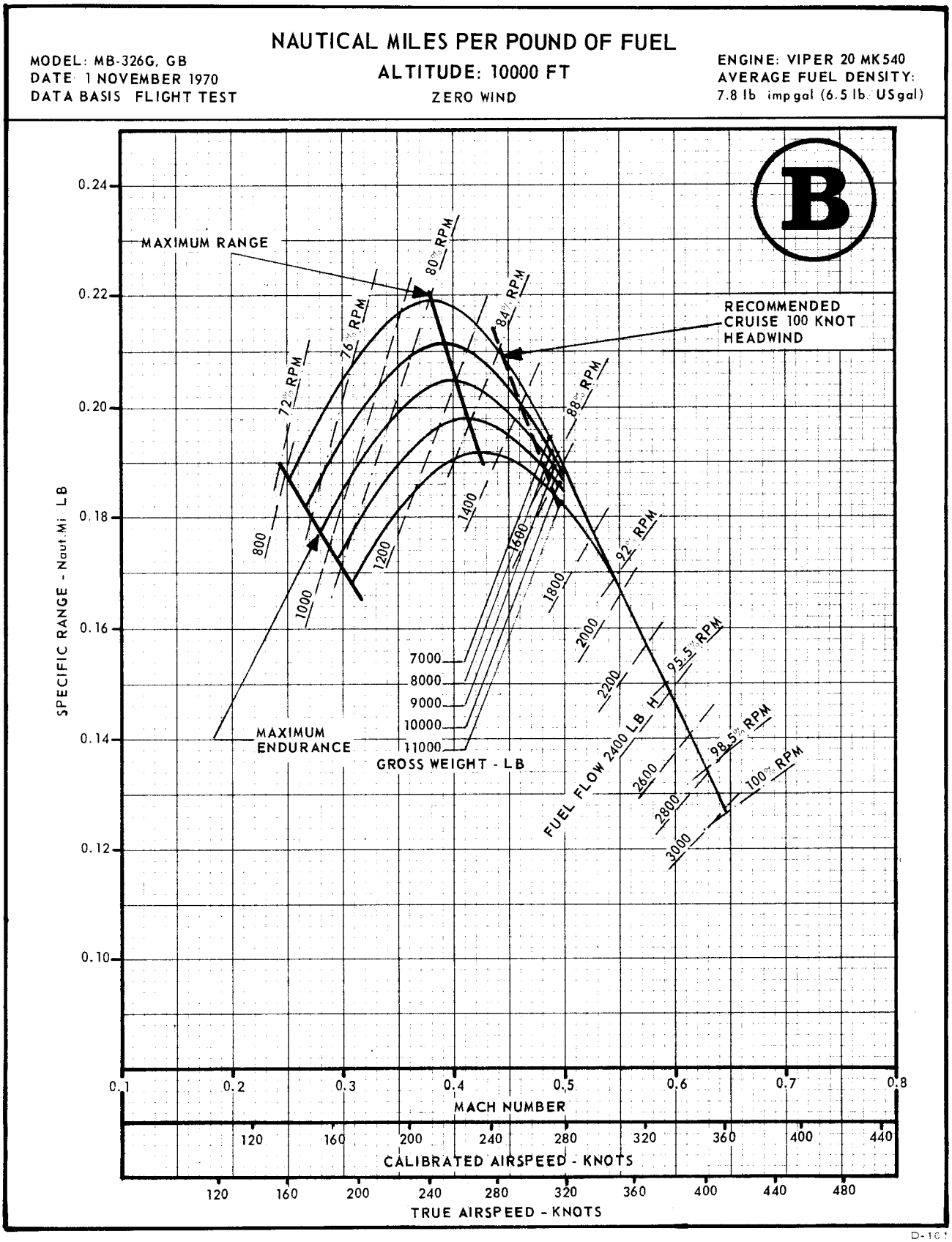


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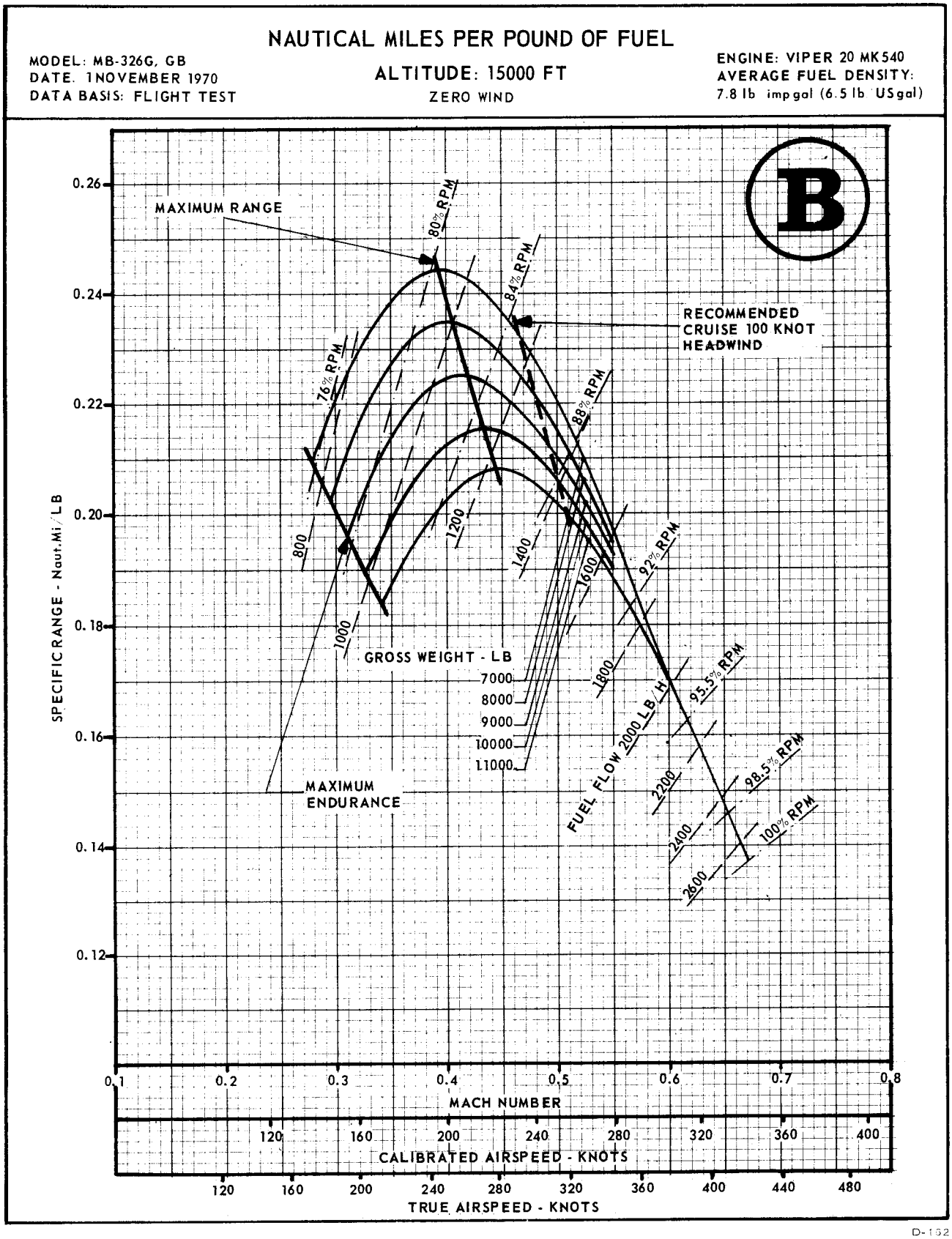


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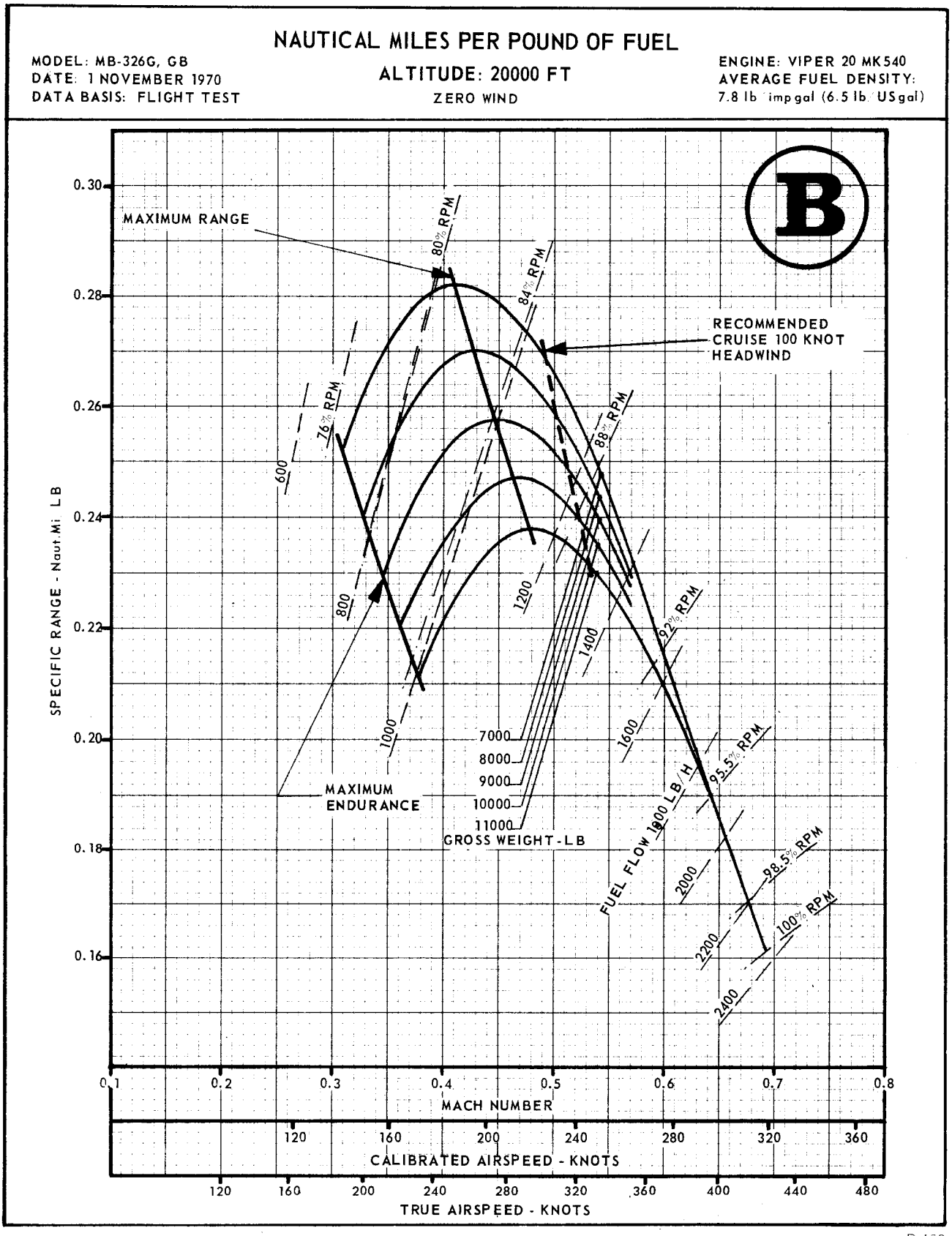


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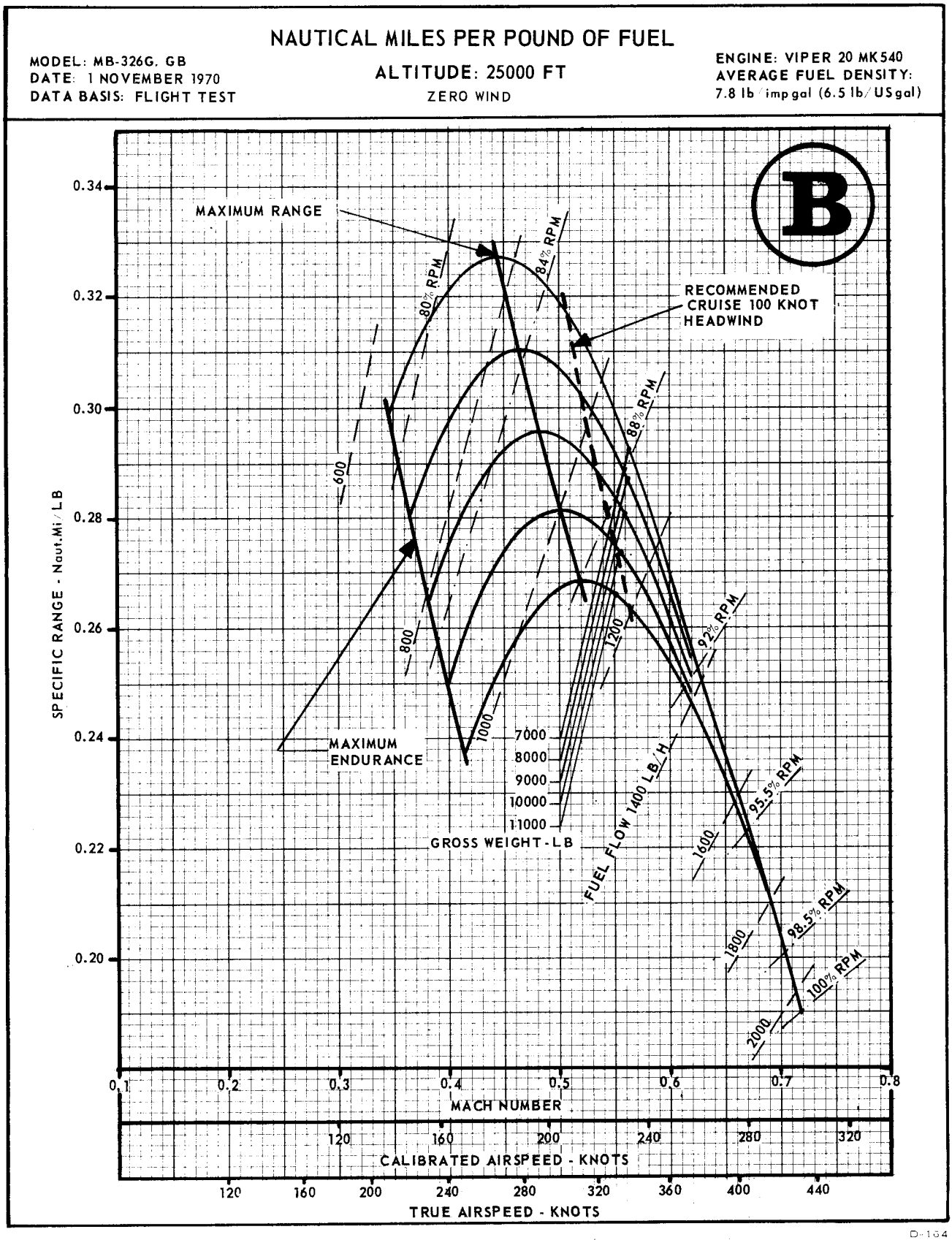


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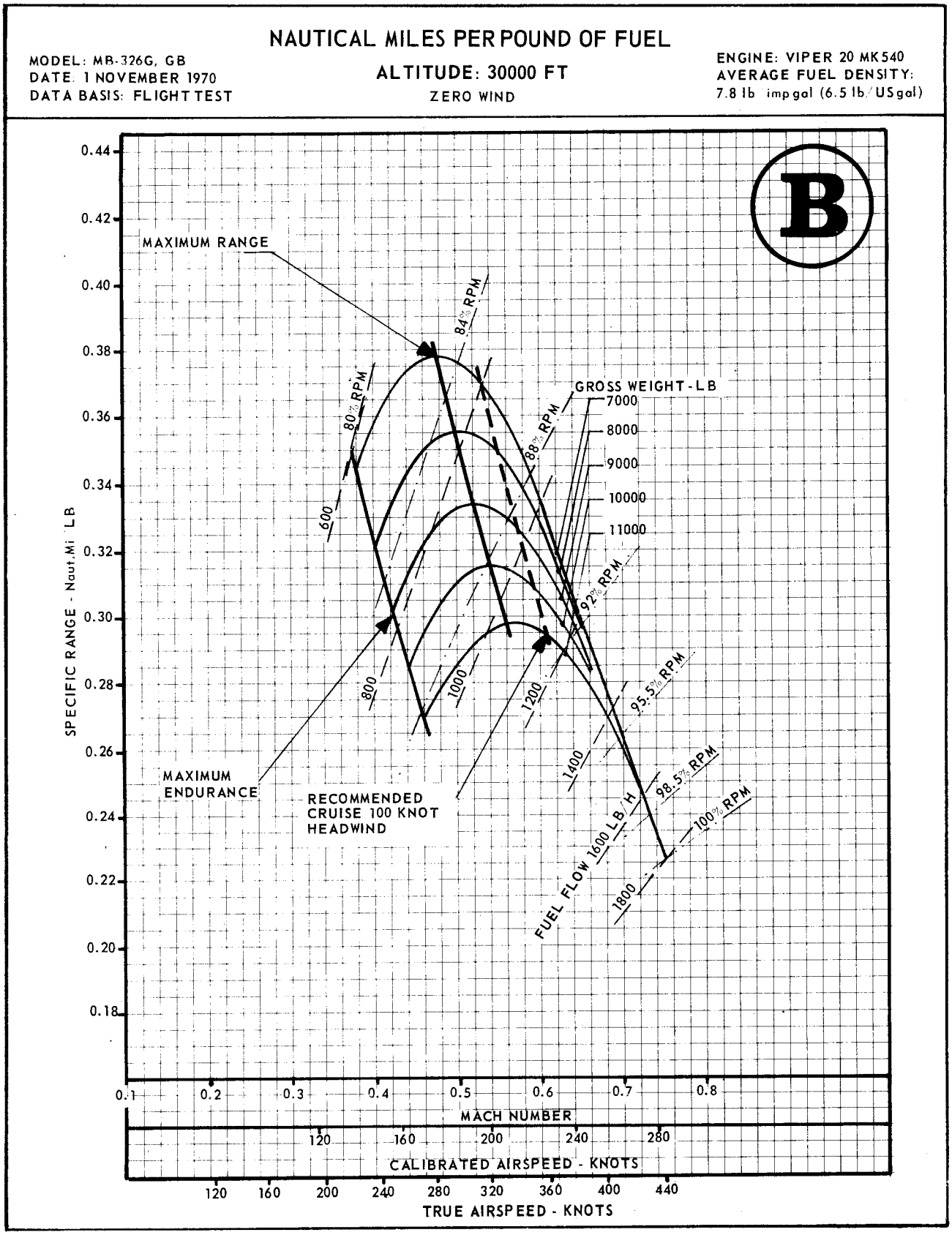


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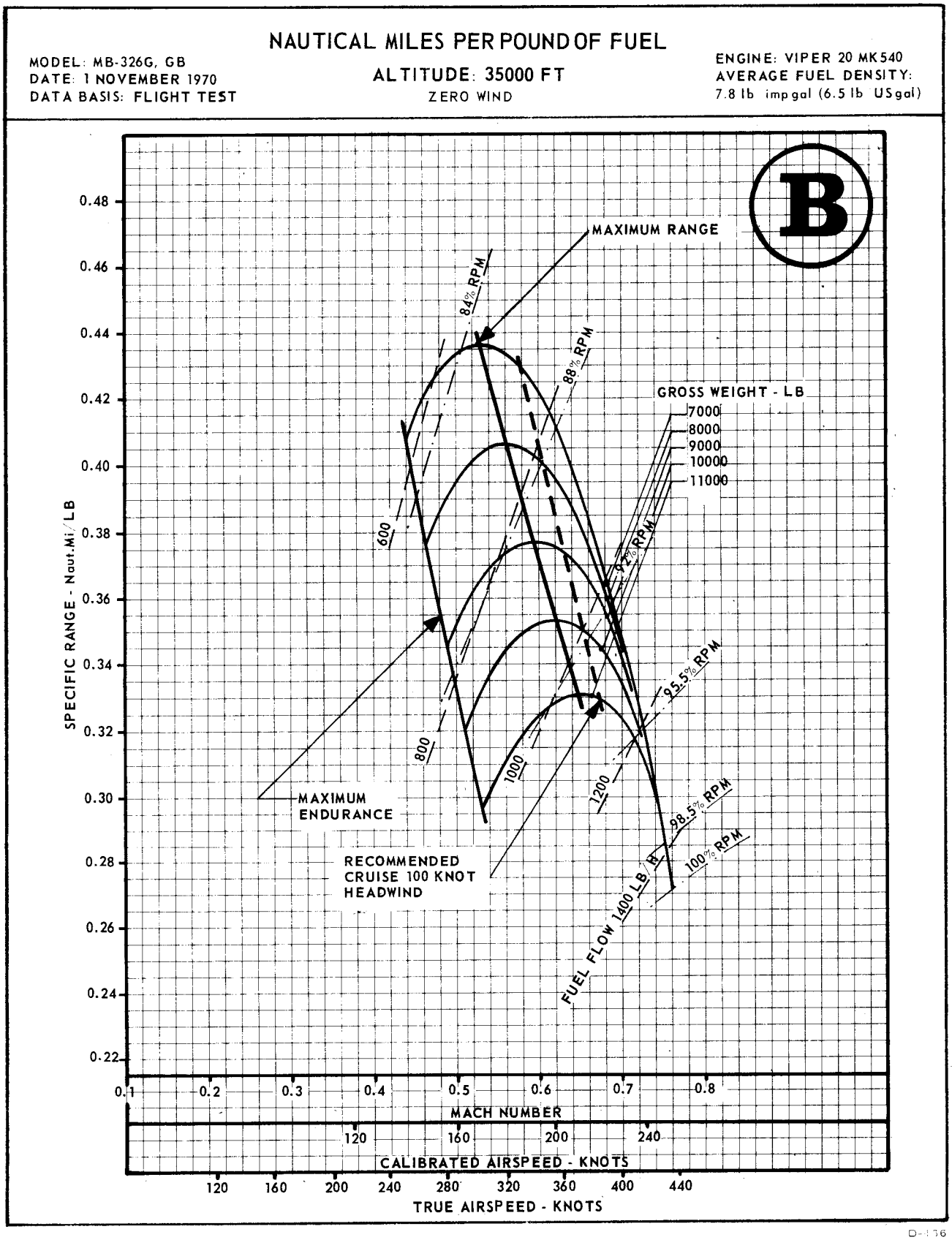


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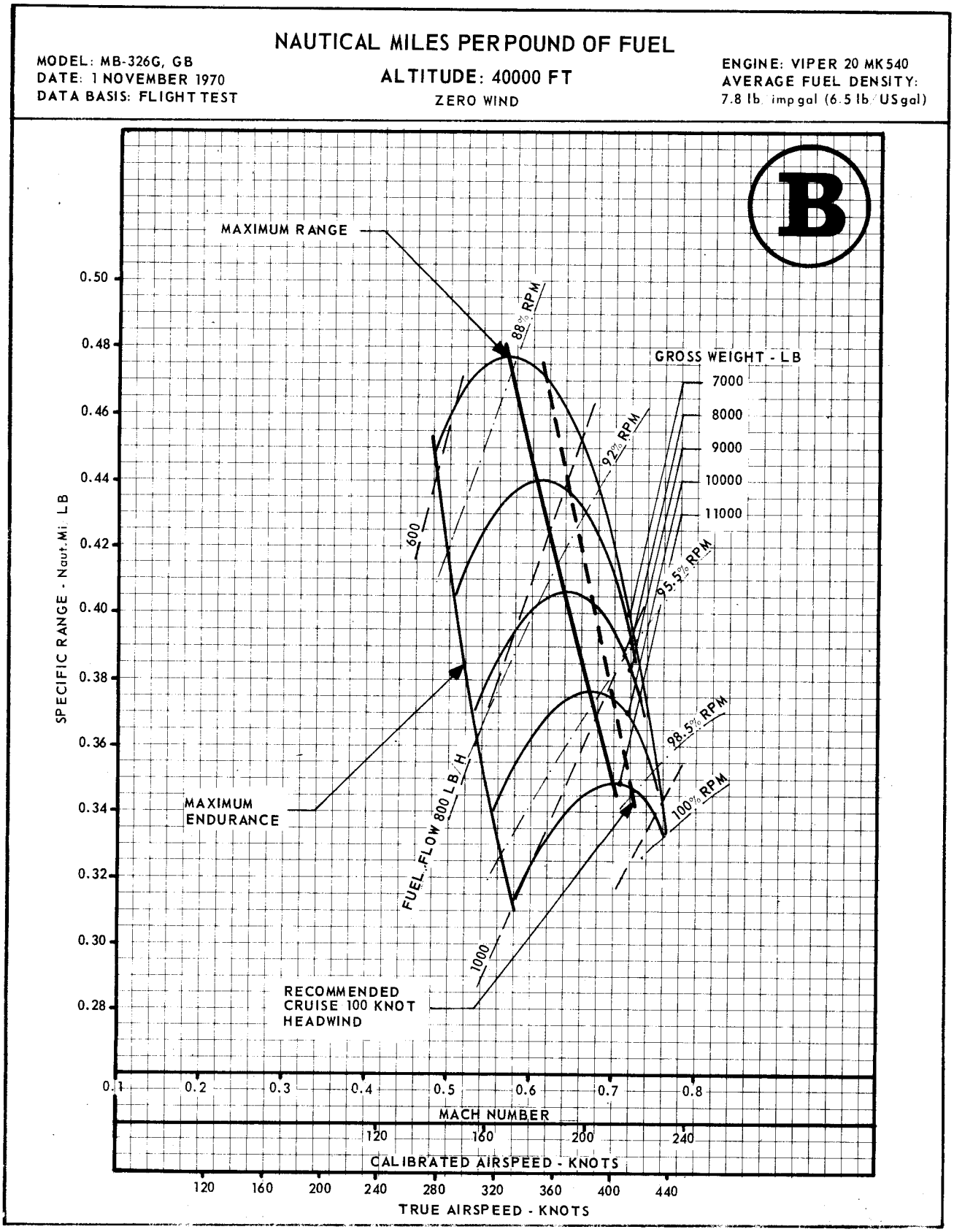


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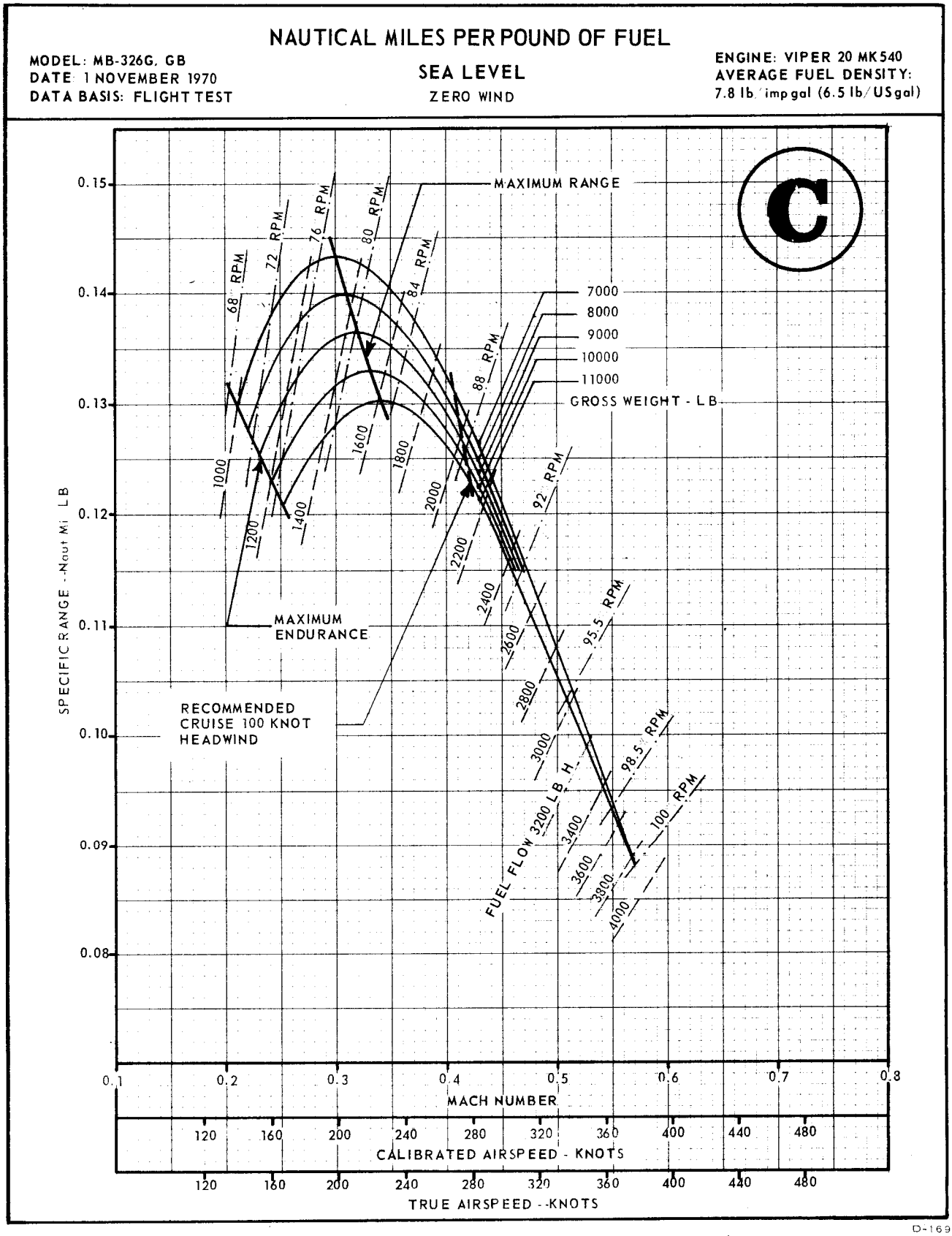


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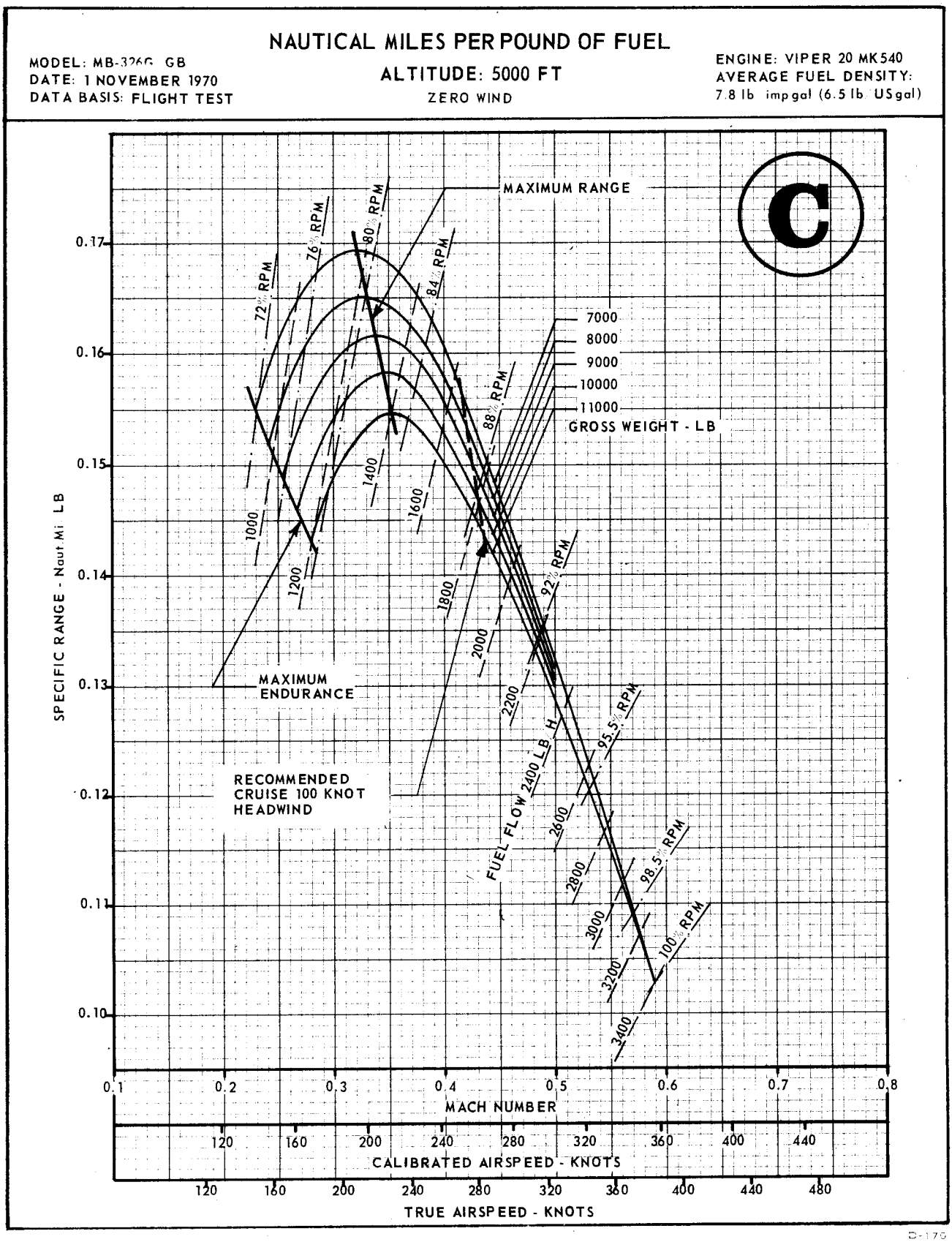


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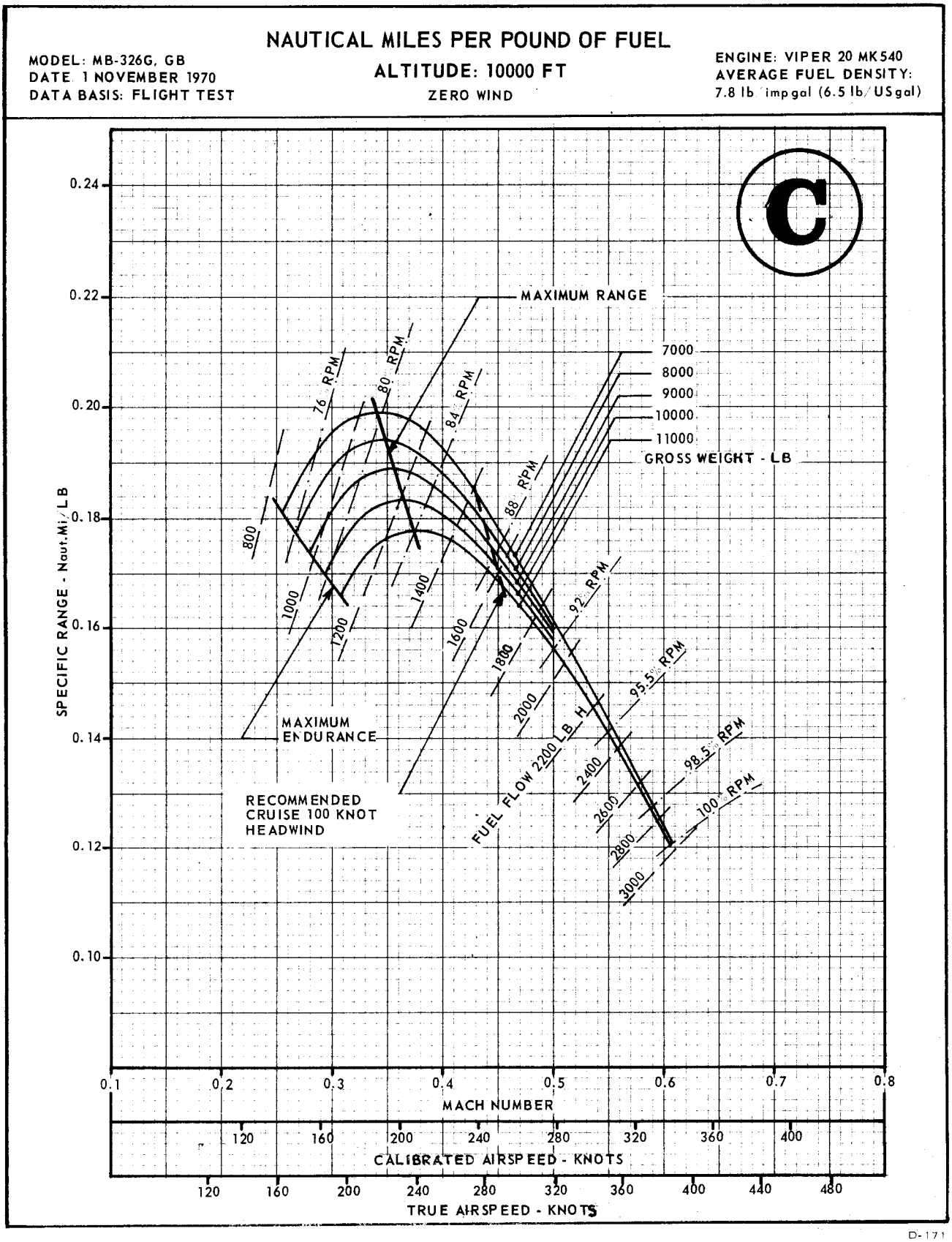


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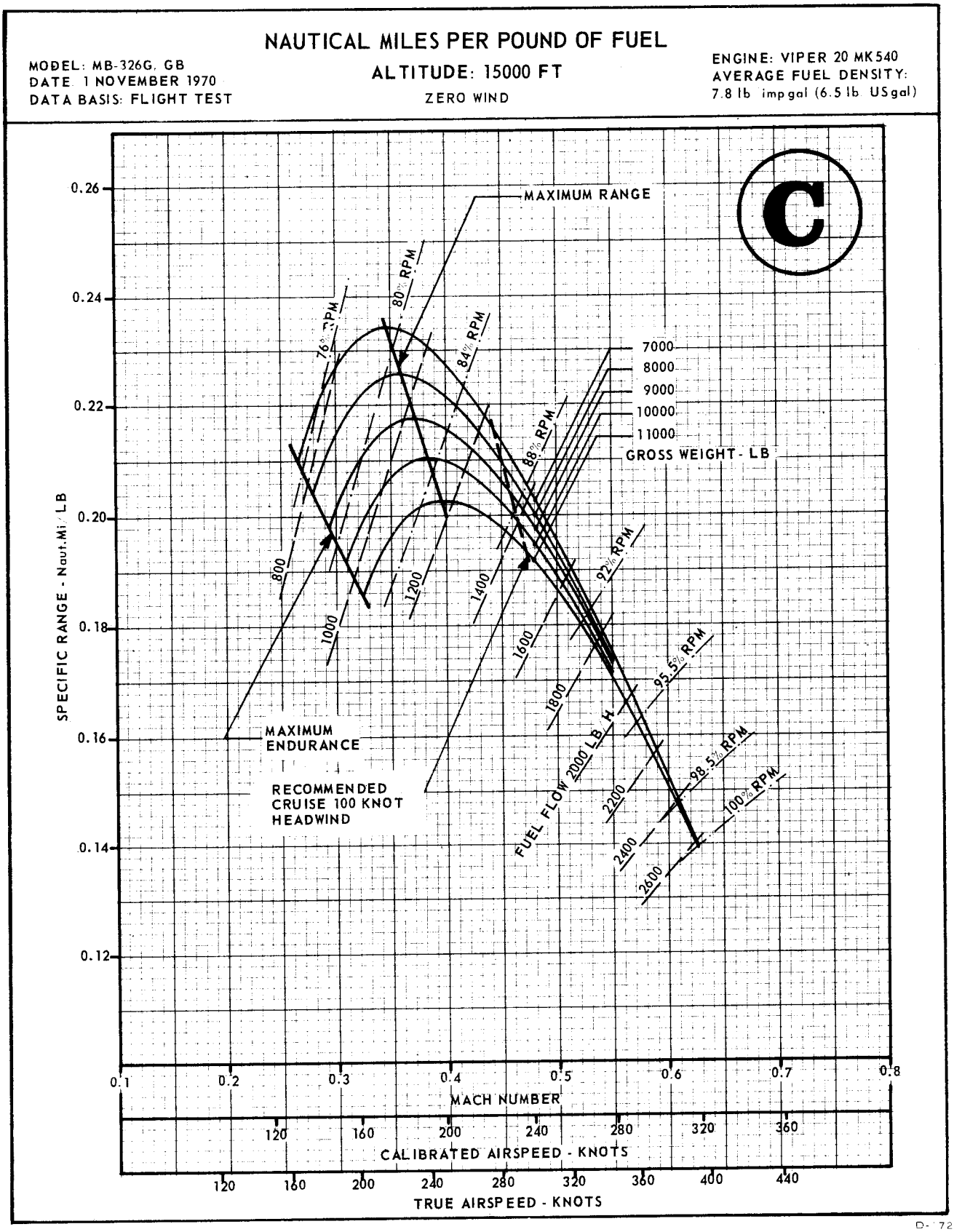


Figure A4-3 (Sheet 4 of 9)

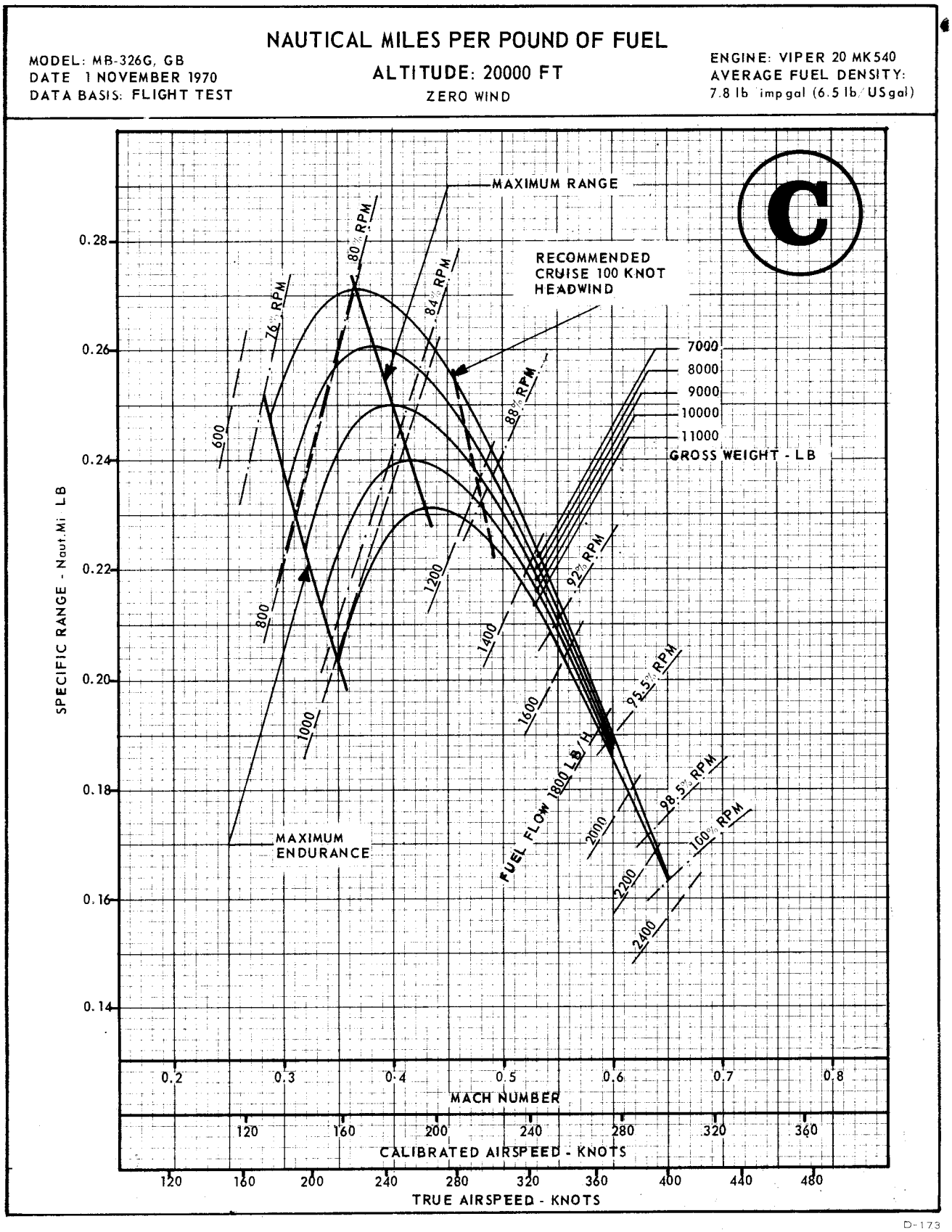


Figure A4-3 (Sheet 5 of 9)

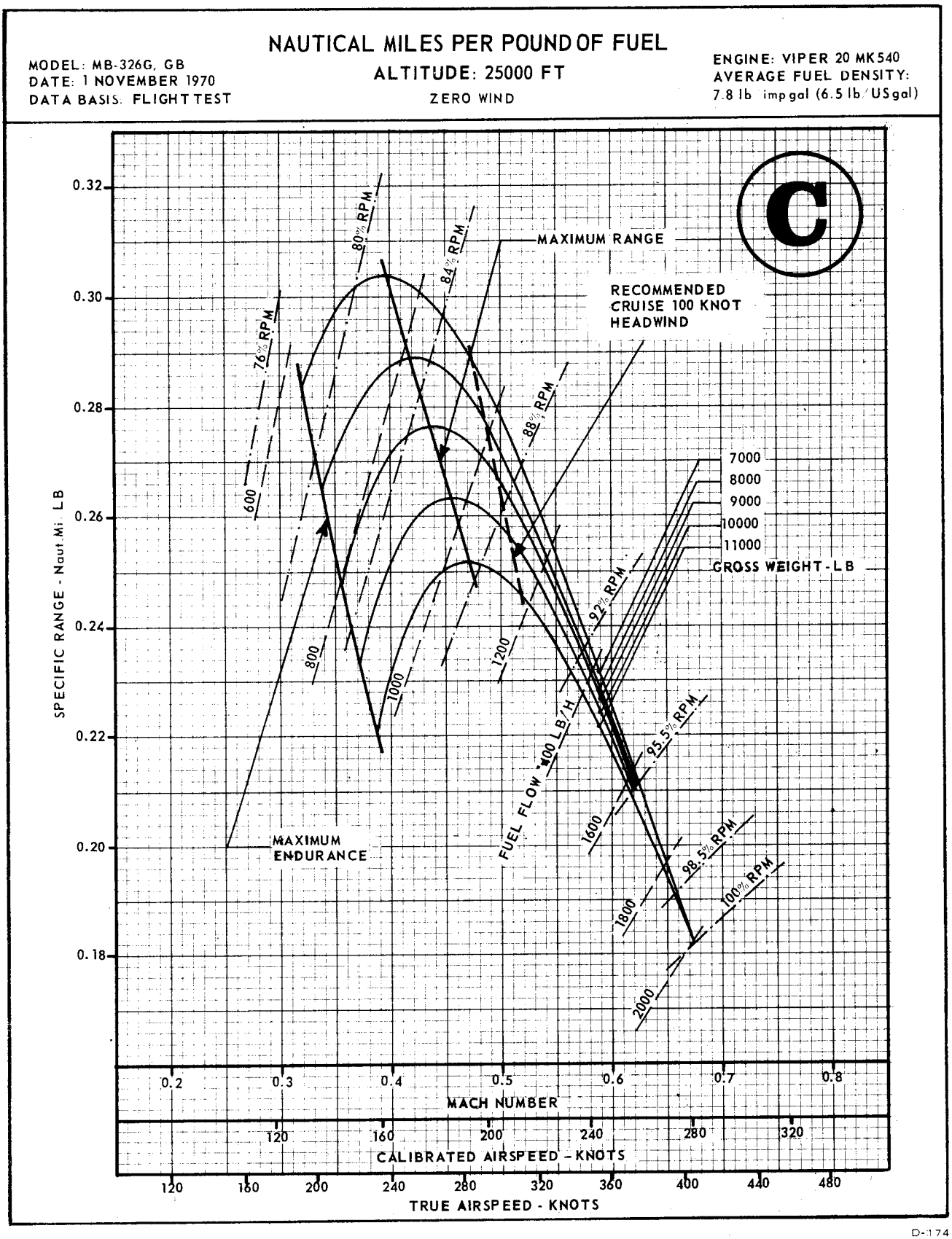


Figure A4-3 (Sheet 6 of 9)

NAUTICAL MILES PER POUND OF FUEL

EXAMPLE BASED ON FIGURE A4-3 (SHEET 7)

DATA:

- Cruise altitude: 30000 ft
- Headwind component: 50 kts
- Initial gross weight: 10000 lb
- During flight the underwing tanks will not be dropped.

FIND:

Cruise speed for maximum range, engine RPM, fuel flow and fuel required to fly 600 Naut.Mi.

PROCEDURE:

1. Enter figure A4-3 (sheet 7).
   a. At initial gross weight = 10000 lb and 50 kt headwind (A) (use linear interpolation between maximum range line and recommended cruise 100 kt Headwind) move horizontally to Specific Range scale and read = .295 N.Mi/lb (B) (zero wind).
   b. Drop vertically from (A) and read:
      - Initial Mach Number = .52 (C)
      - Initial C.A.S. = 190 kts (D)
      - Initial T.A.S. = 305 kts (E)
   c. Initial G.S. = 305-50) = 255 kts
   d. Initial RPM (A) = 88.5% (use linear interpolation between 88% RPM line and 92% RPM line)
   e. Initial Fuel Flow (A) = 970 lb/h (use linear interpolation between 800 lb/h line and 1000 lb/h line)
2. Use formula of page A4-5 for wind effect:

   $$\text{Ground Specific Range} = .295 \times \frac{255}{305} = .247 \text{ N.Mi/lb.}$$

3. Determine Estimated Average Gross Weight:
   a. $\text{Estimated fuel used} = \frac{600 \text{ N.Mi}}{.247 \text{ N.Mi/lb}} = 2420 \text{ lb}$
   b. Estimated Final Weight = 10000 – 2420 = 7580 lb
   c. $\text{Estimated Average Gross Weight} = \frac{10000 + 7580}{2} = 8790 \text{ lb}$
4. Re-enter figure A4-3 (sheet 7):
   a. At estimated average gross weight = 8790 lb and 50 kt headwind (F)
      Move horizontally to Specific Range scale and read = .317 N.Mi/lb (G) (zero wind)
   b. Drop vertically from (F) and read:
      - Cruise Mach Number = .50 (H)
      - Cruise speed C.A.S. = 185 Kts (I)
      - Cruise speed T.A.S. = 295 (J)
   c. Cruise speed G.S. = (295-50) = 245 kts
   d. Indicative cruise RPM = 87%
   e. Indicative Fuel flow = 870 lb/h
5. Use formula of page A4-5 for wind effect:

   $$\text{Ground Specific Range} = .317 \times \frac{245}{295} = .263 \text{ N.Mi/lb}$$

6. Revise estimated average gross weight:
   a. $\text{Computed fuel used} = \frac{600 \text{ N.Mi}}{.263 \text{ N.Mi/lb}} = 2280 \text{ lb}$
   b. Final gross weight = 10000 – 2280 = 7720 lb
   c. $\text{Average Gross weight} = \frac{10000 + 7720}{2} = 8860 \text{ lb}$
7. Entering the chart at 8860 lb Average Gross Weight it is evident that this would result in essentially the same solutions as above, therefore the problem is not reworked.
8. The informative data for pre-flight planning are:
   - Cruise speed = 185 Kts-CAS (M = 0.50)
   - Engine RPM = 87%
   - Fuel flow = 870 lb/h
   - Fuel required = 2280 lb

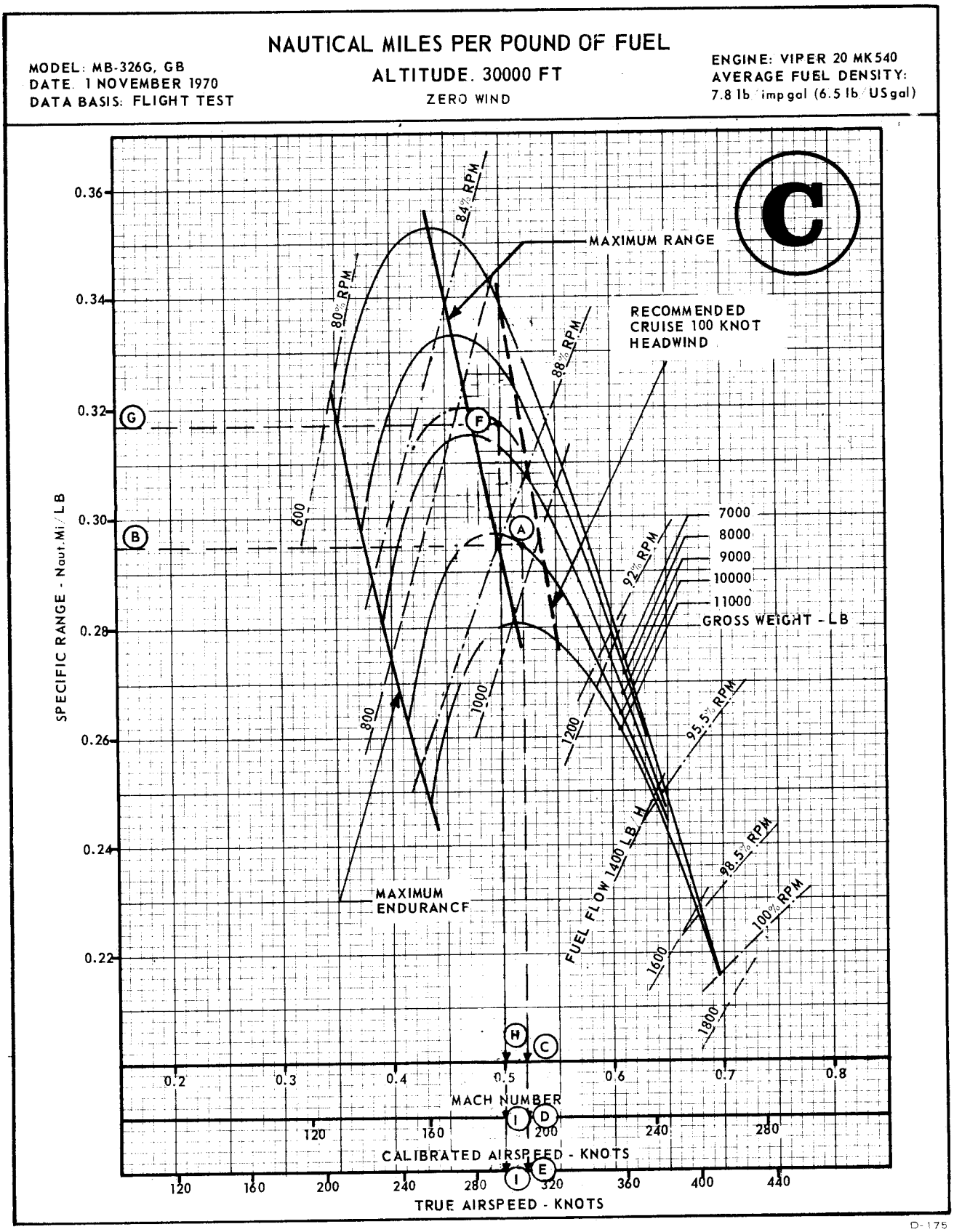


Figure A4-3 (Sheet 7 of 9)

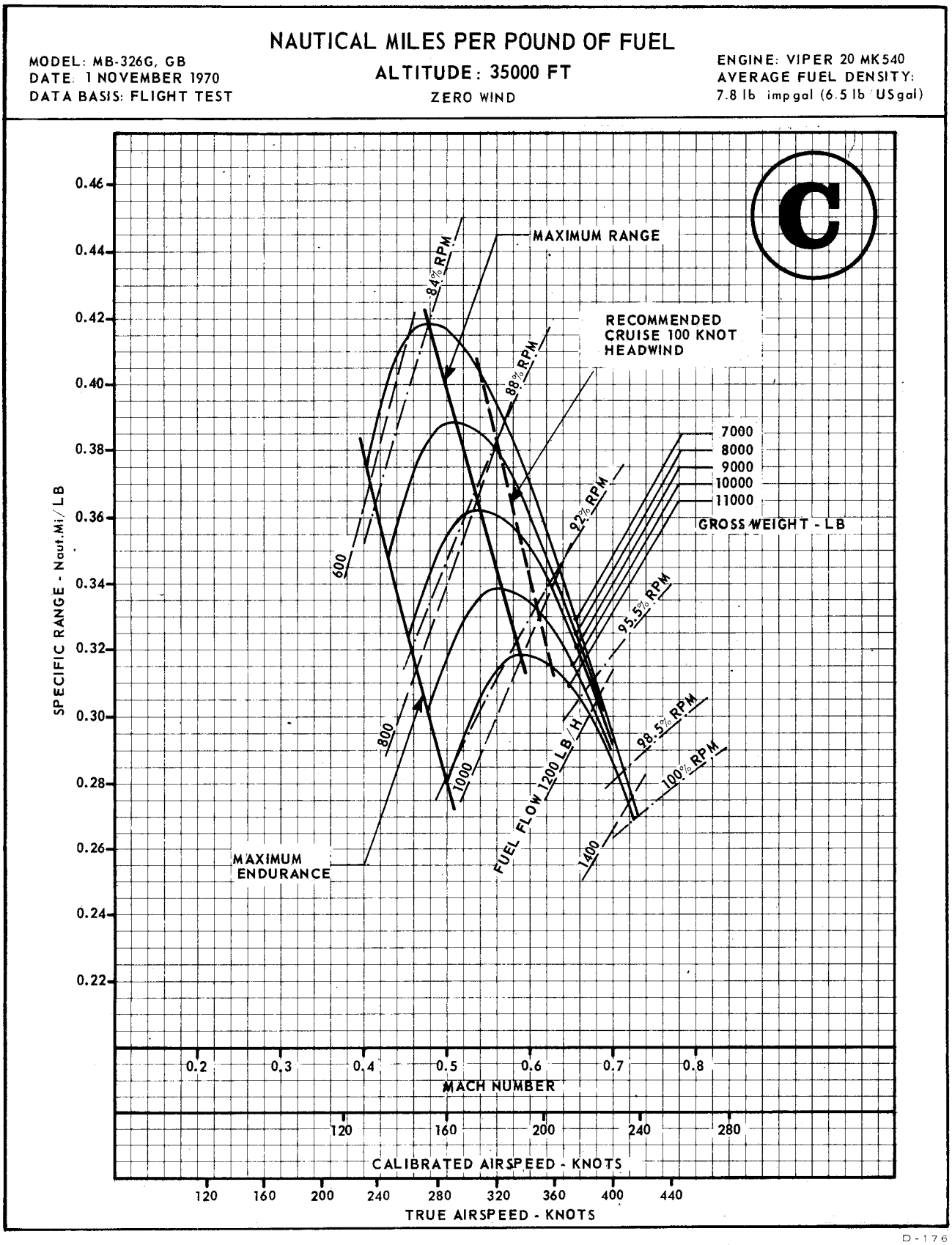


Figure A4-3 (Sheet 8 of 9)

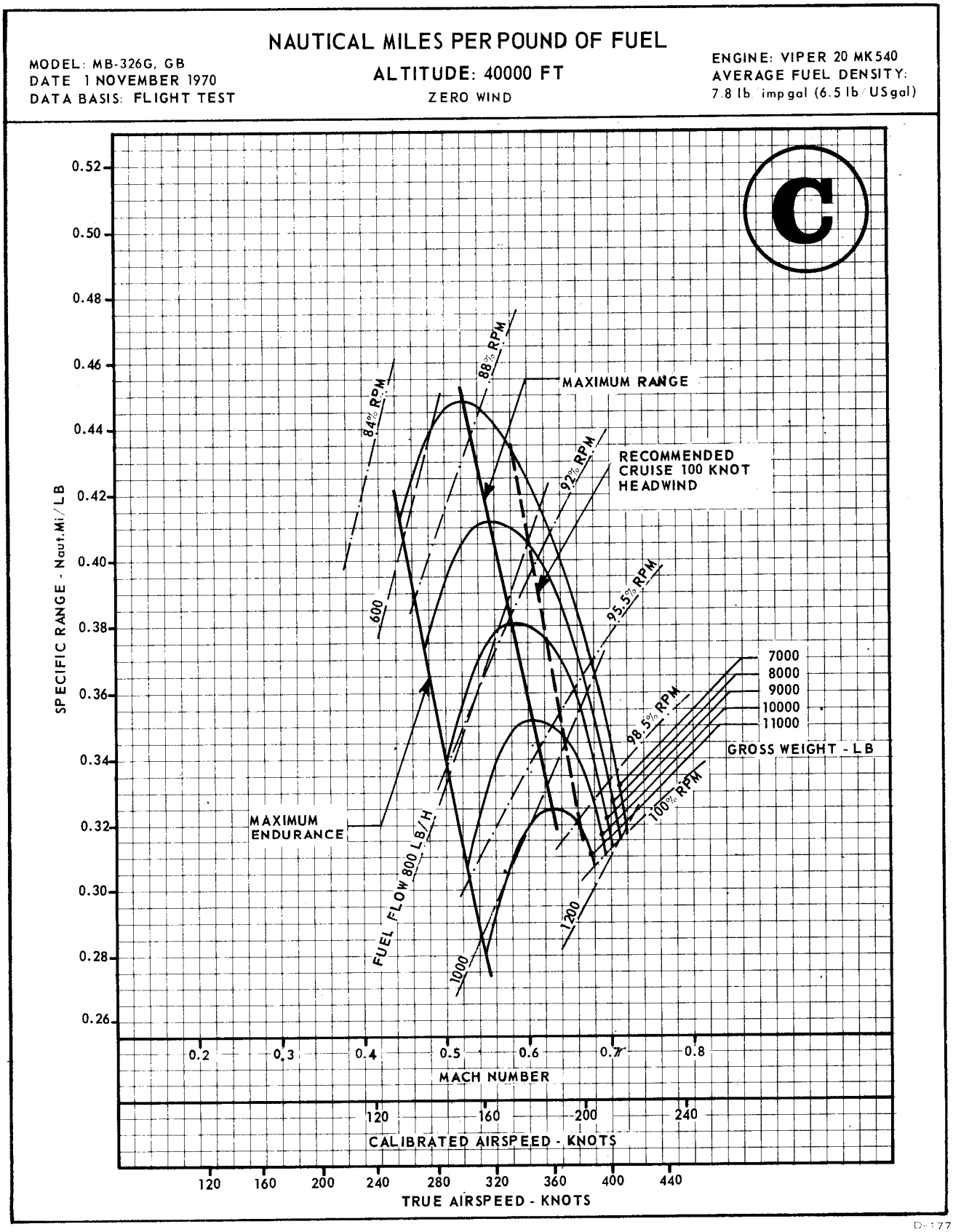


Figure A4-3 (Sheet 9 of 9)

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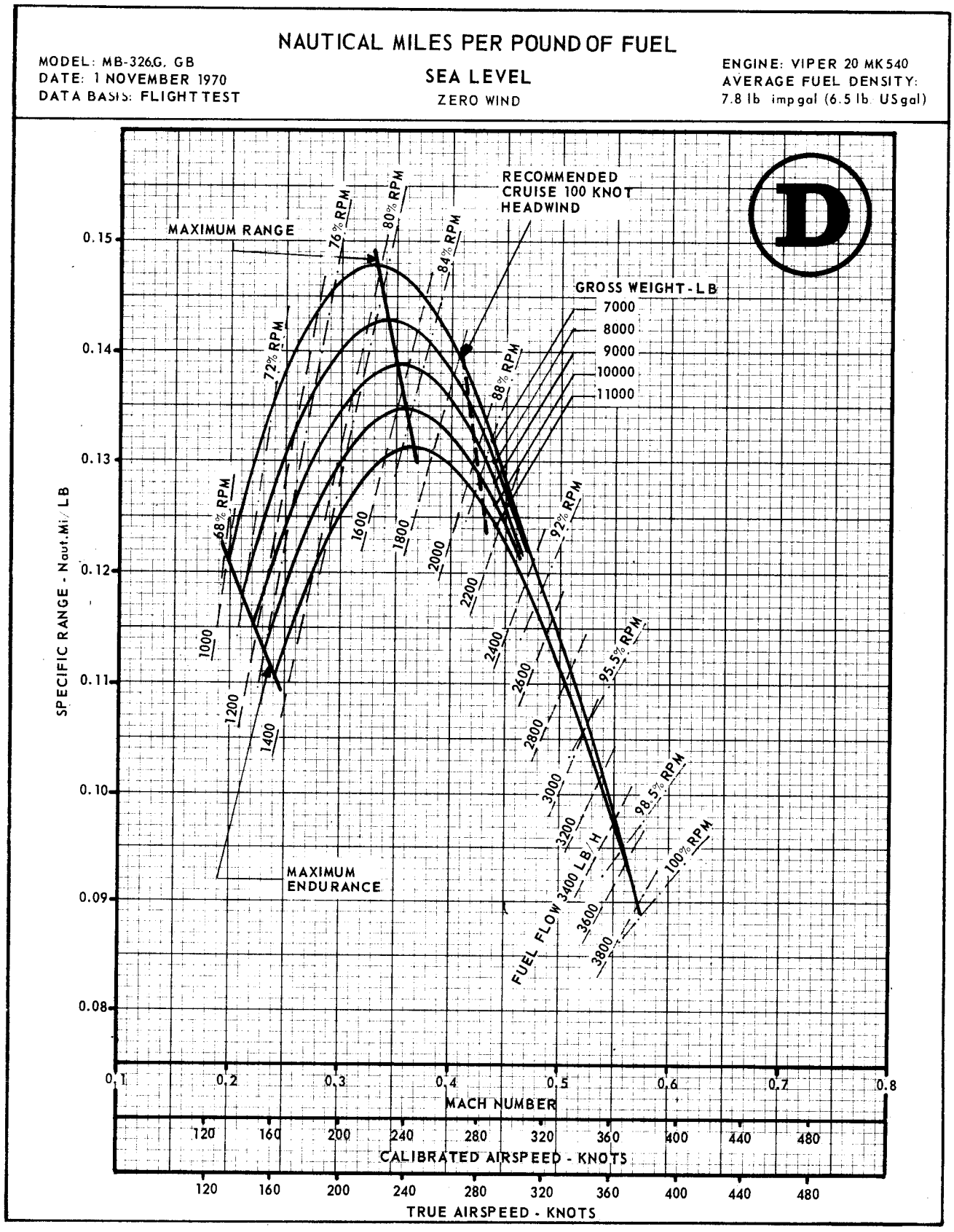


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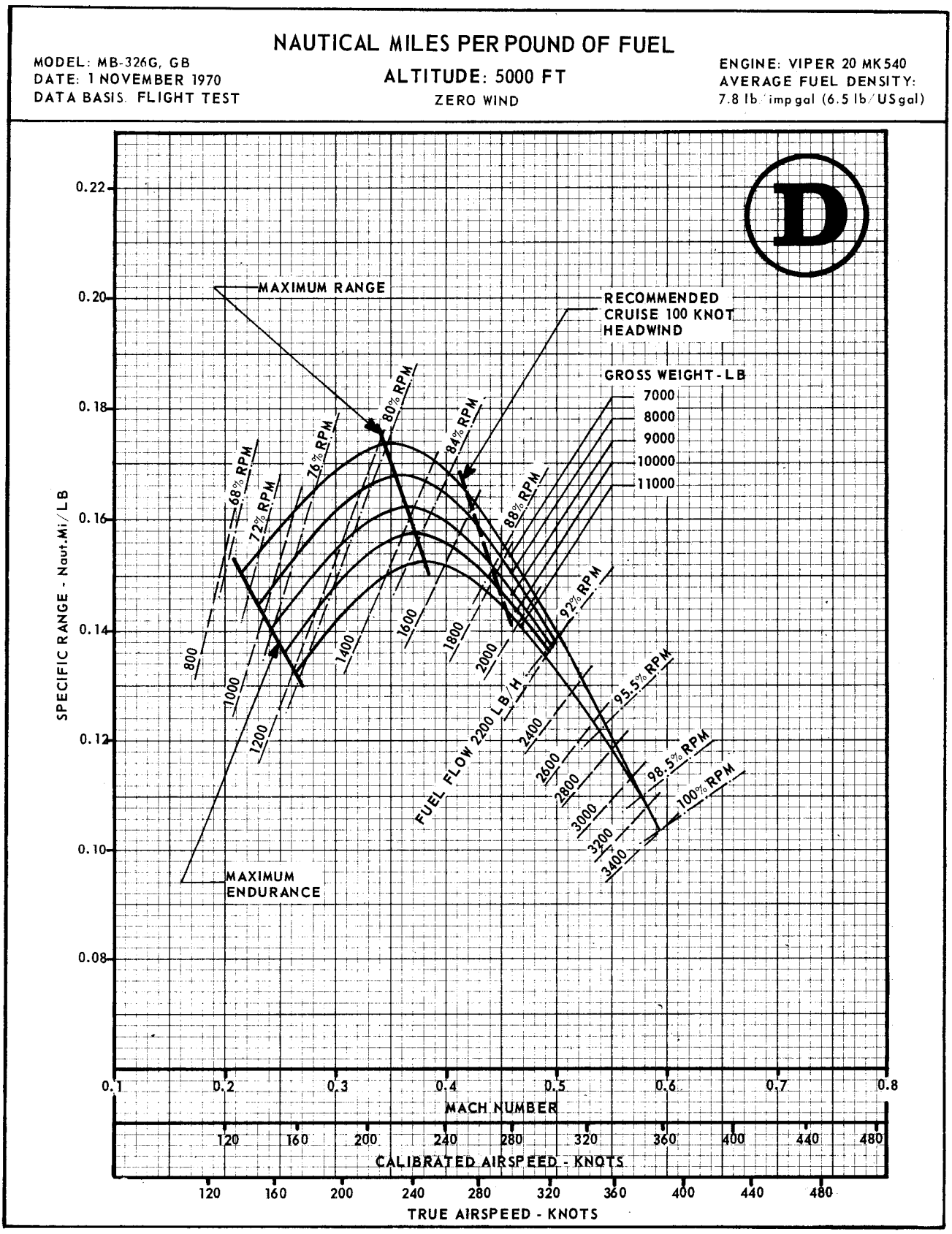


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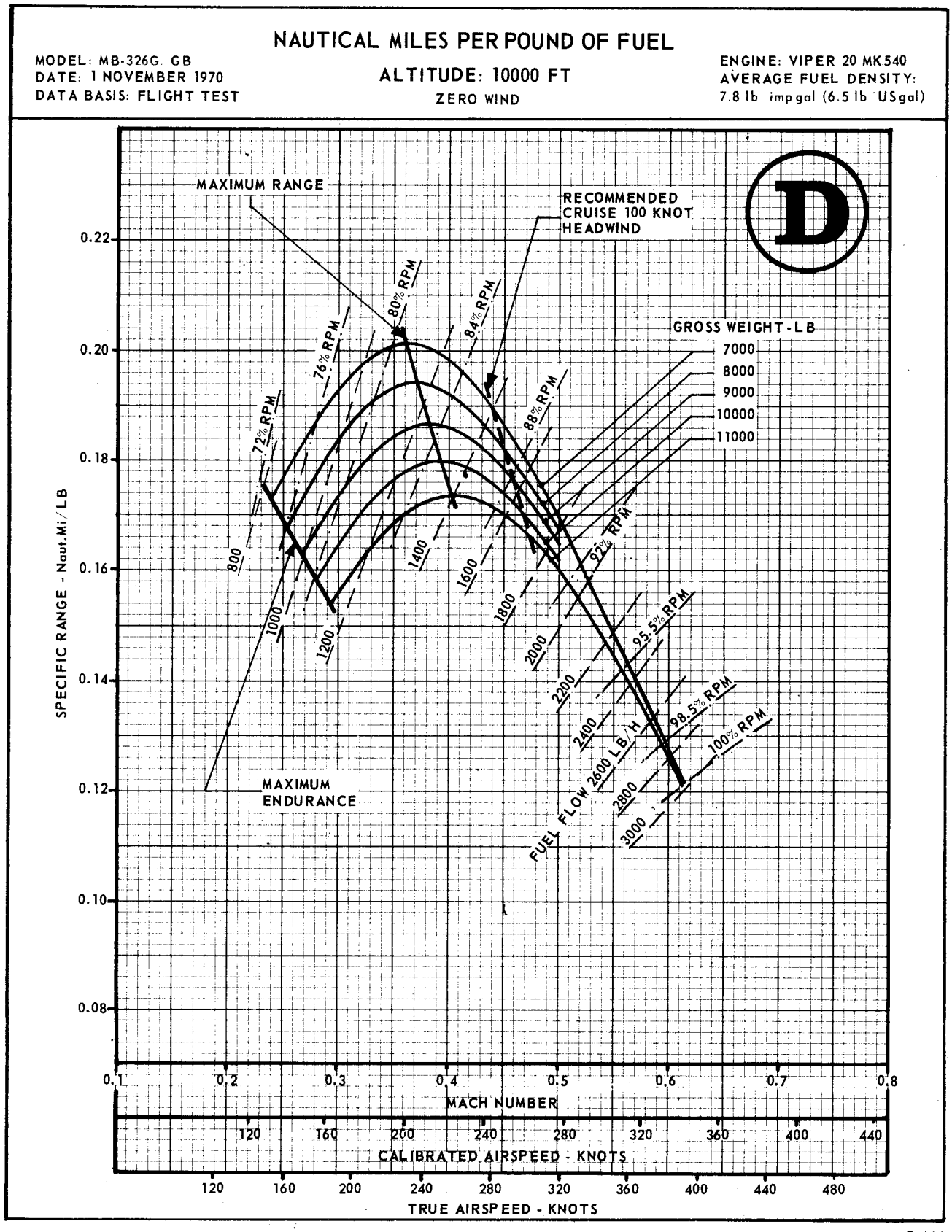


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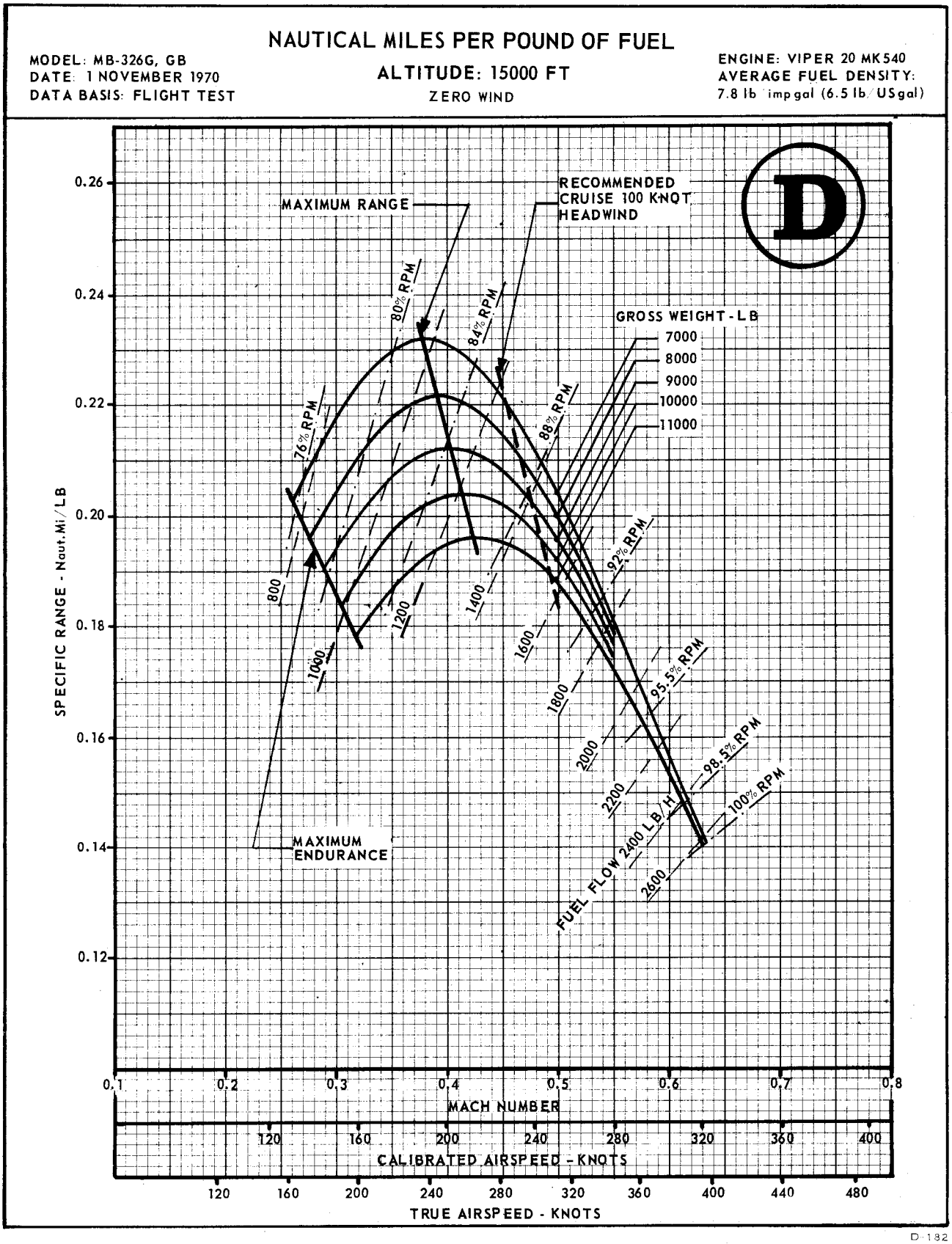


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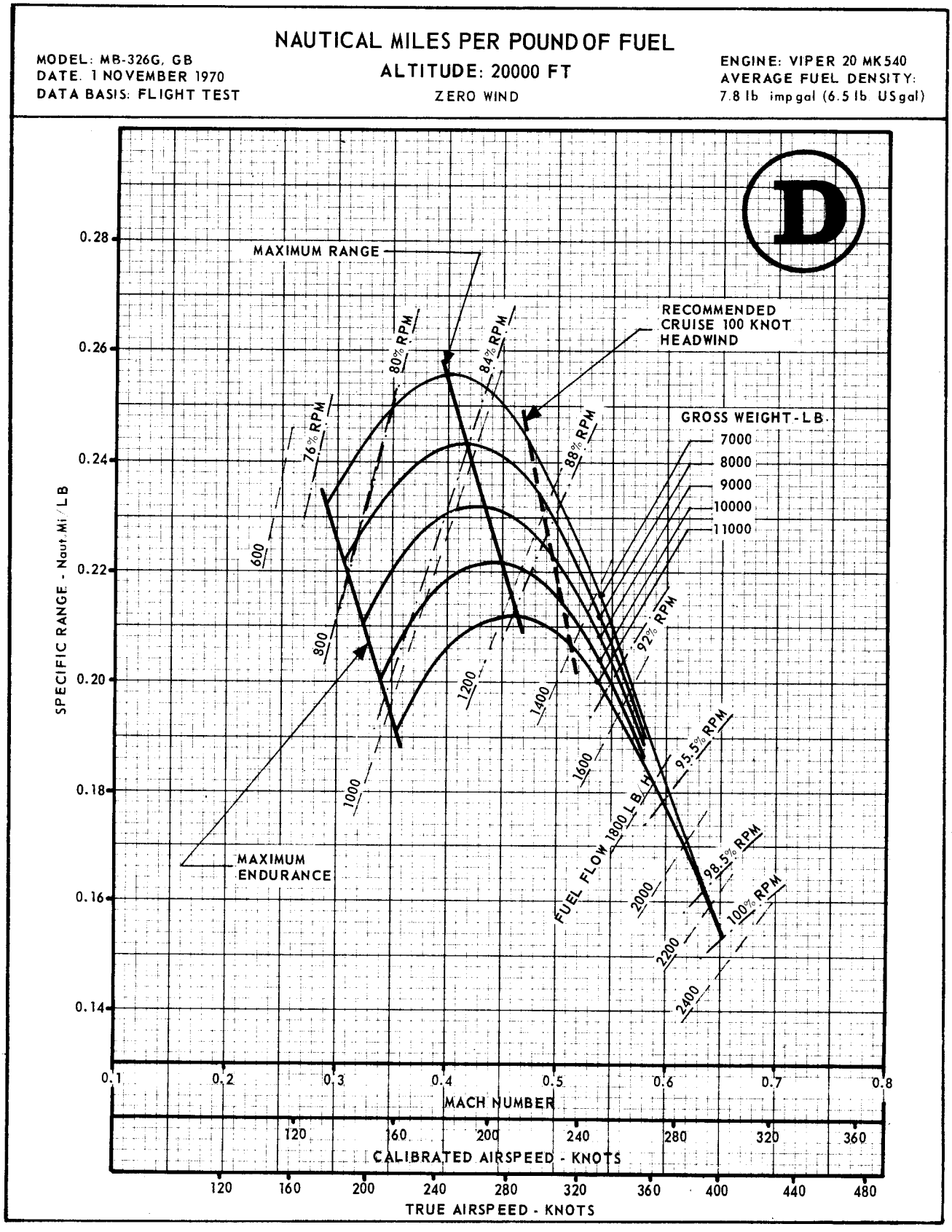


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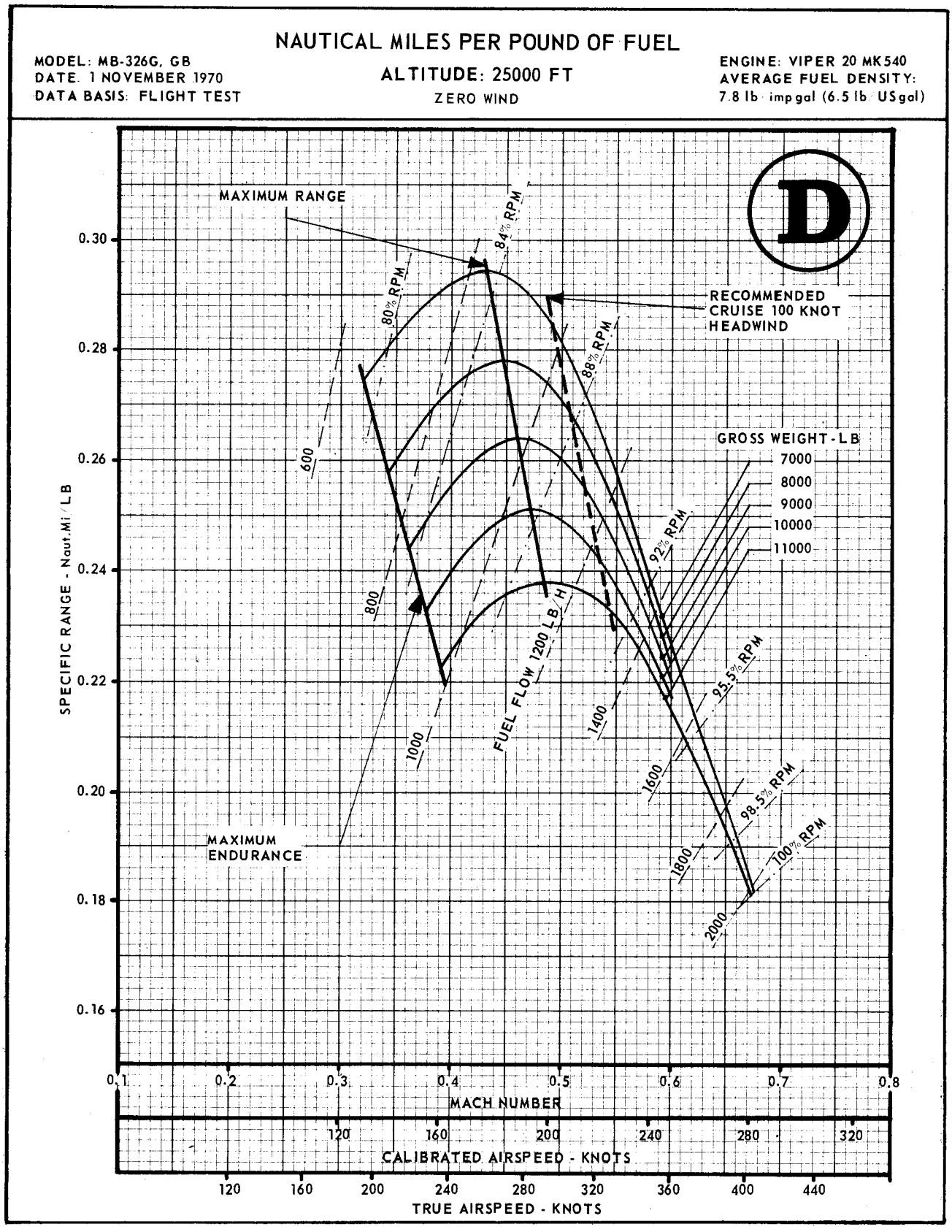


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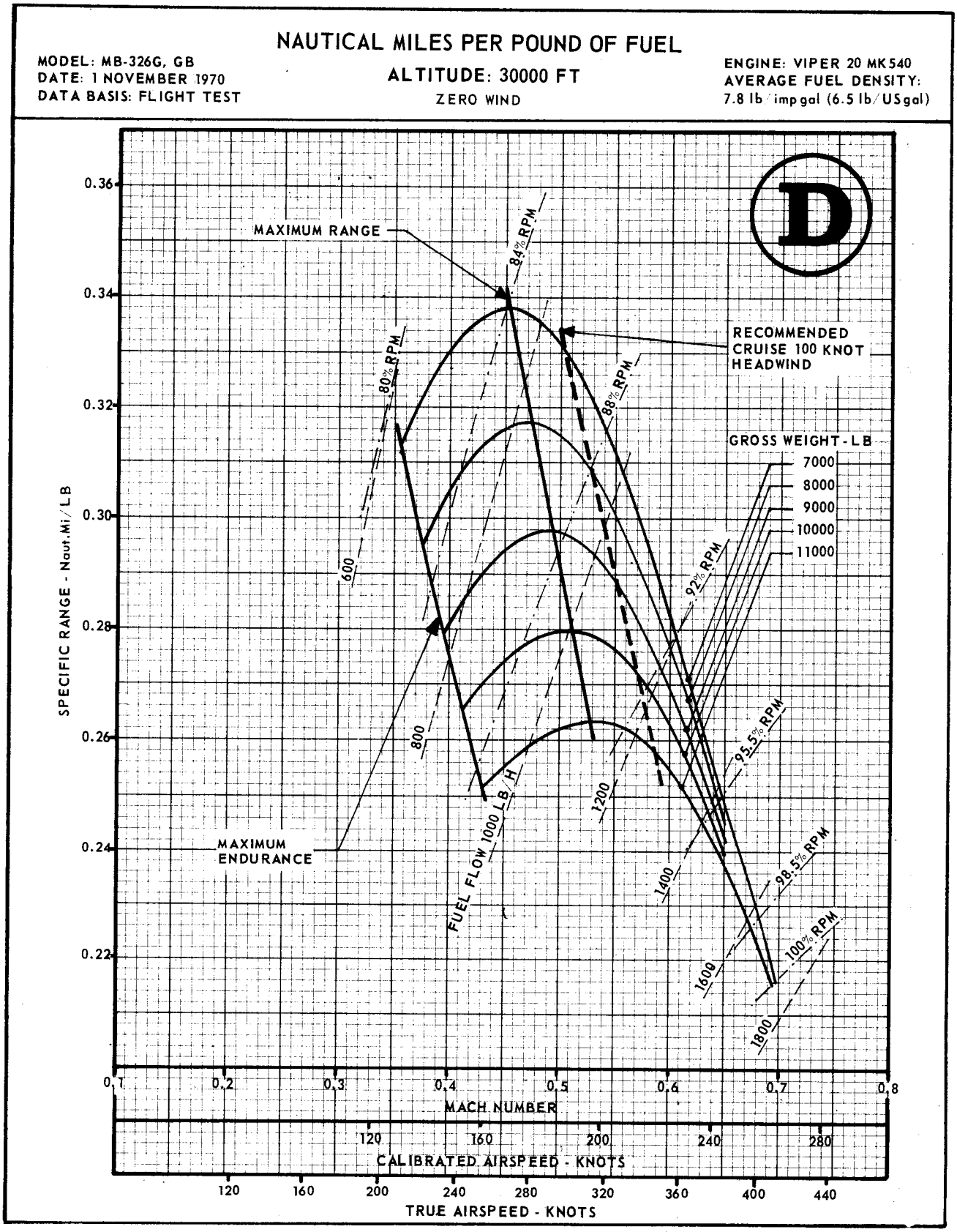


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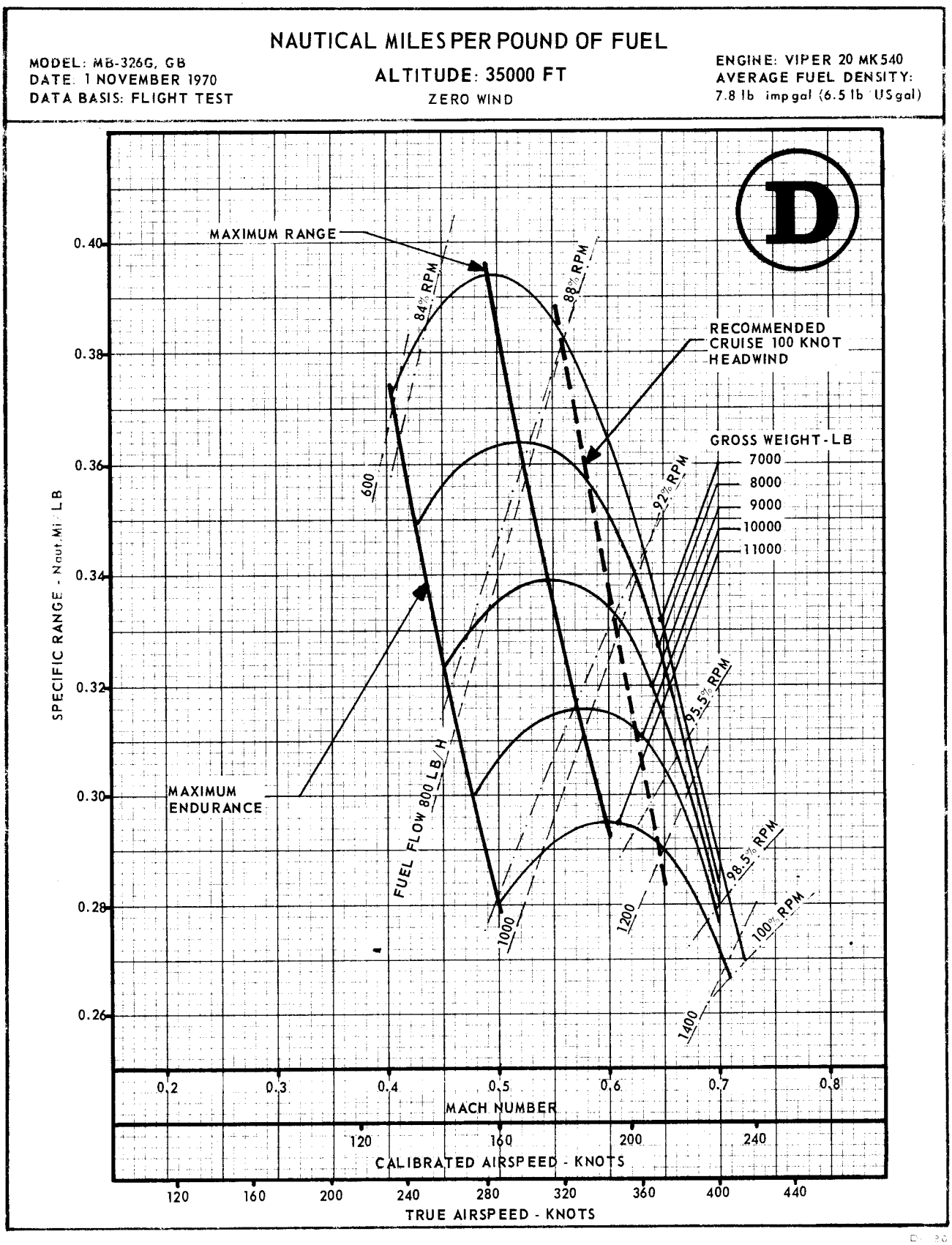


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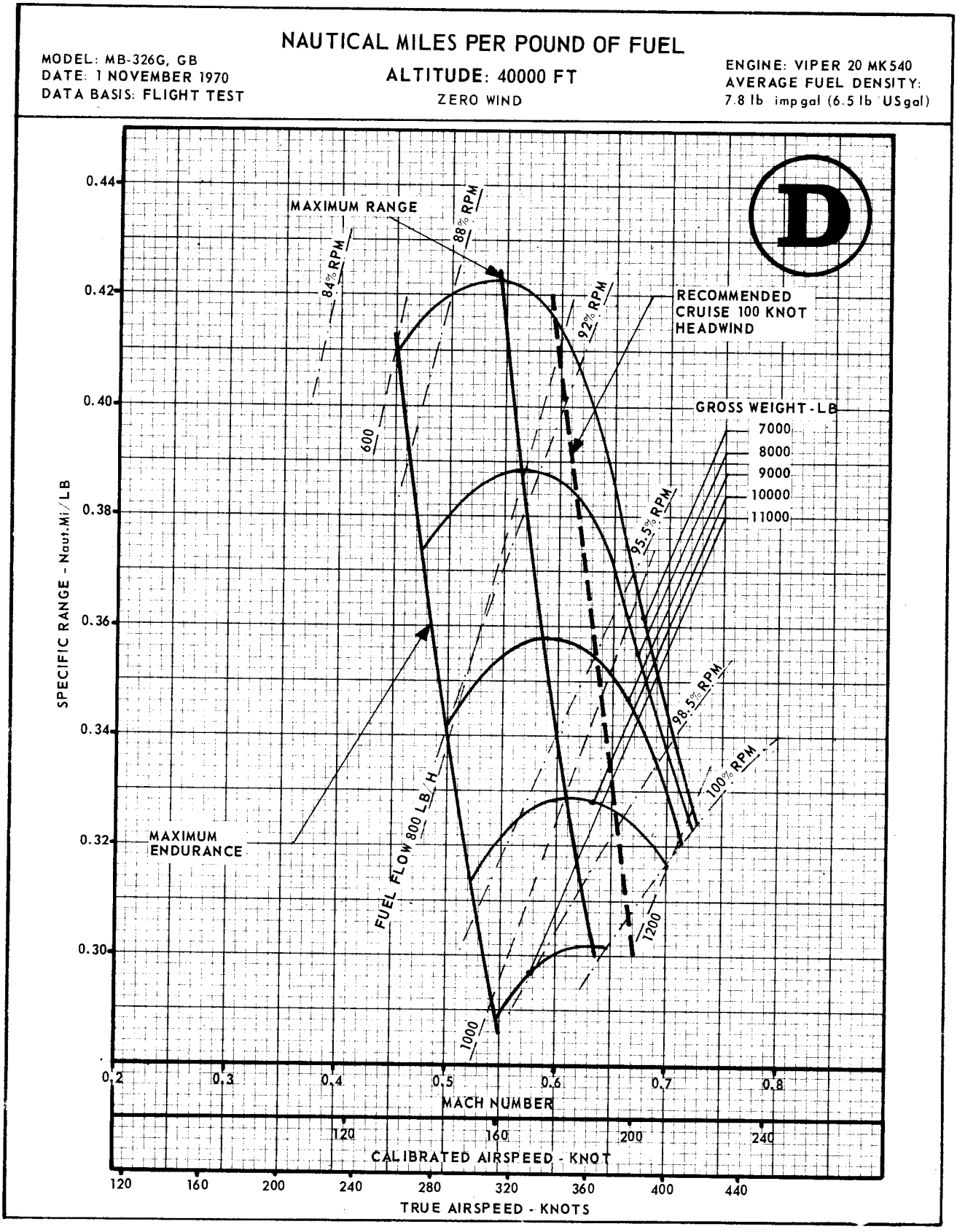


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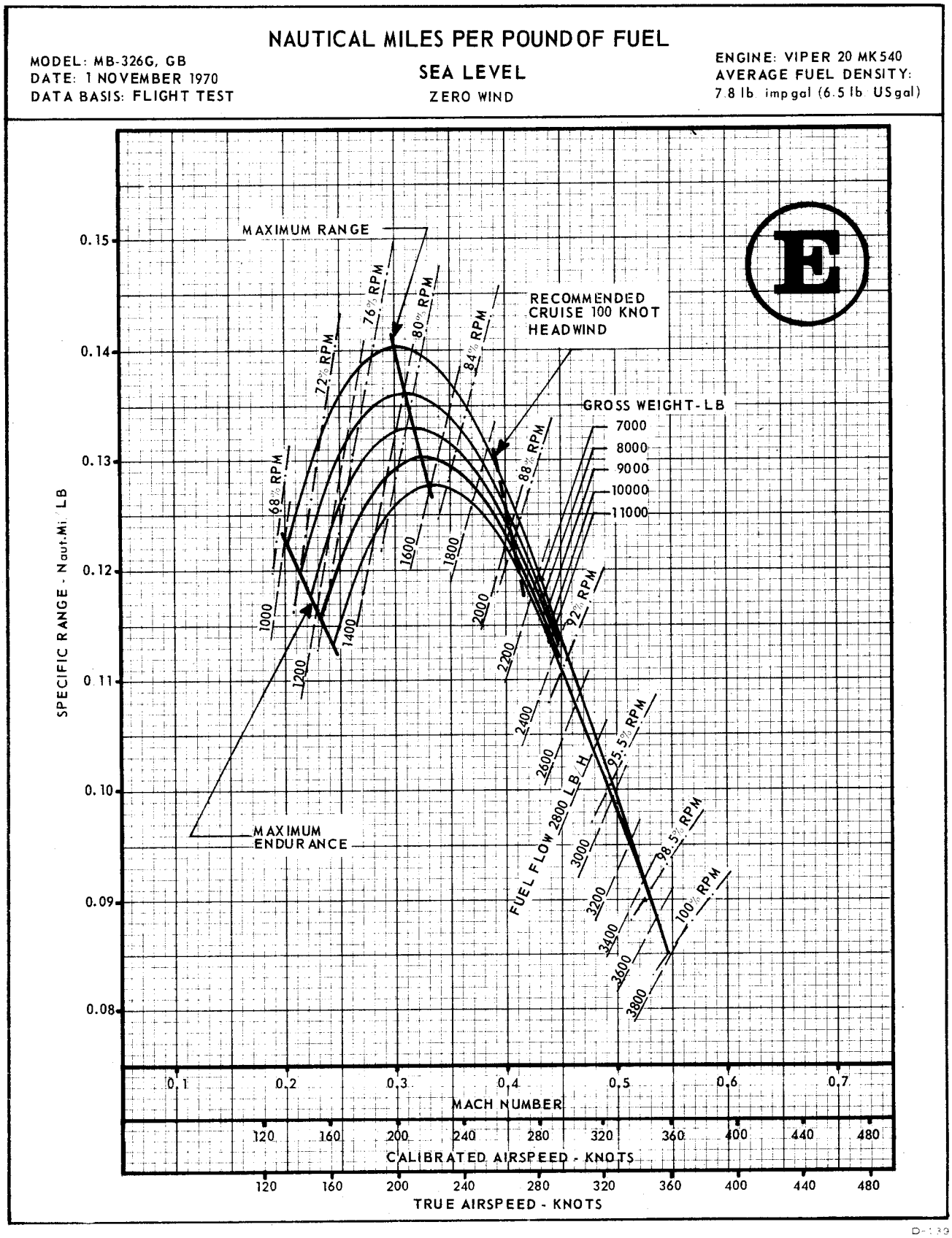


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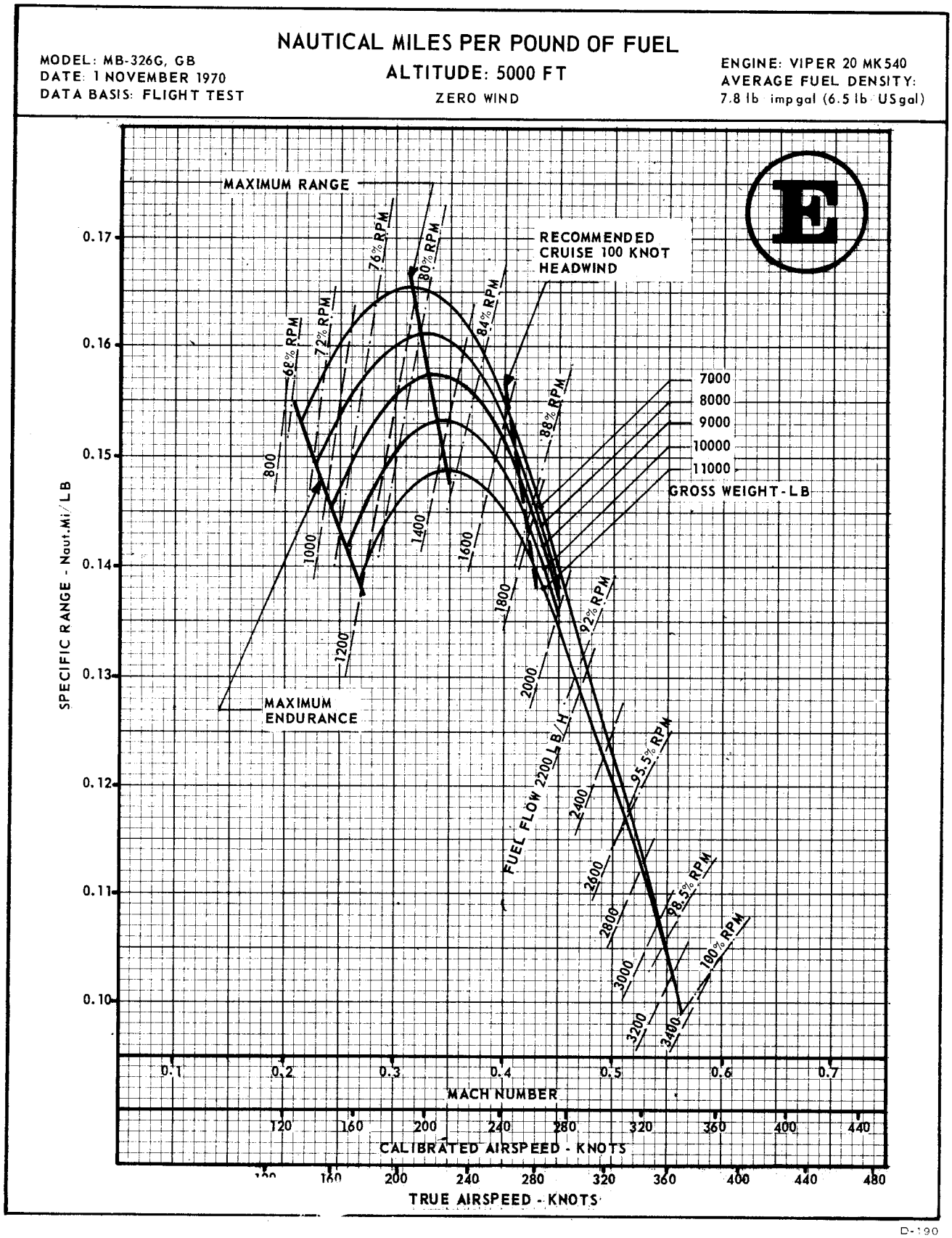


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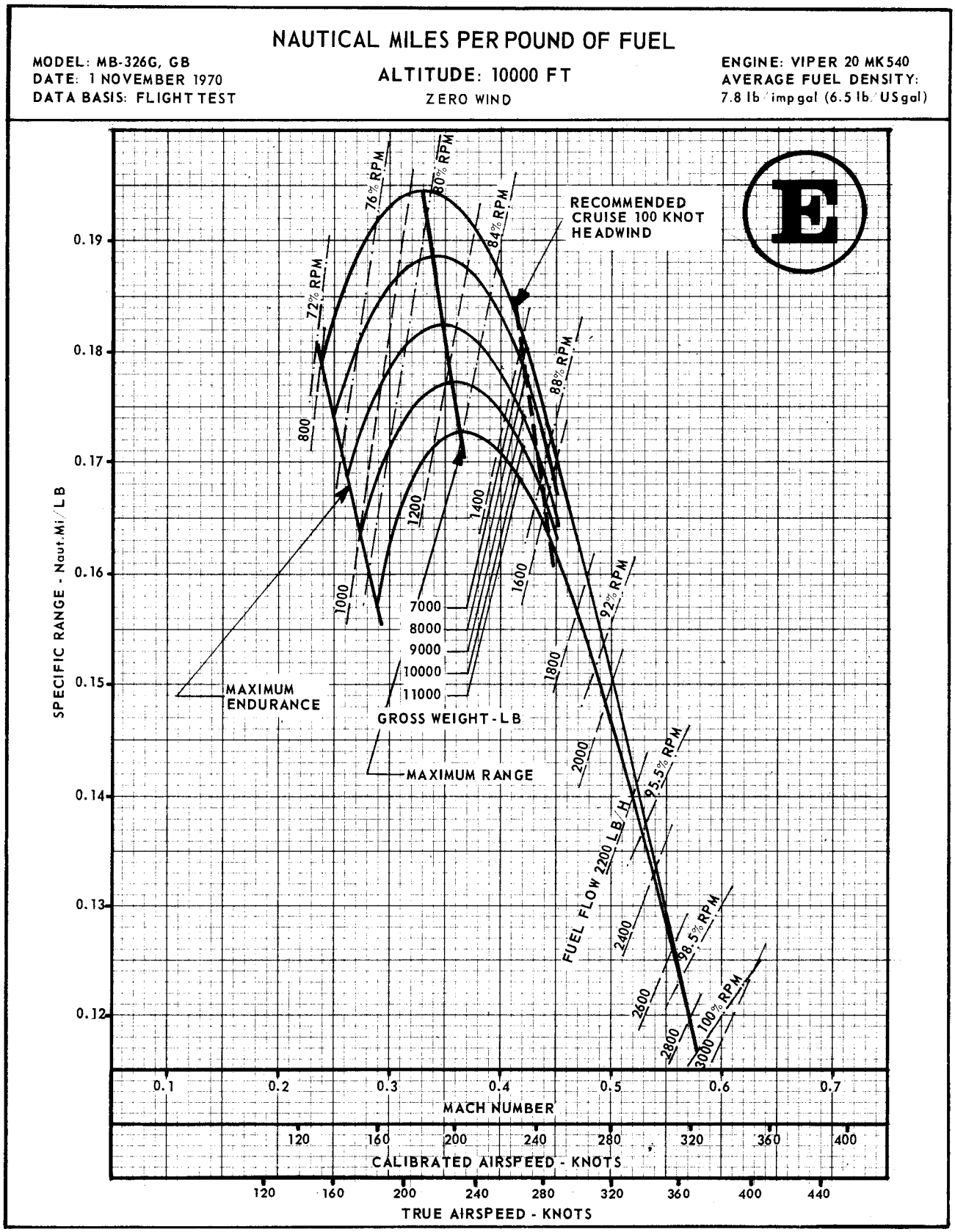


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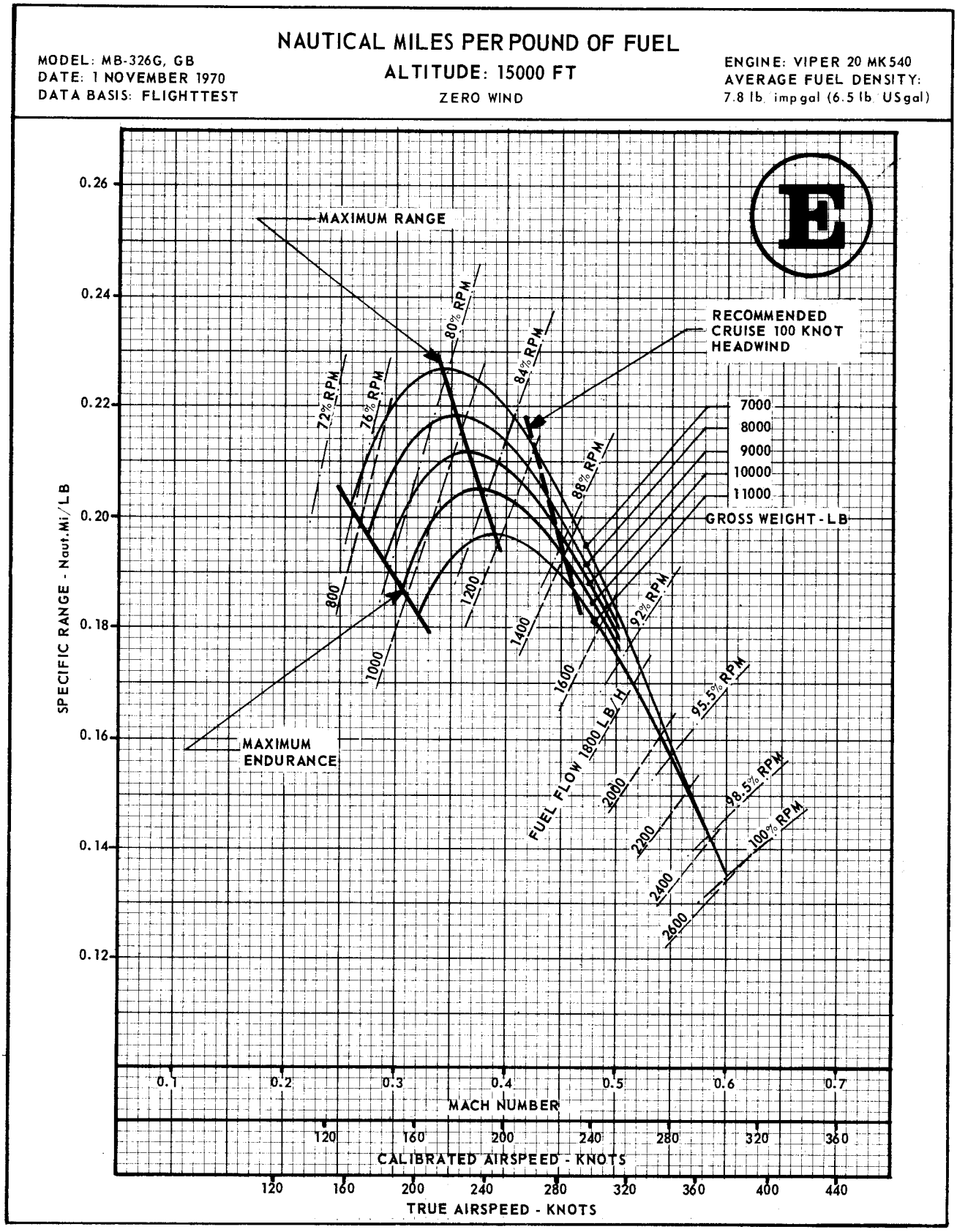


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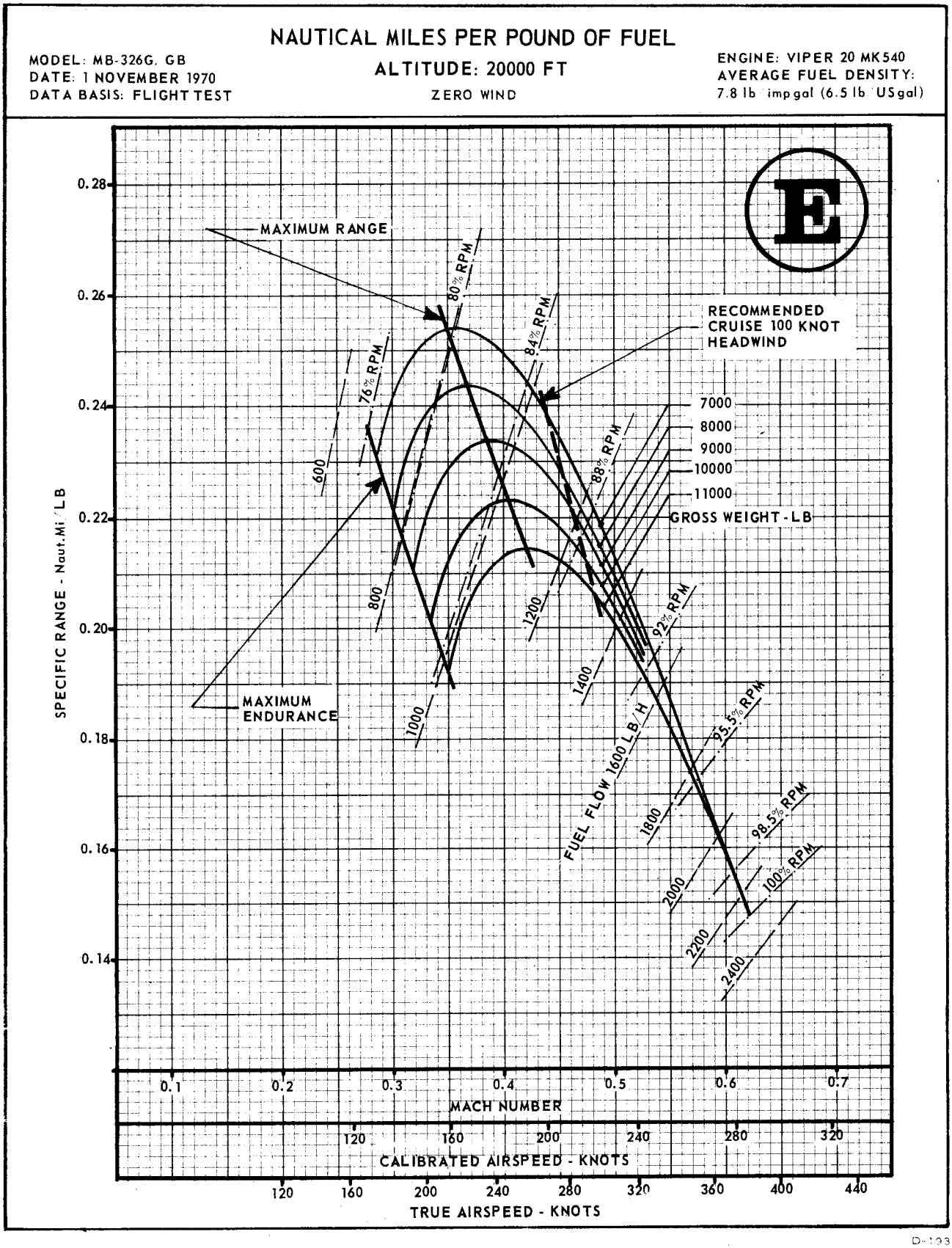


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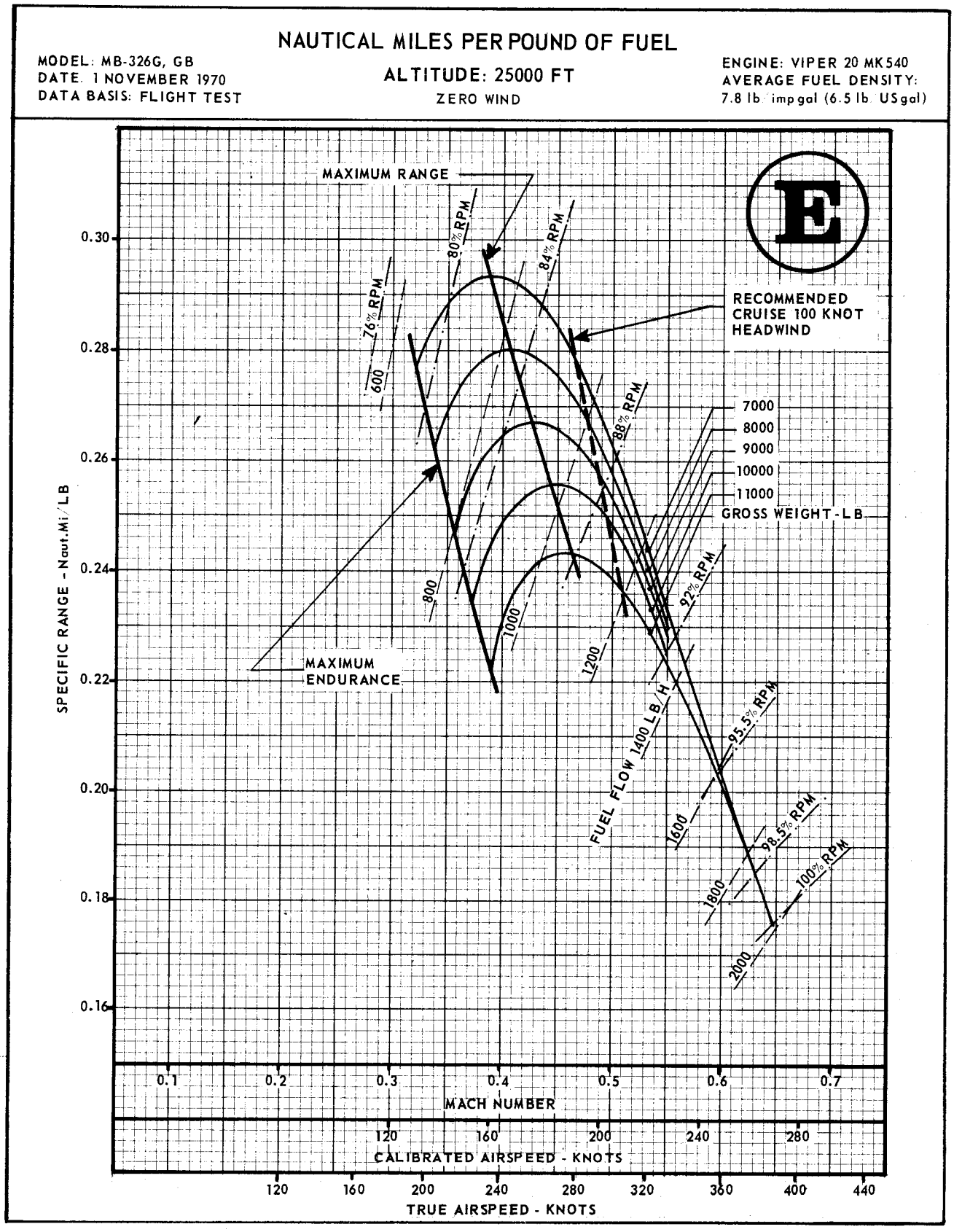


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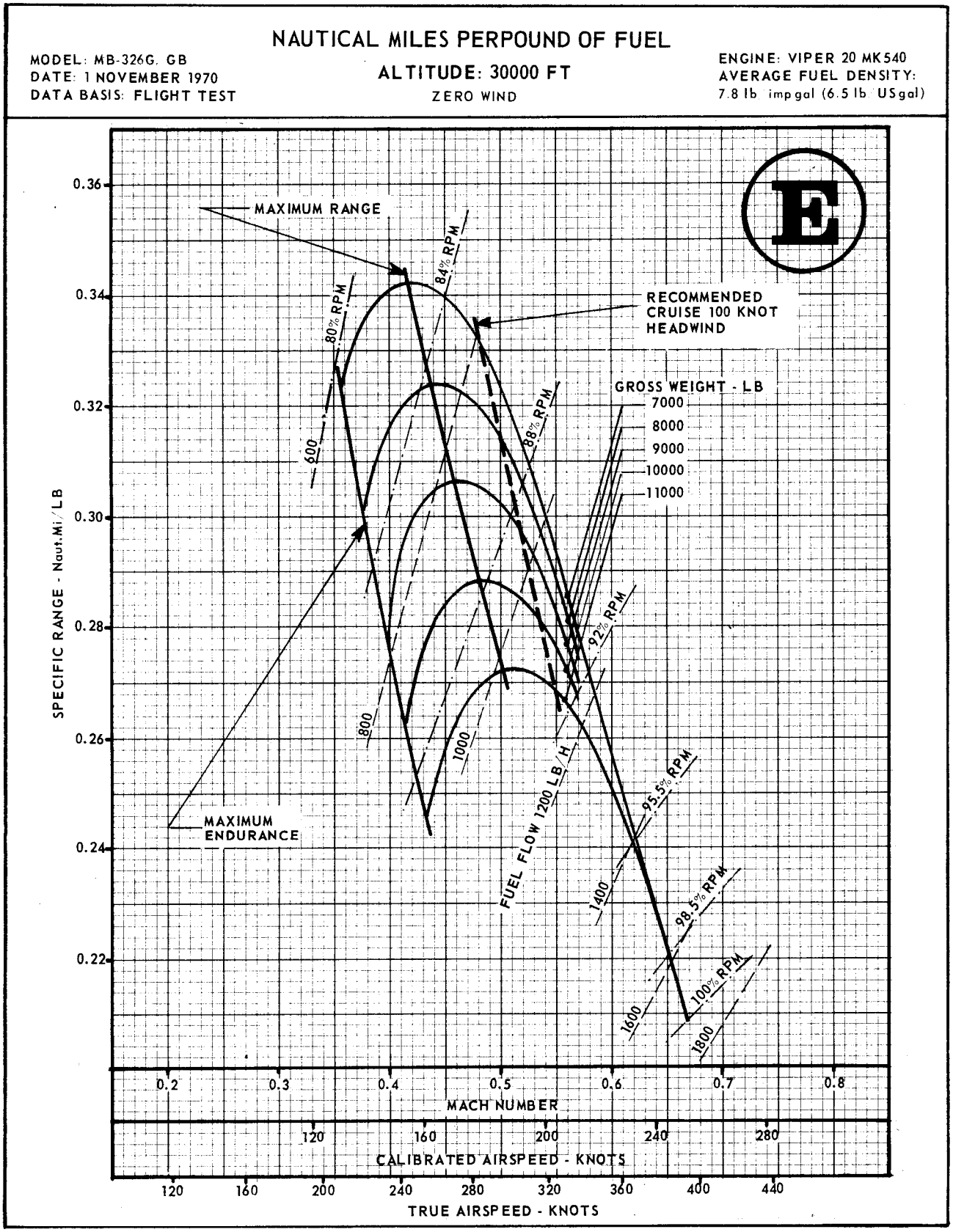


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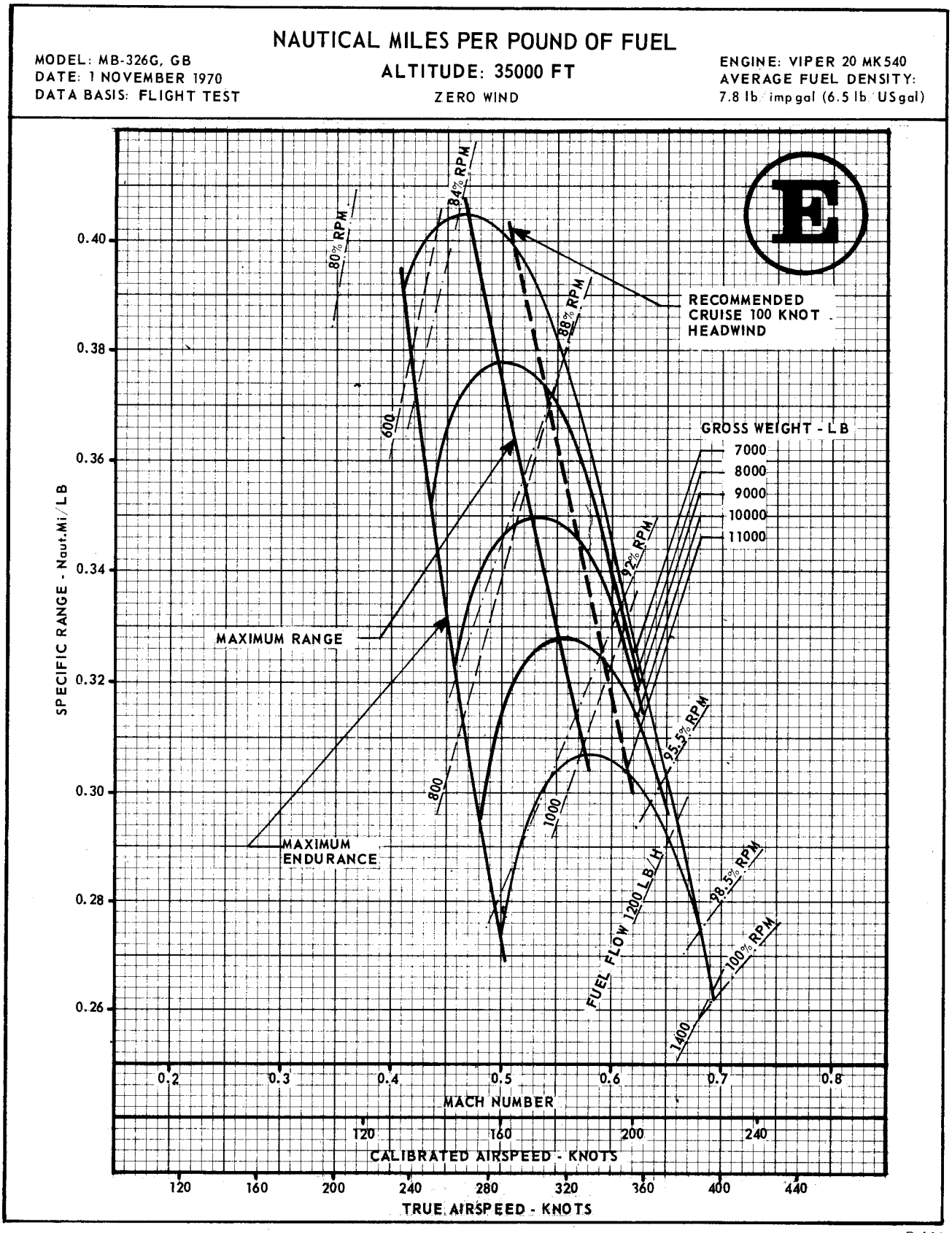


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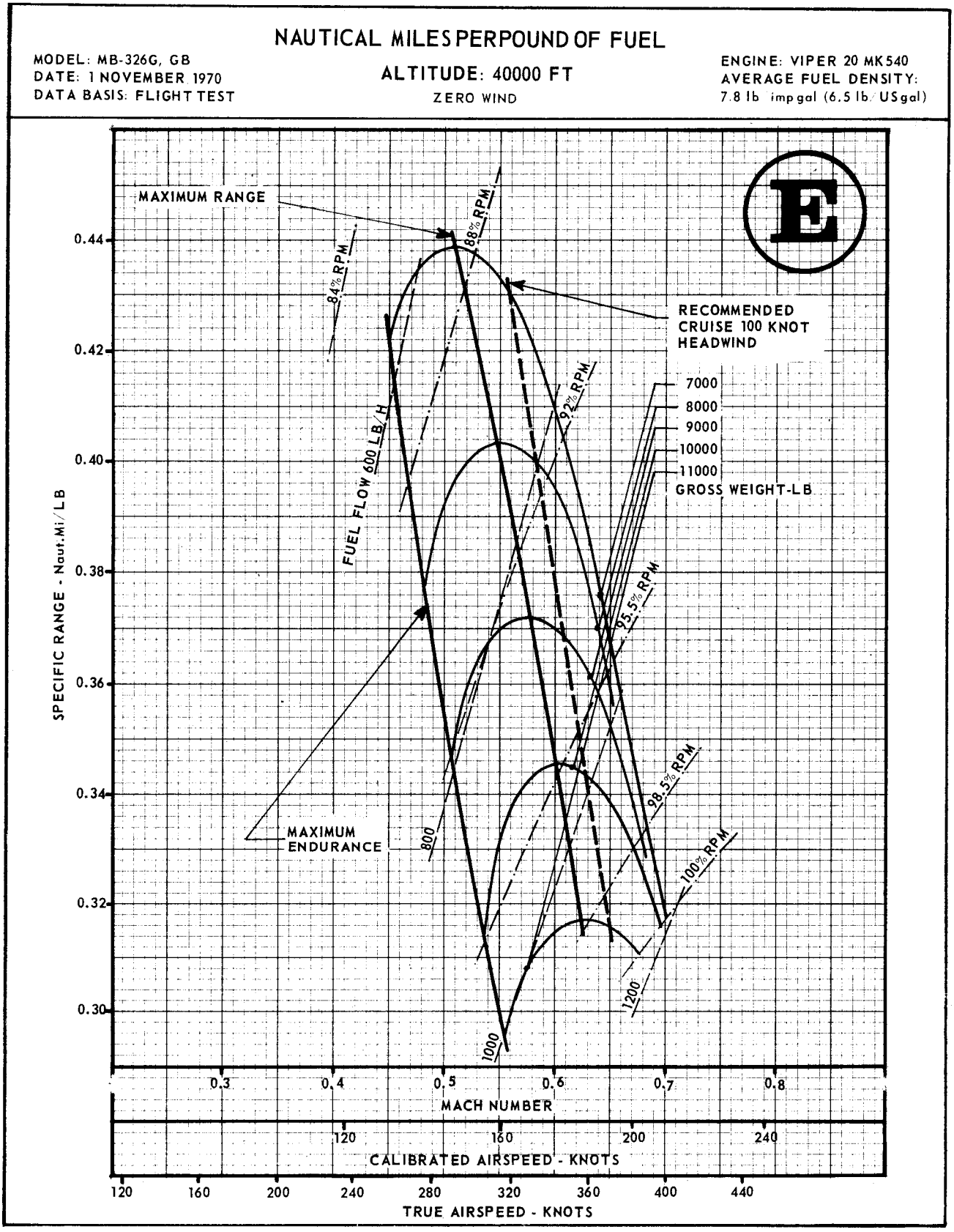


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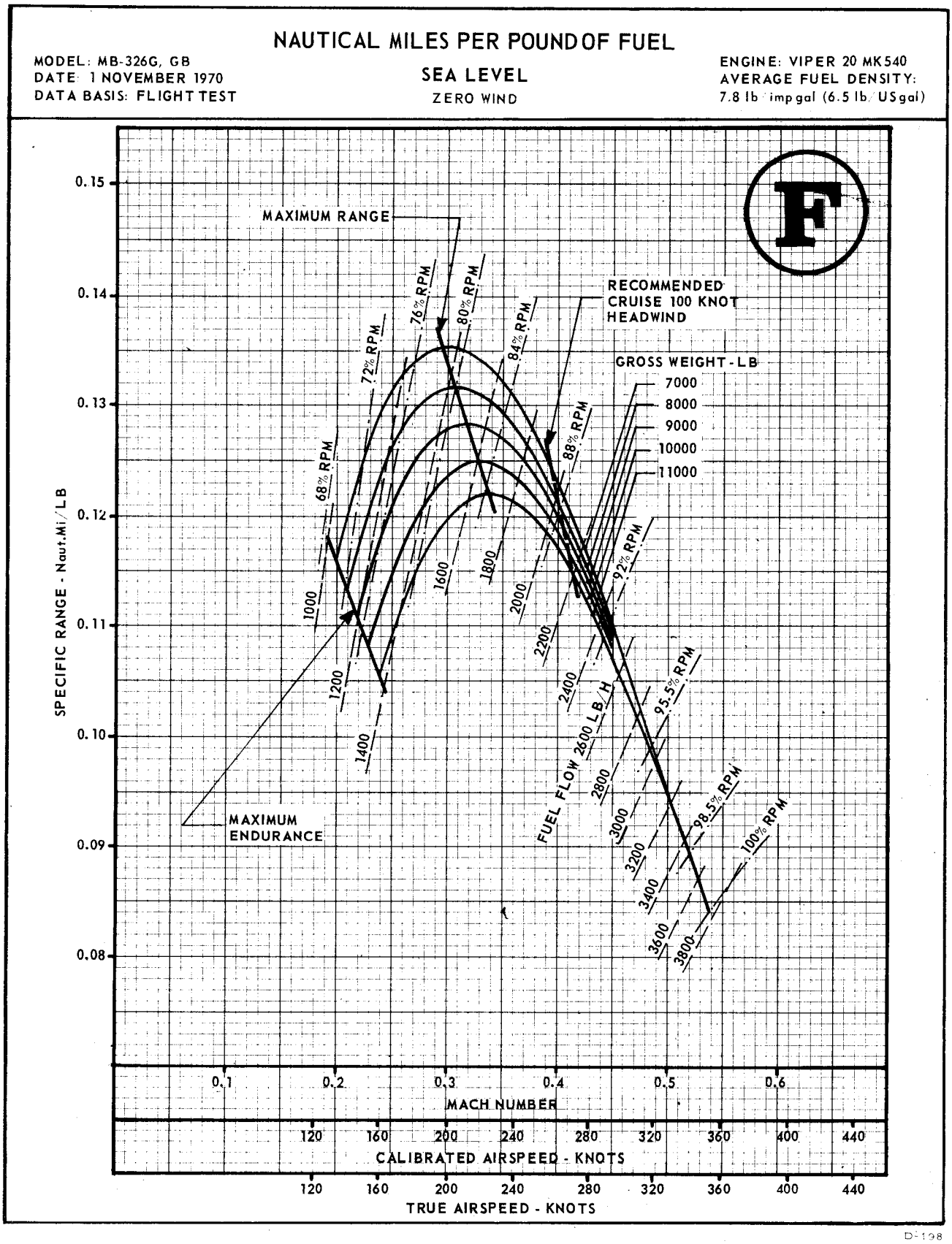


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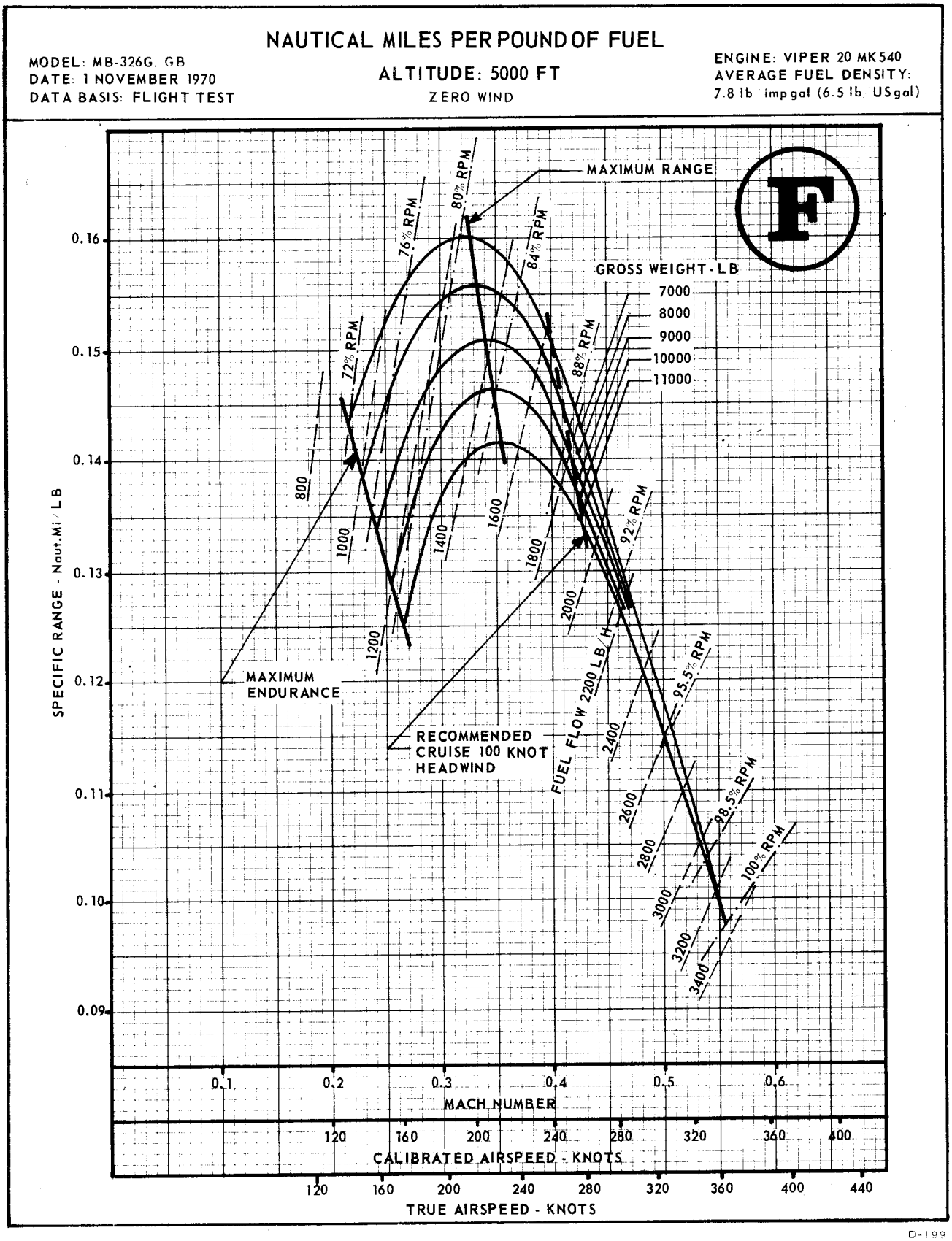


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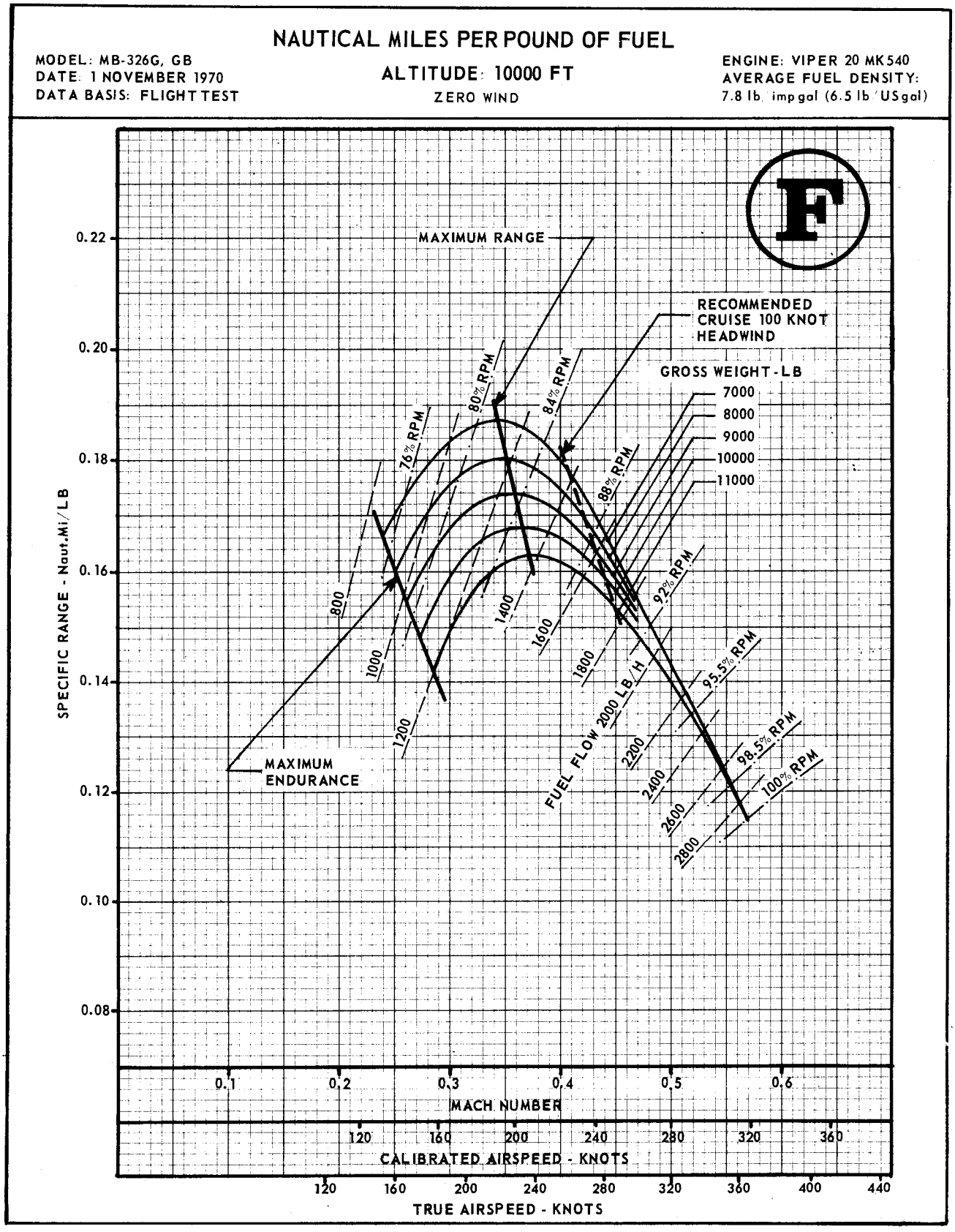


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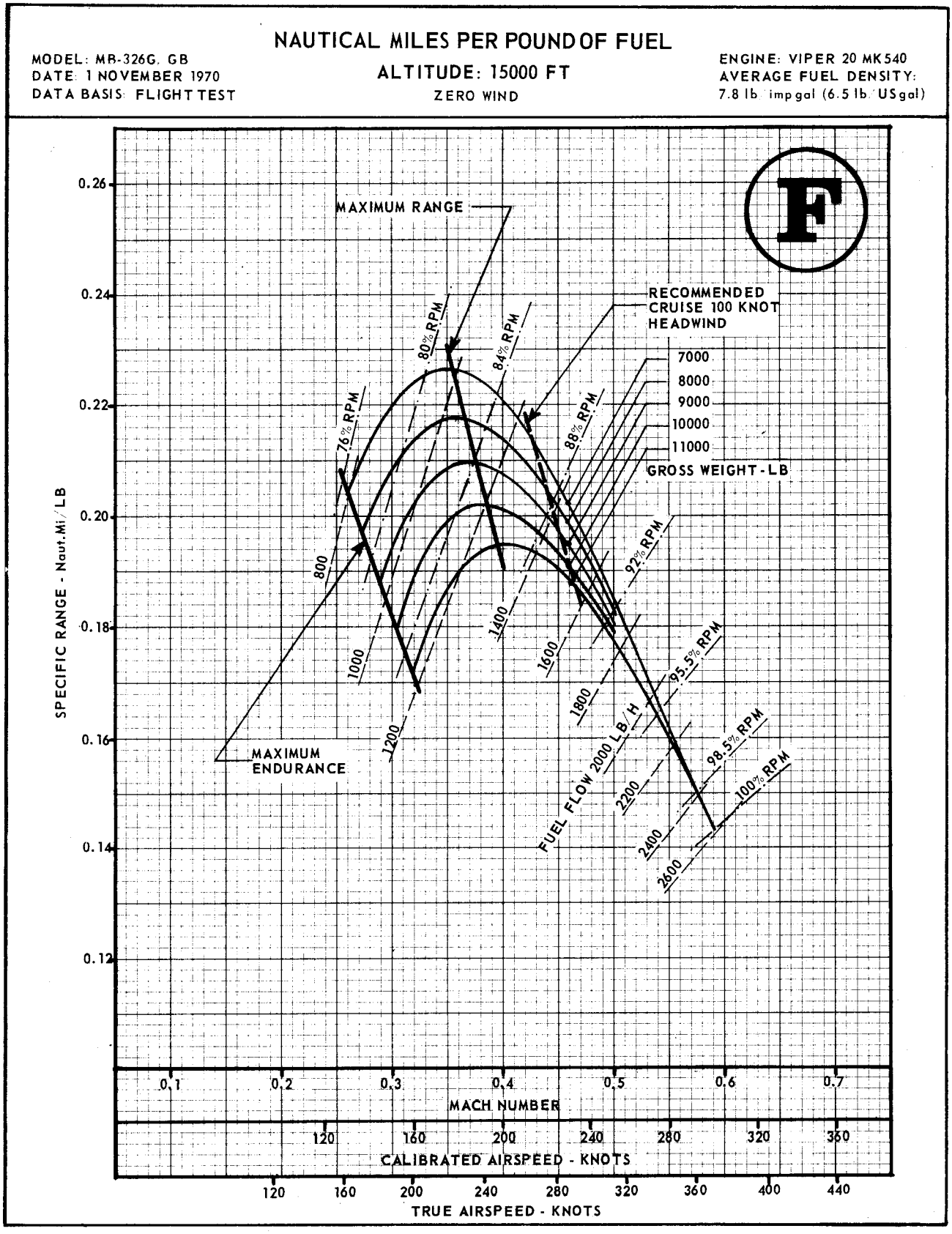


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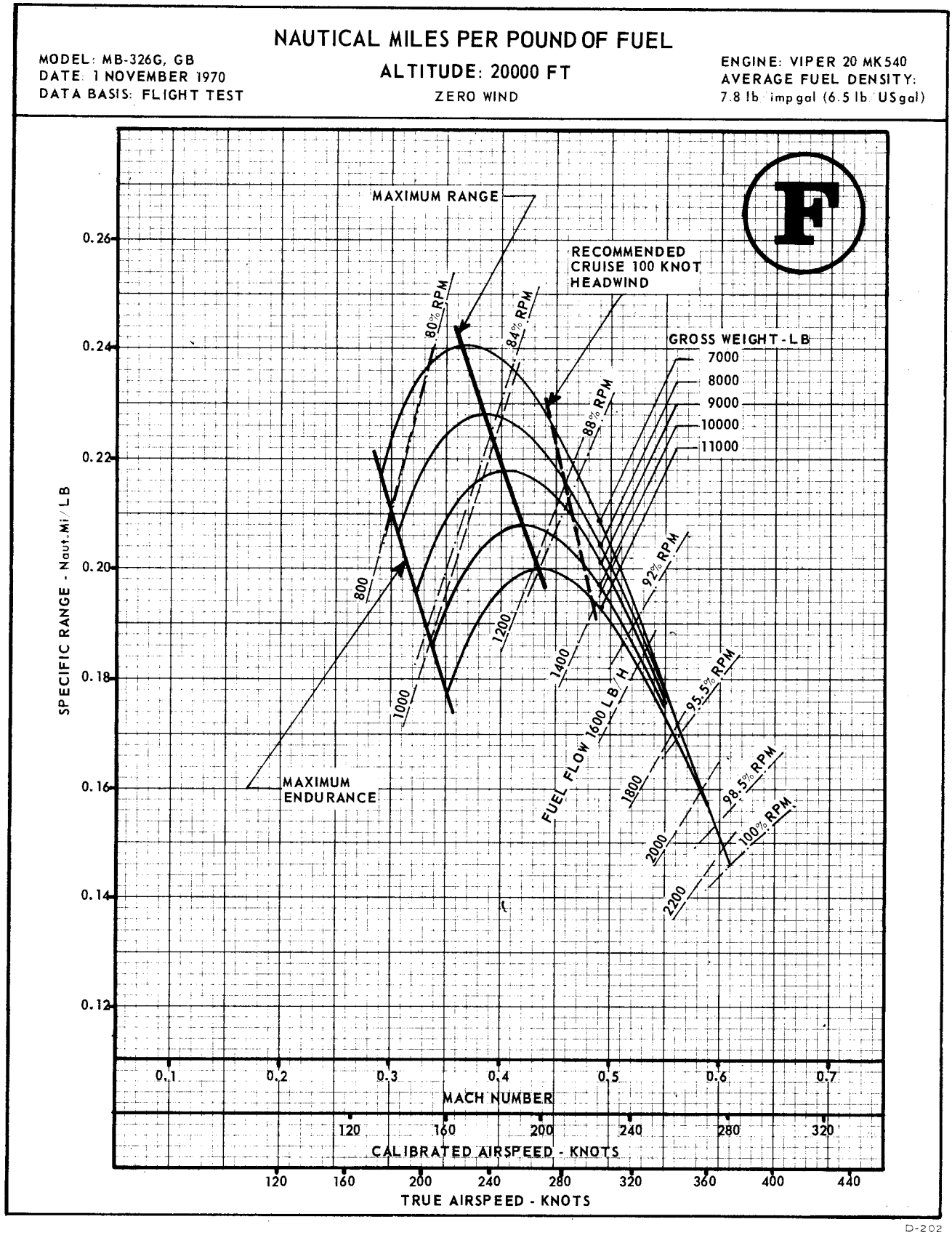


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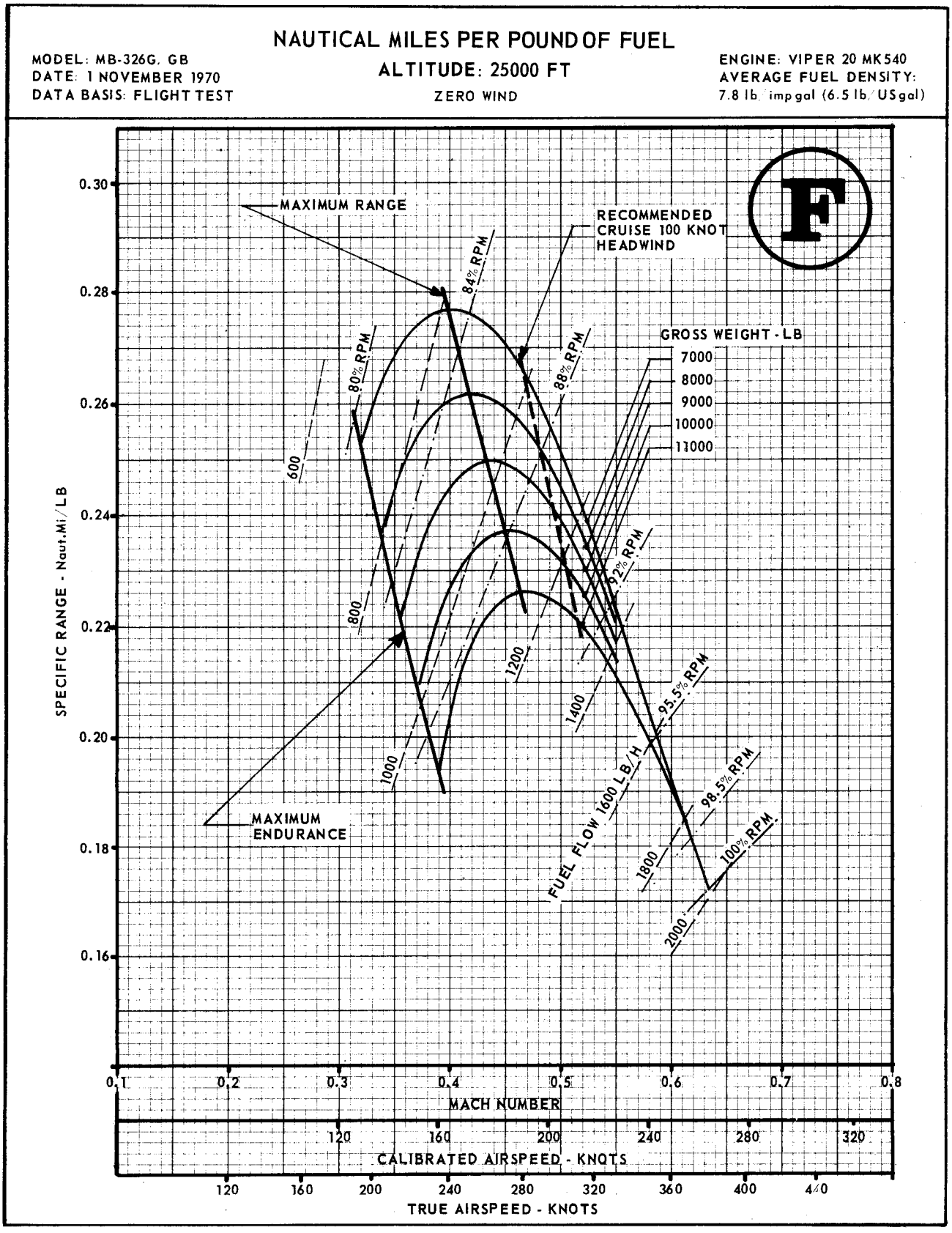


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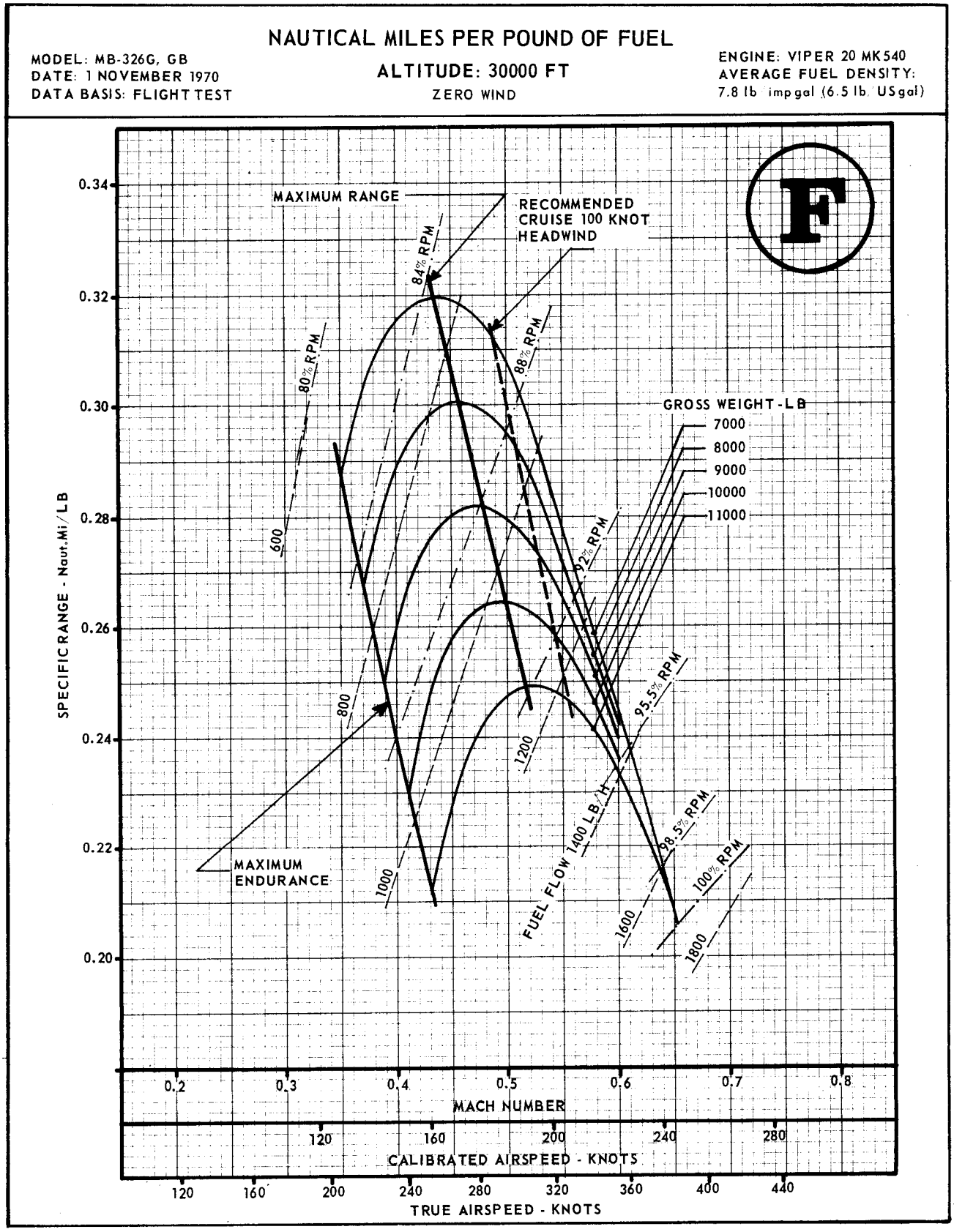


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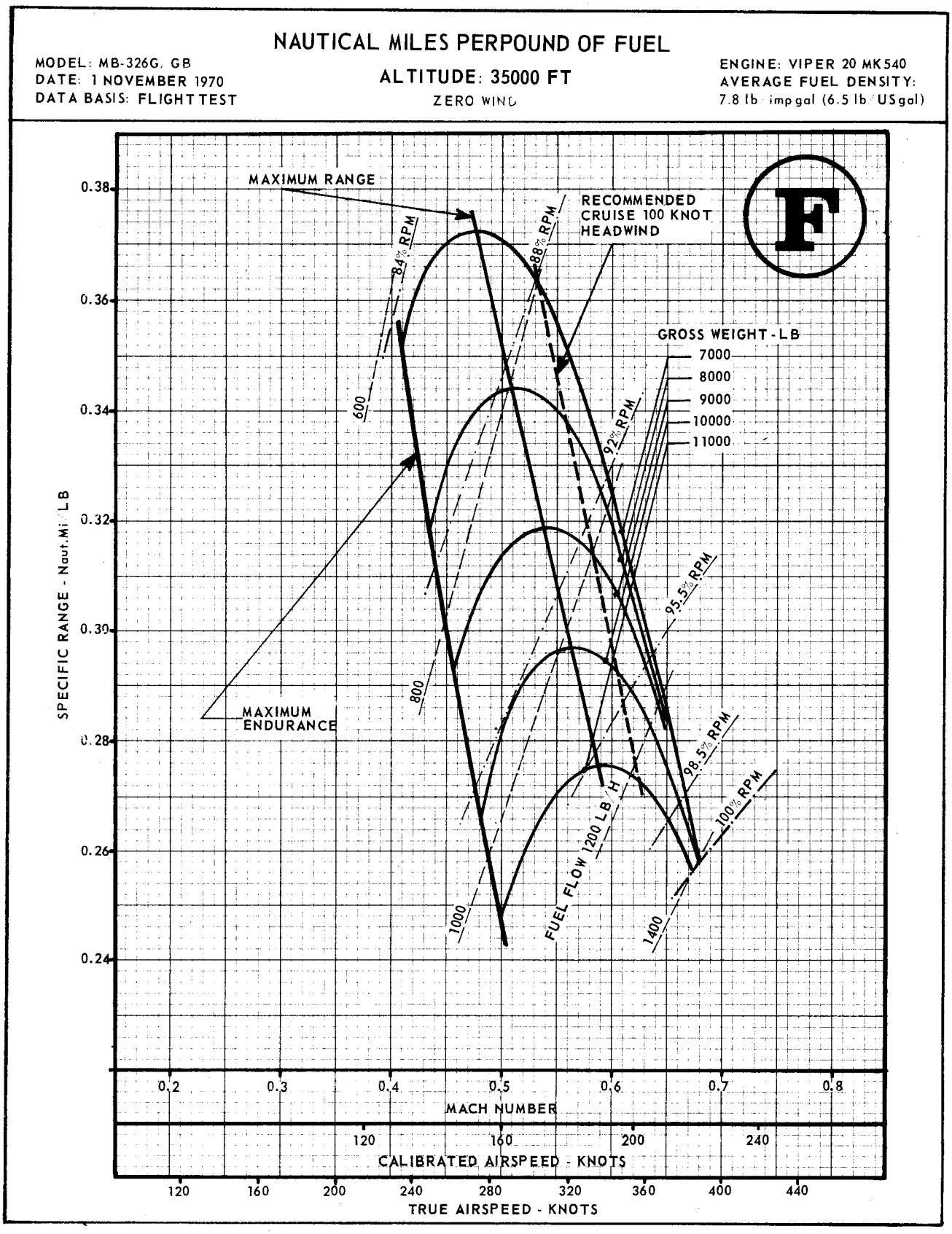


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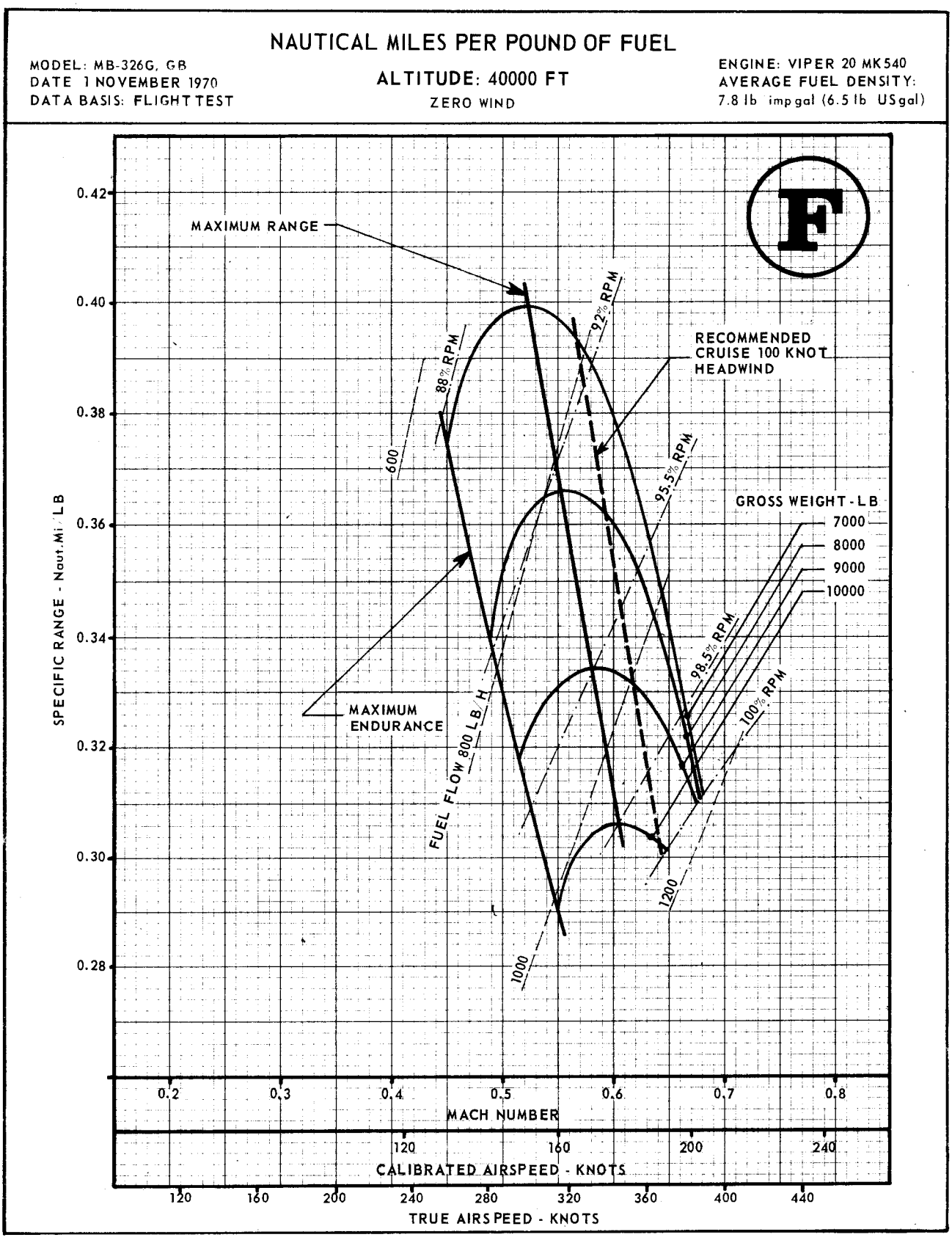


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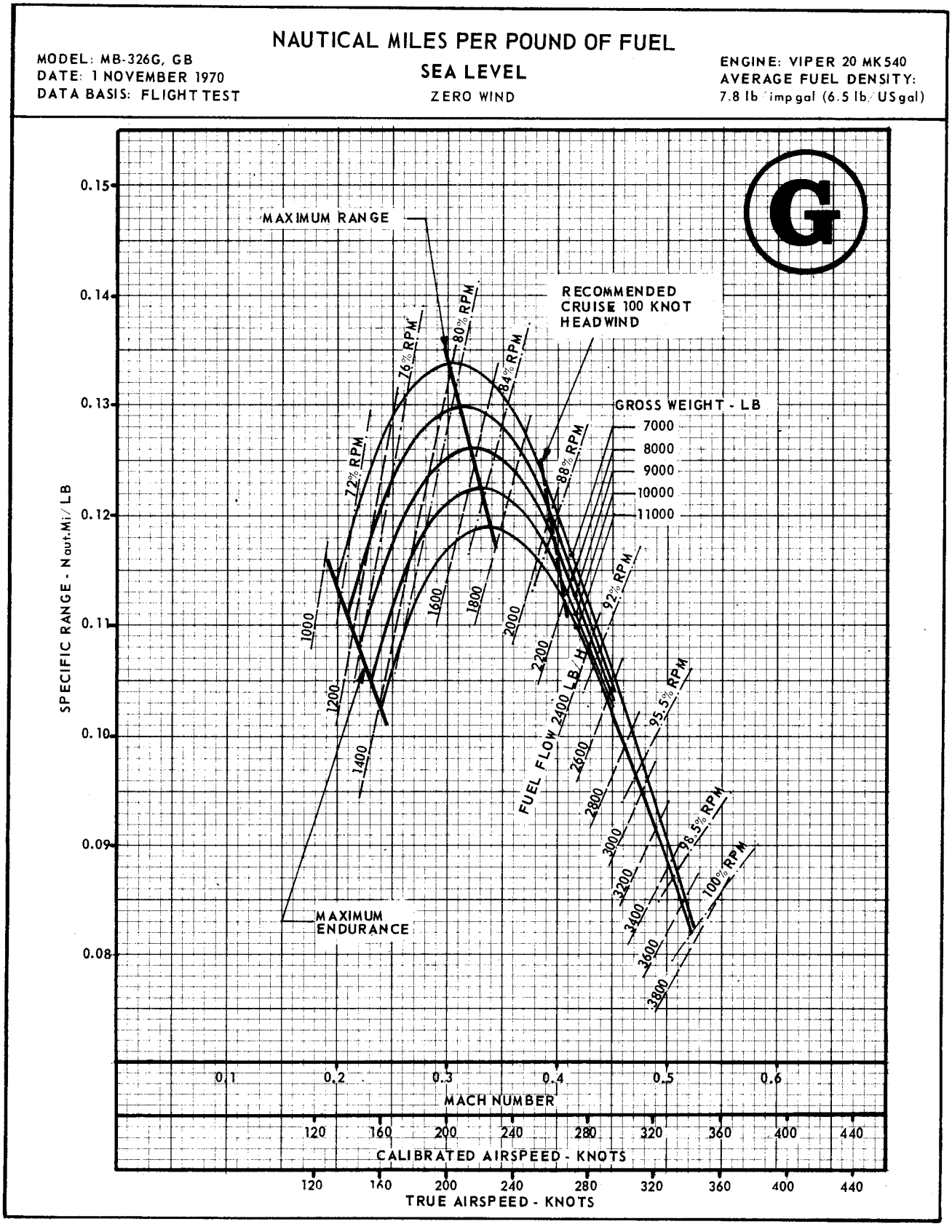


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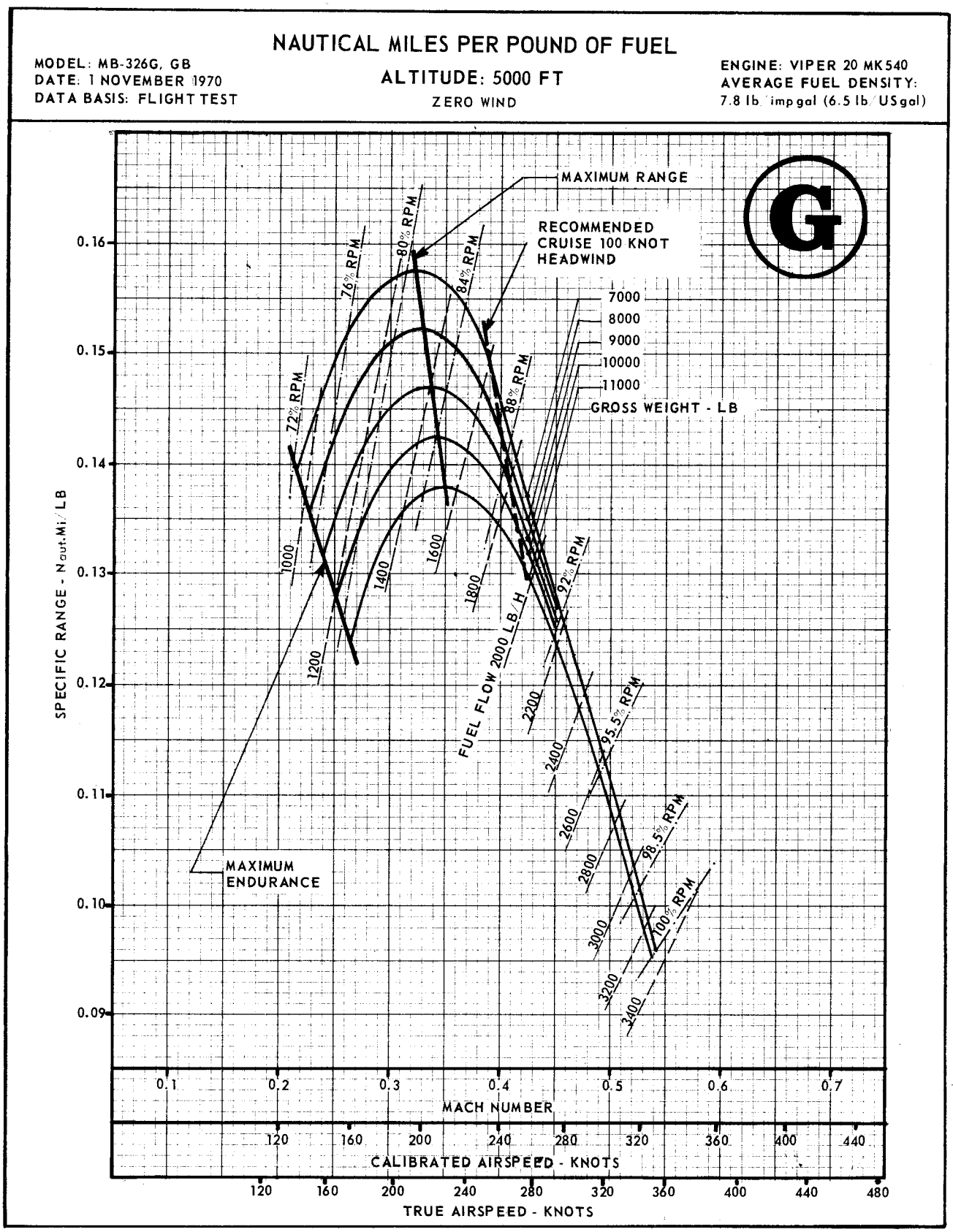


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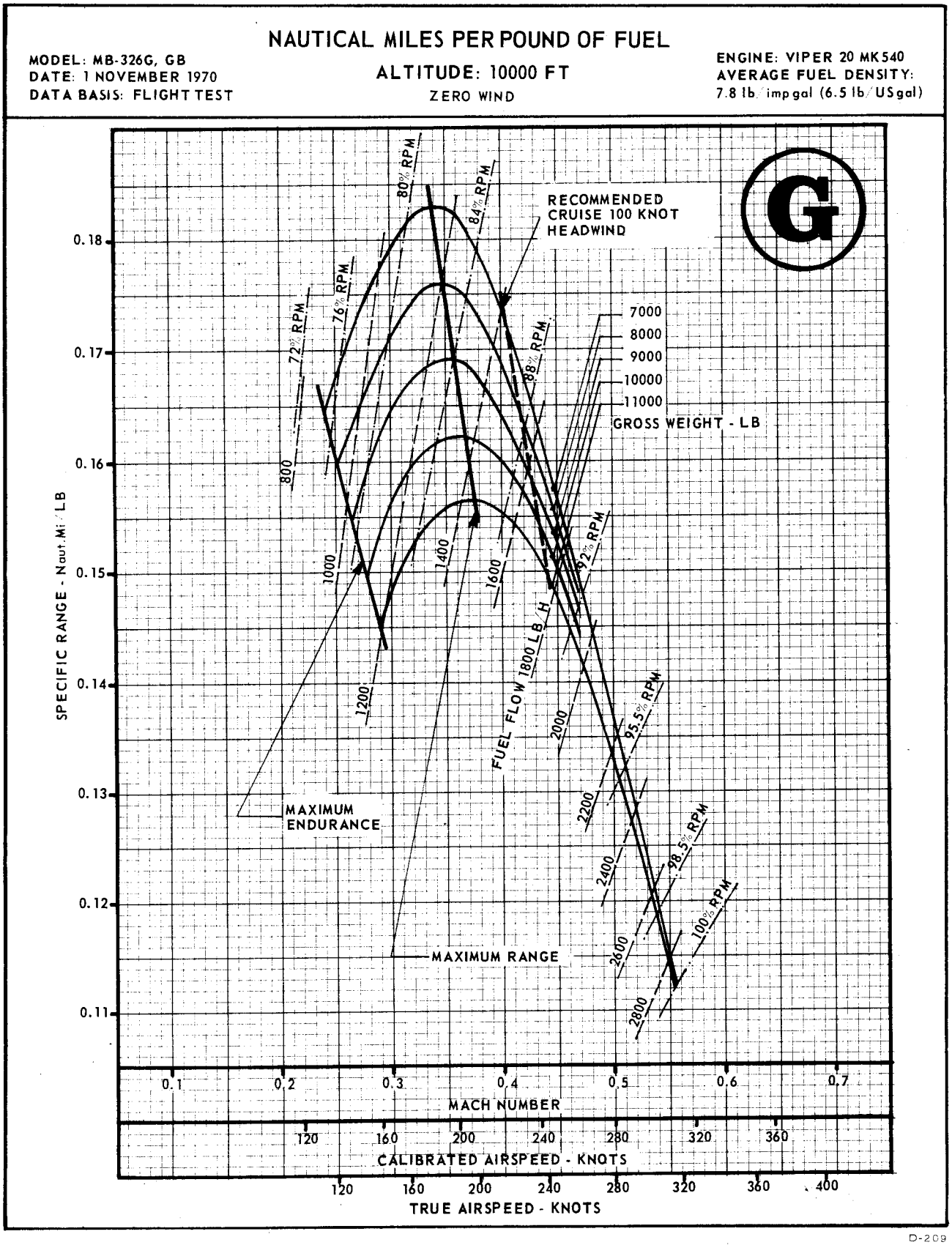


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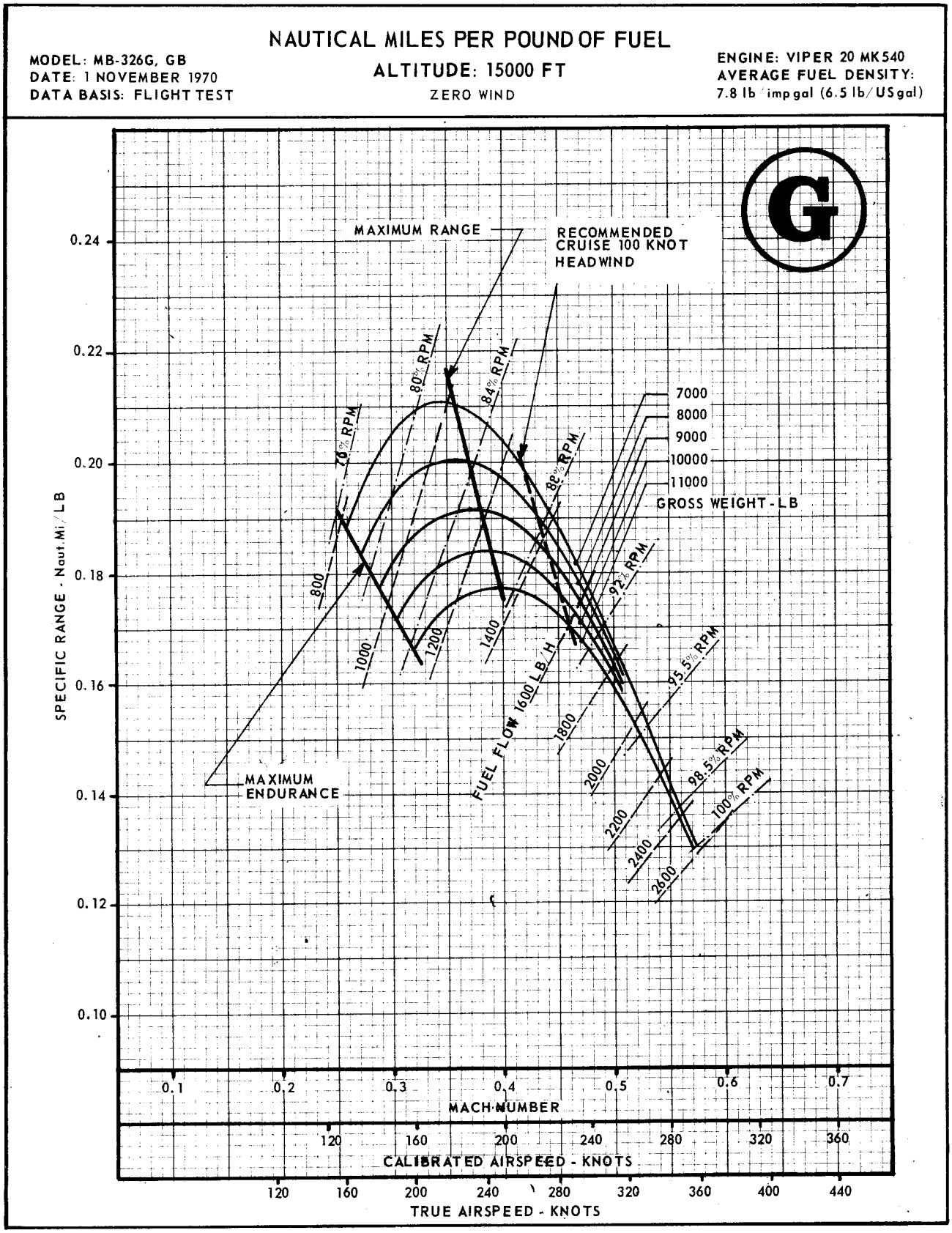


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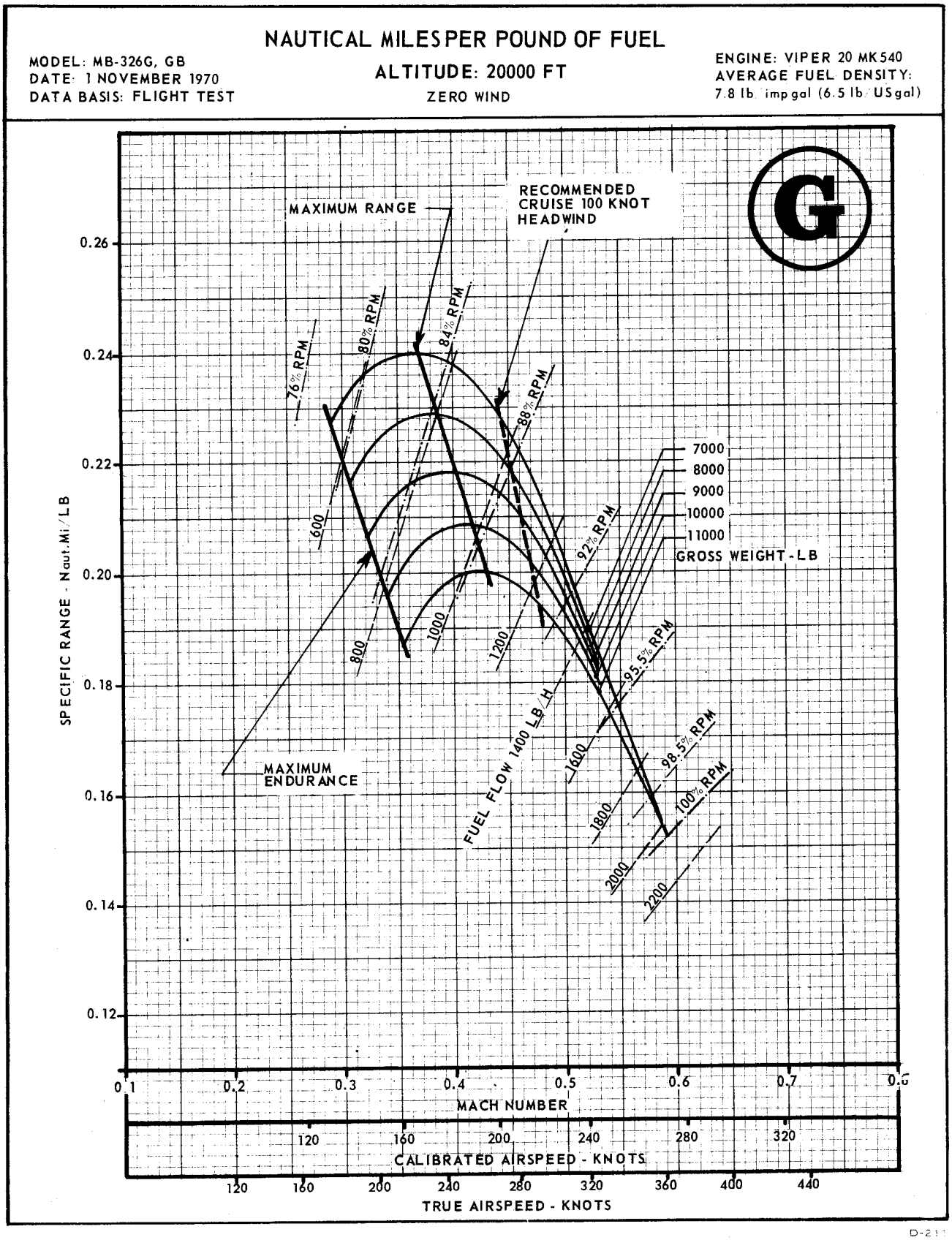


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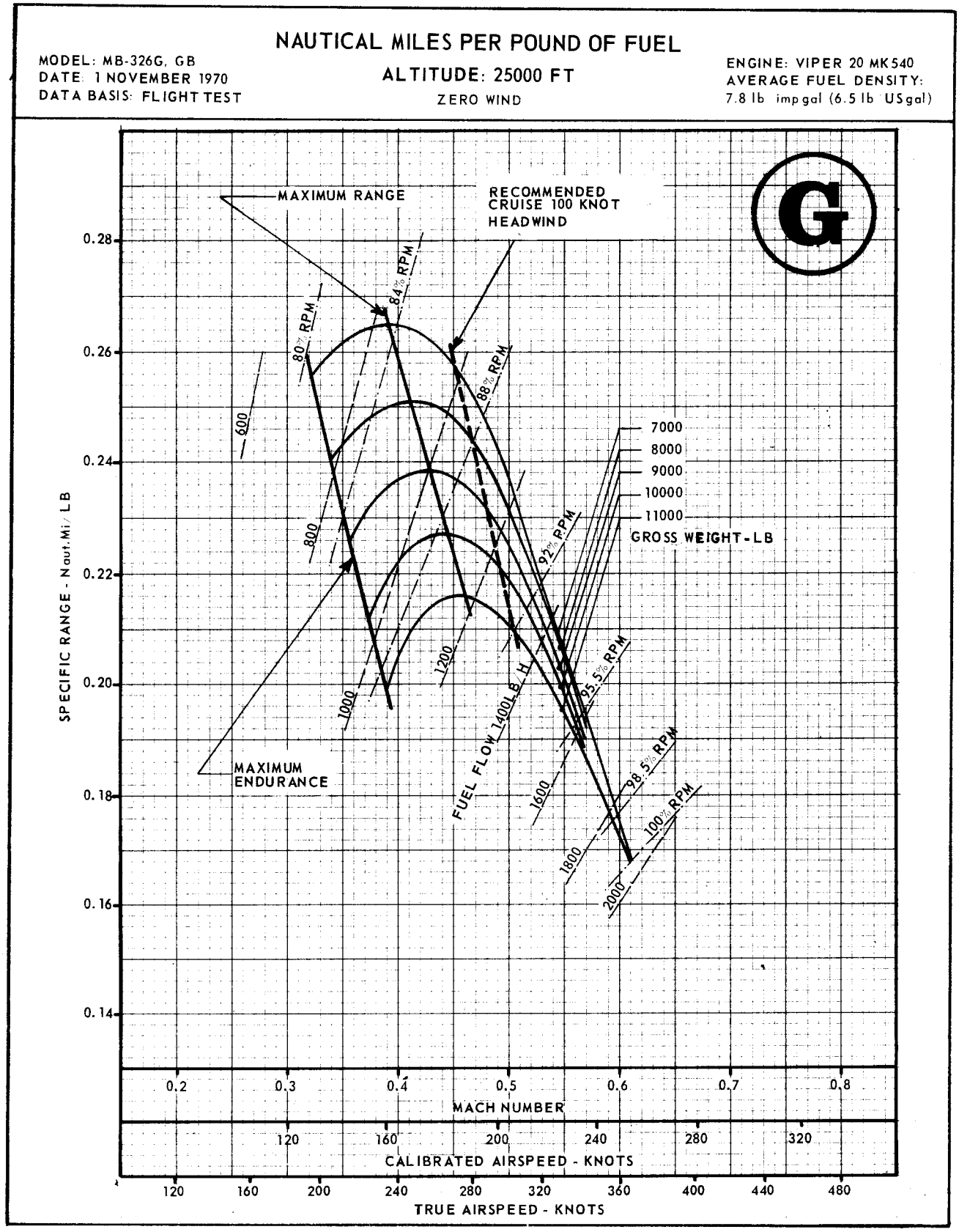


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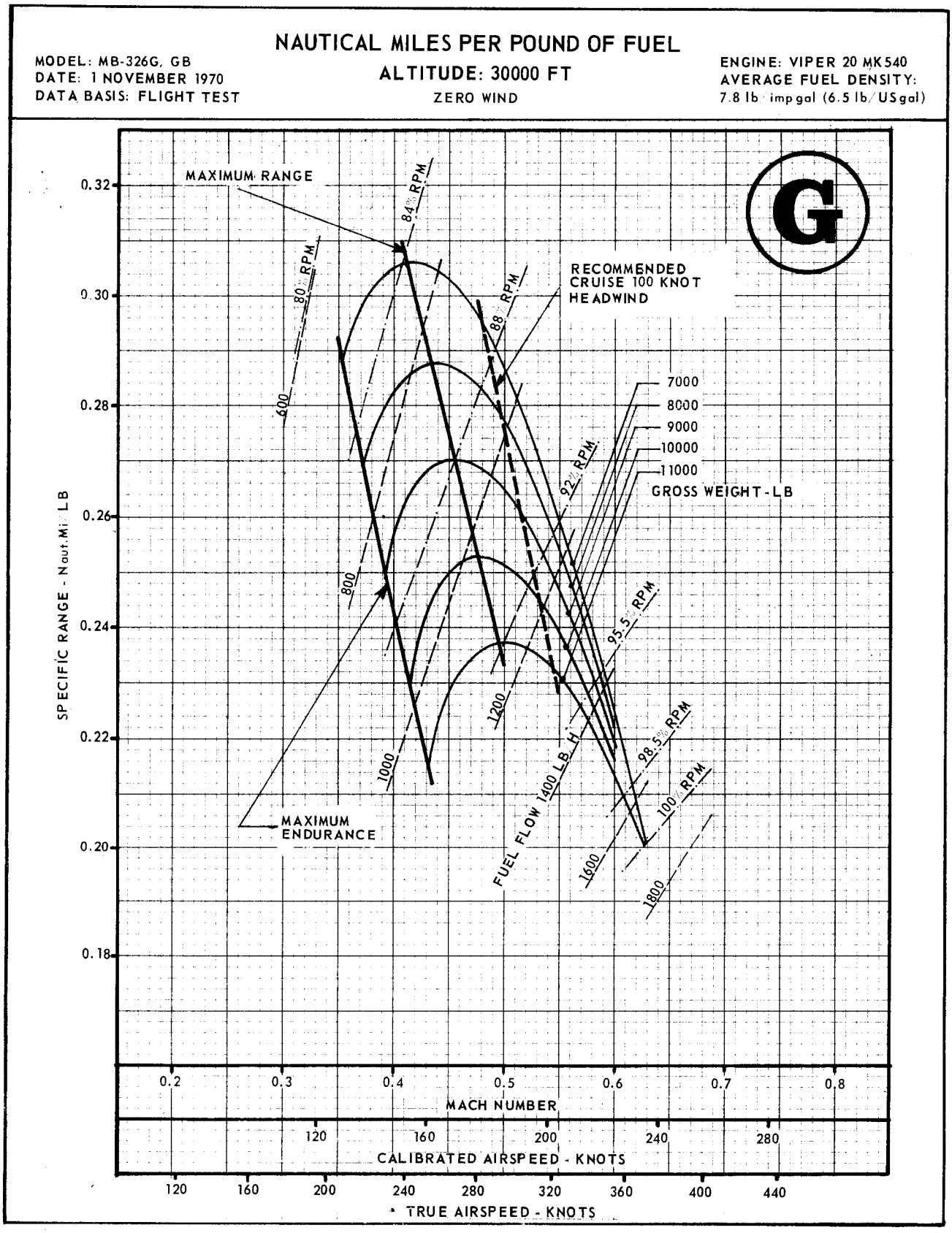


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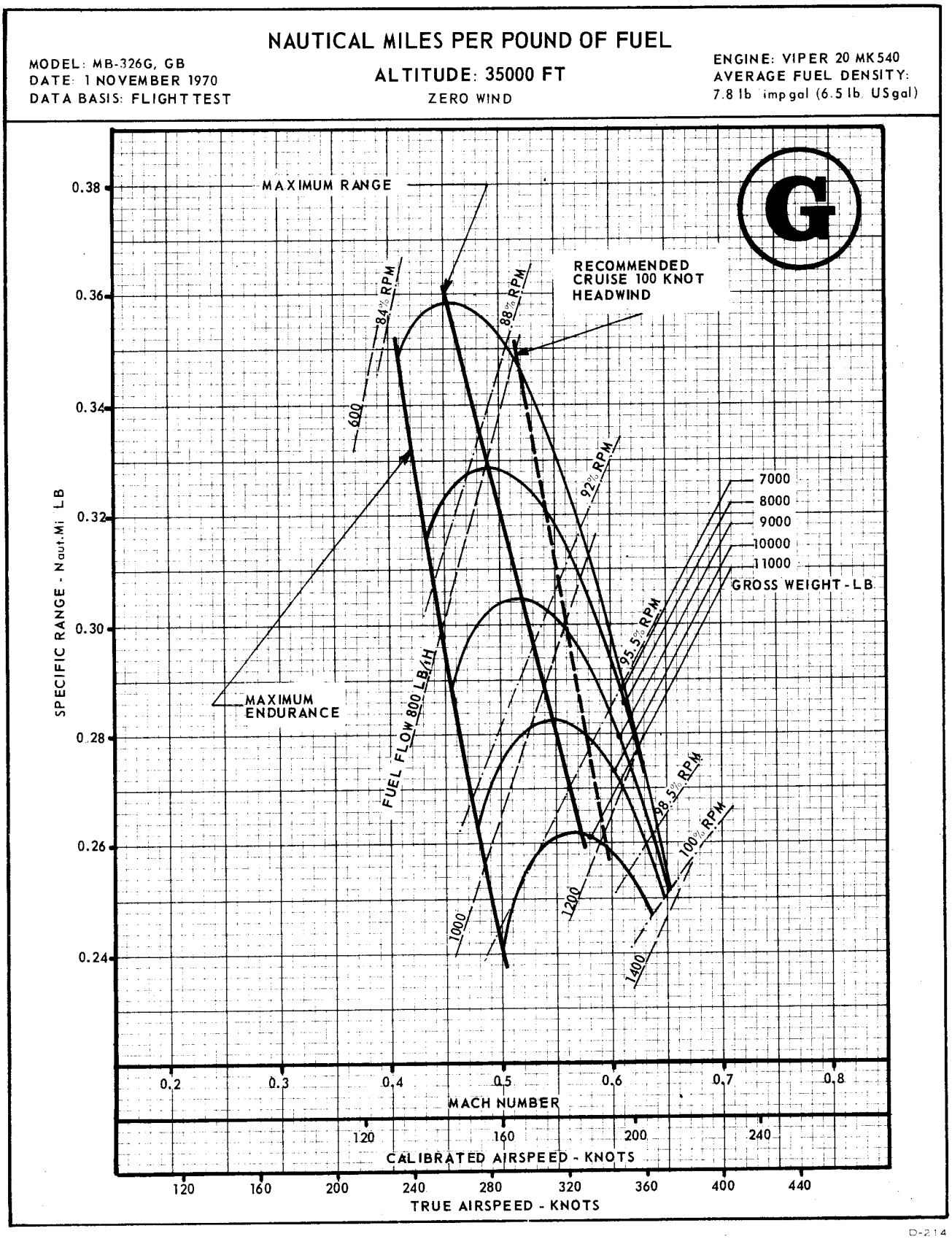


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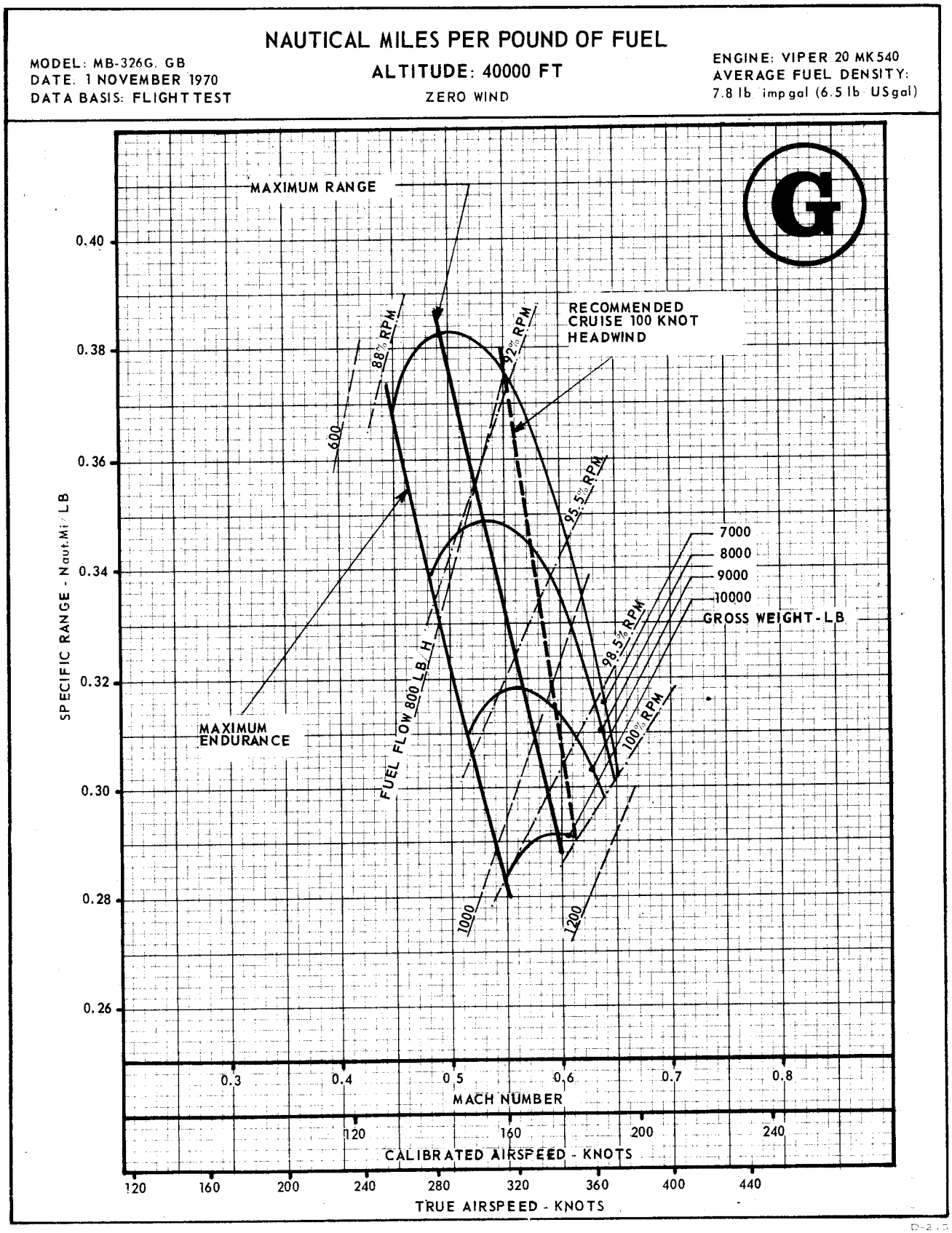


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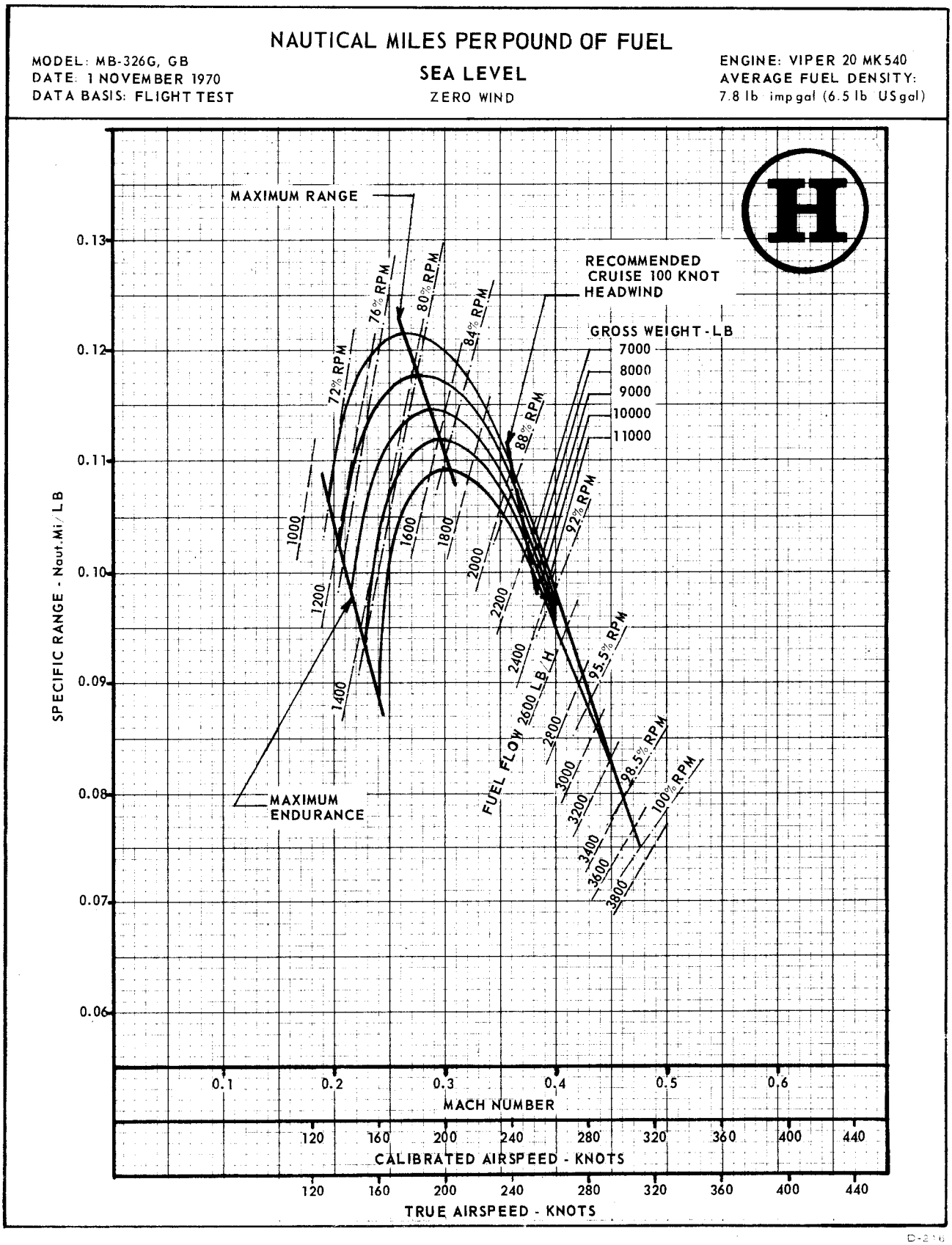


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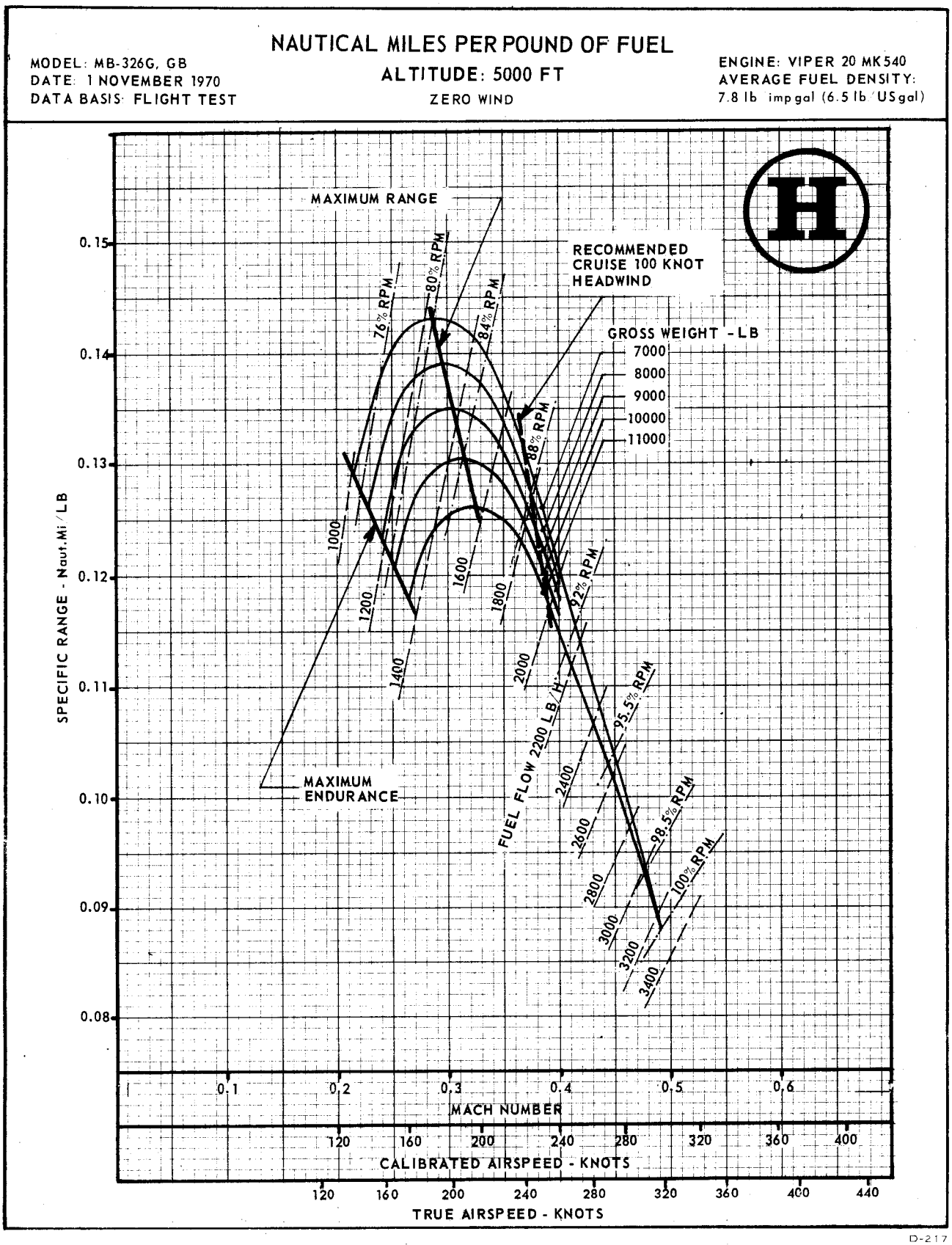


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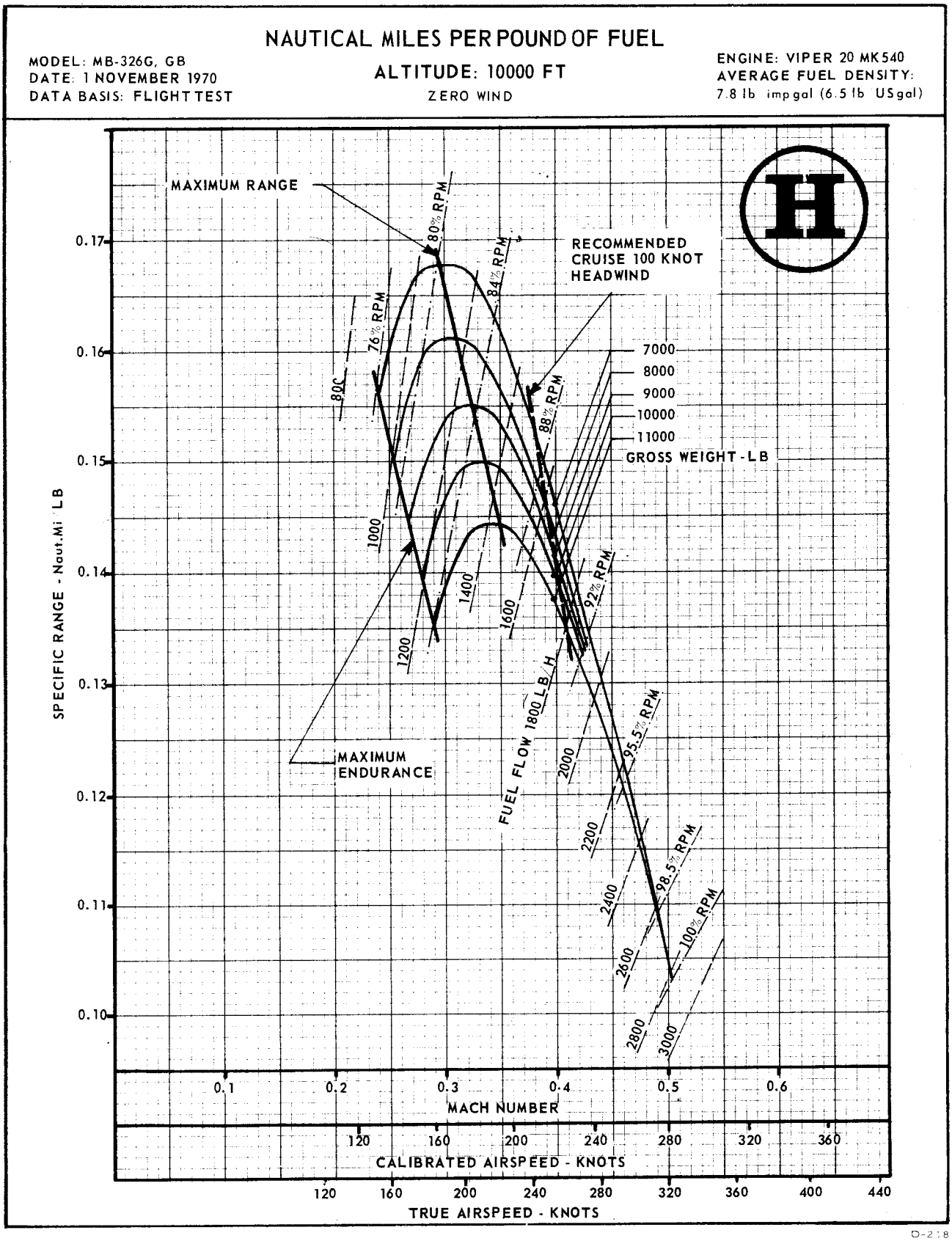


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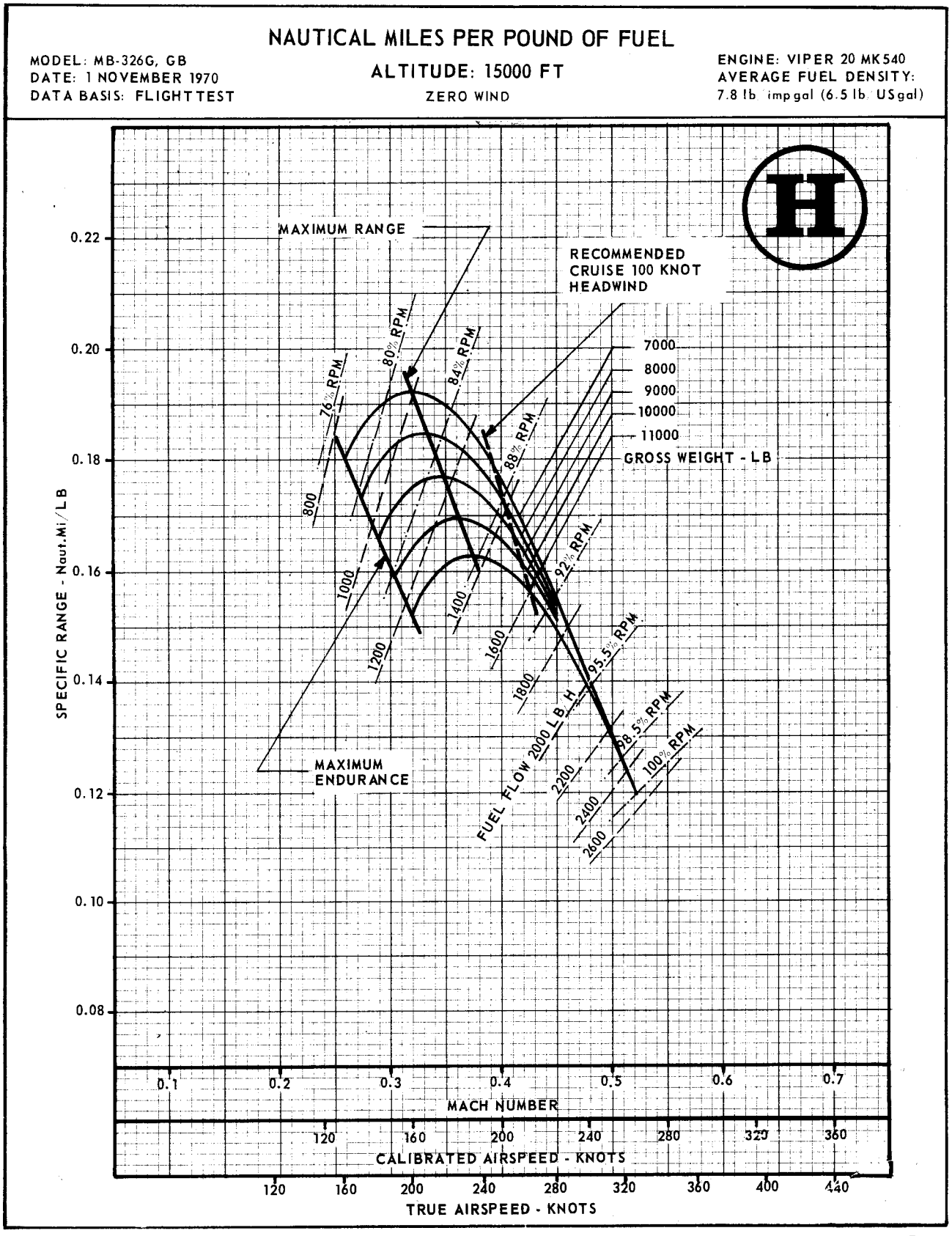


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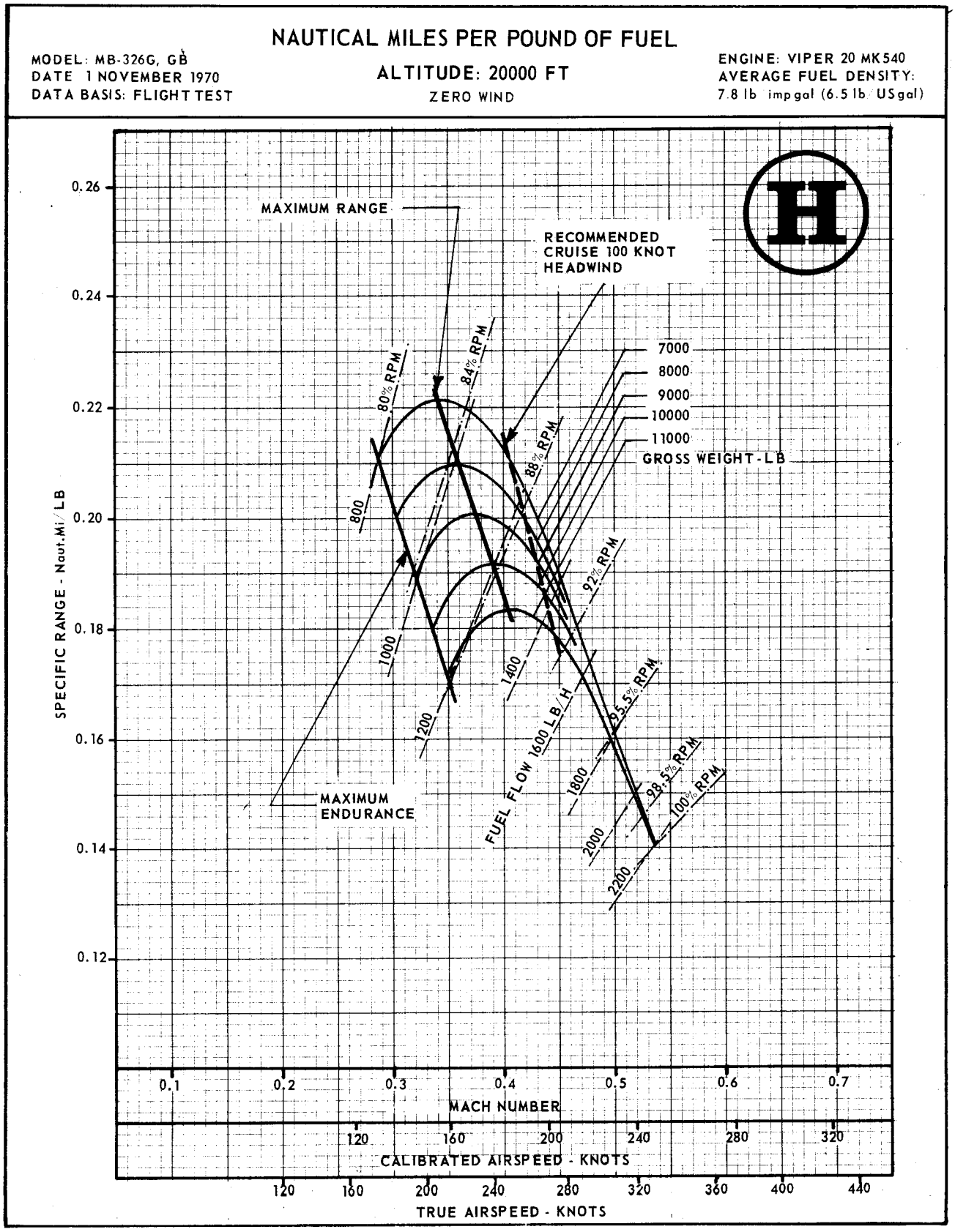


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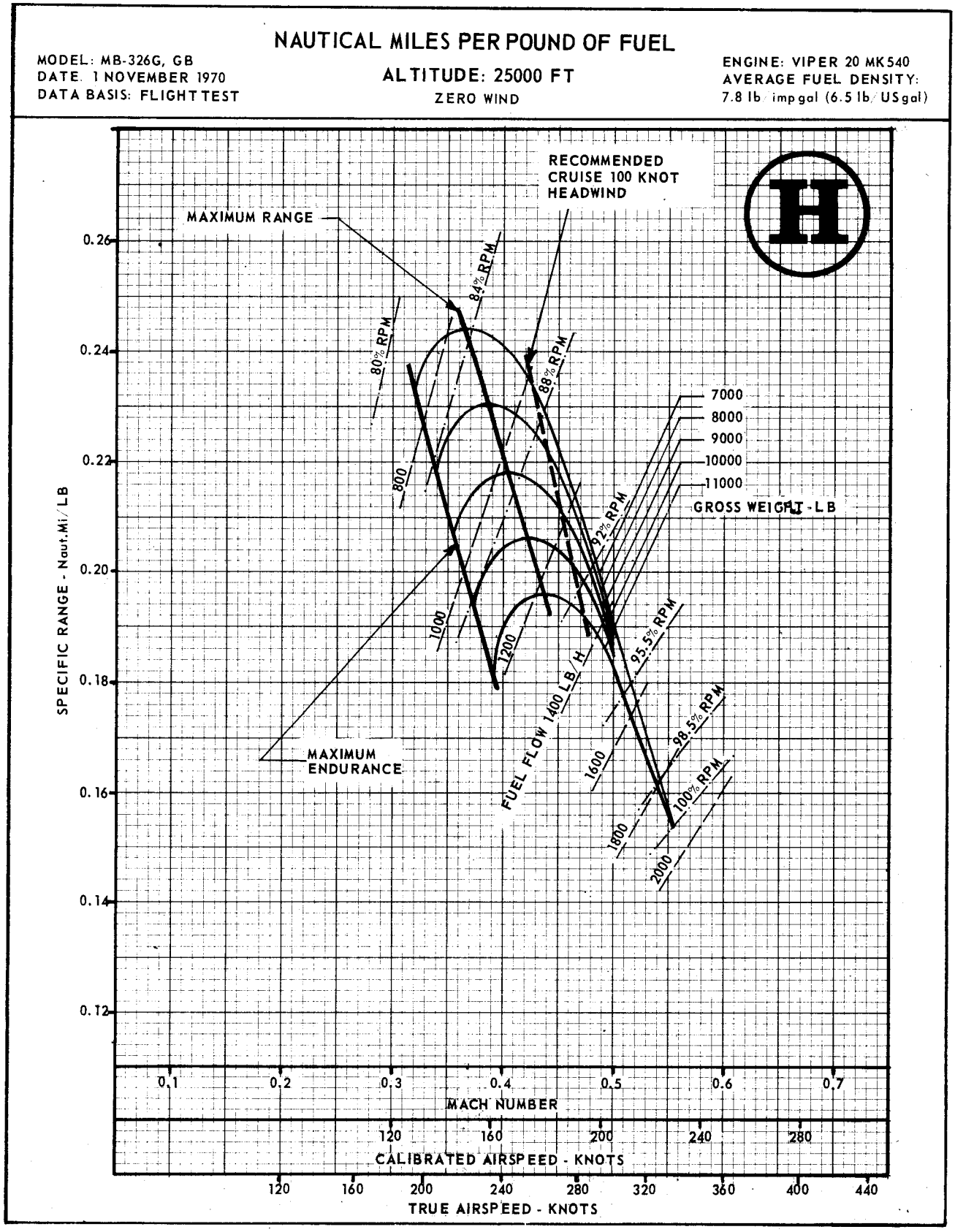


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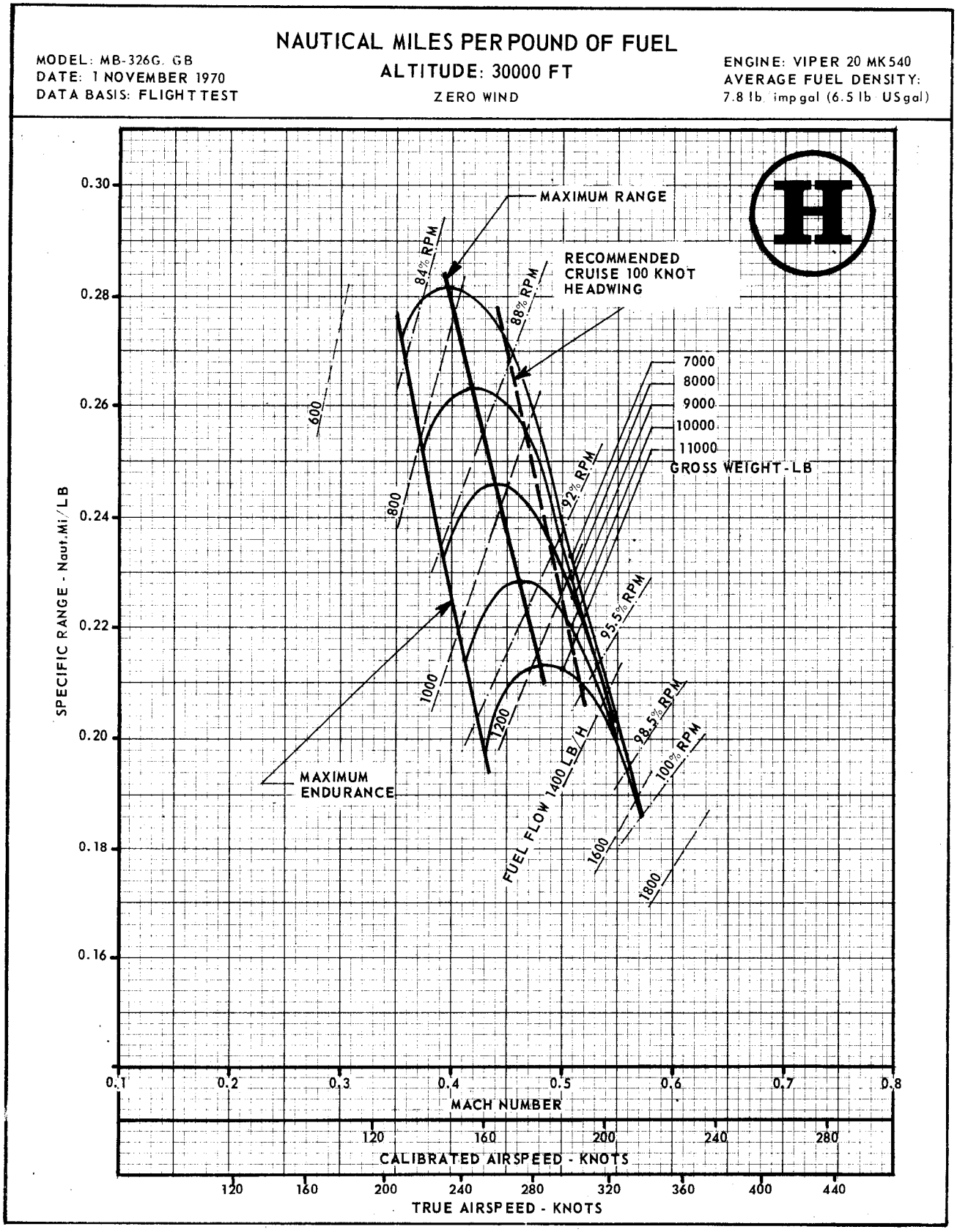


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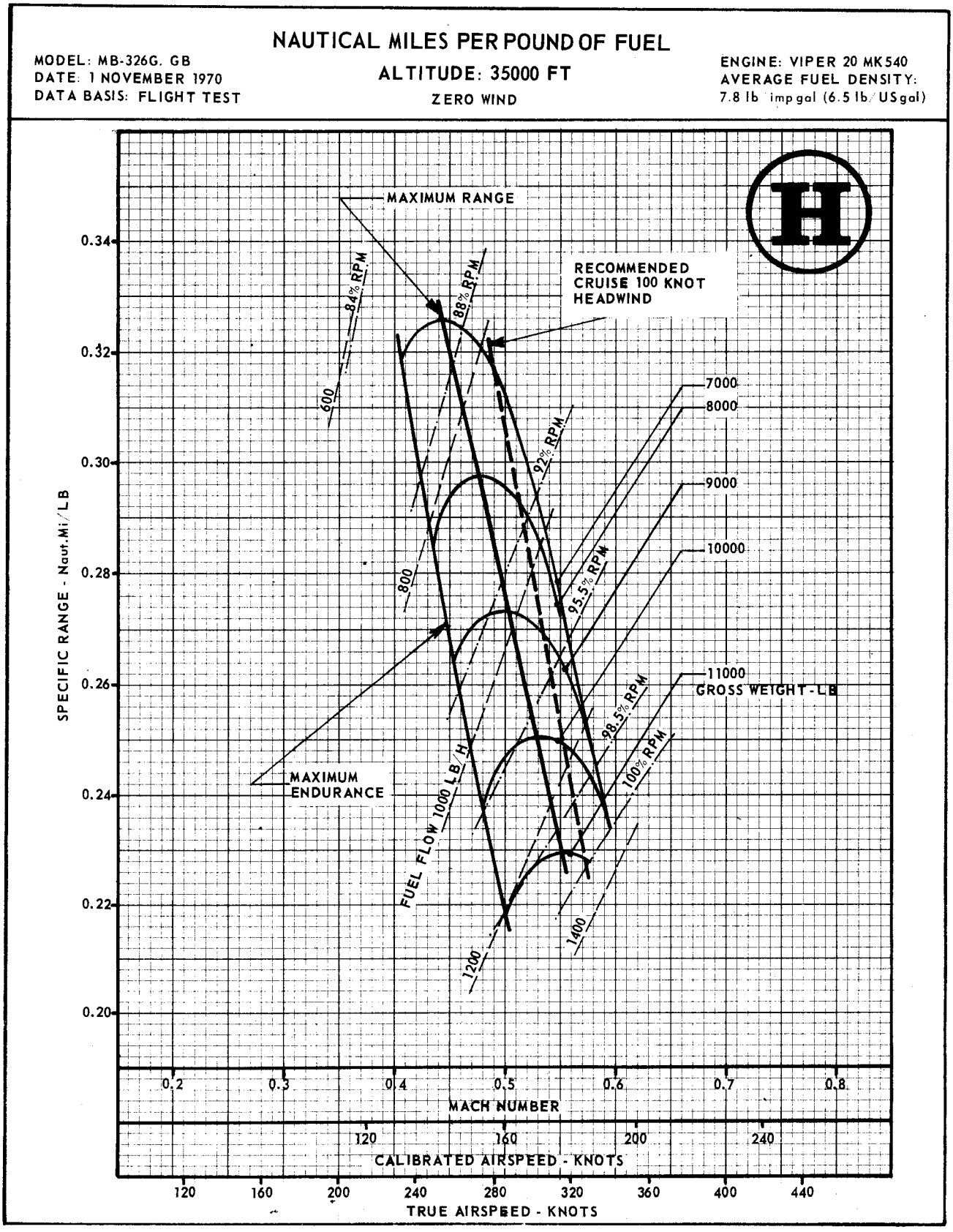


Figure A4-8 (Sheet 8 of 8)

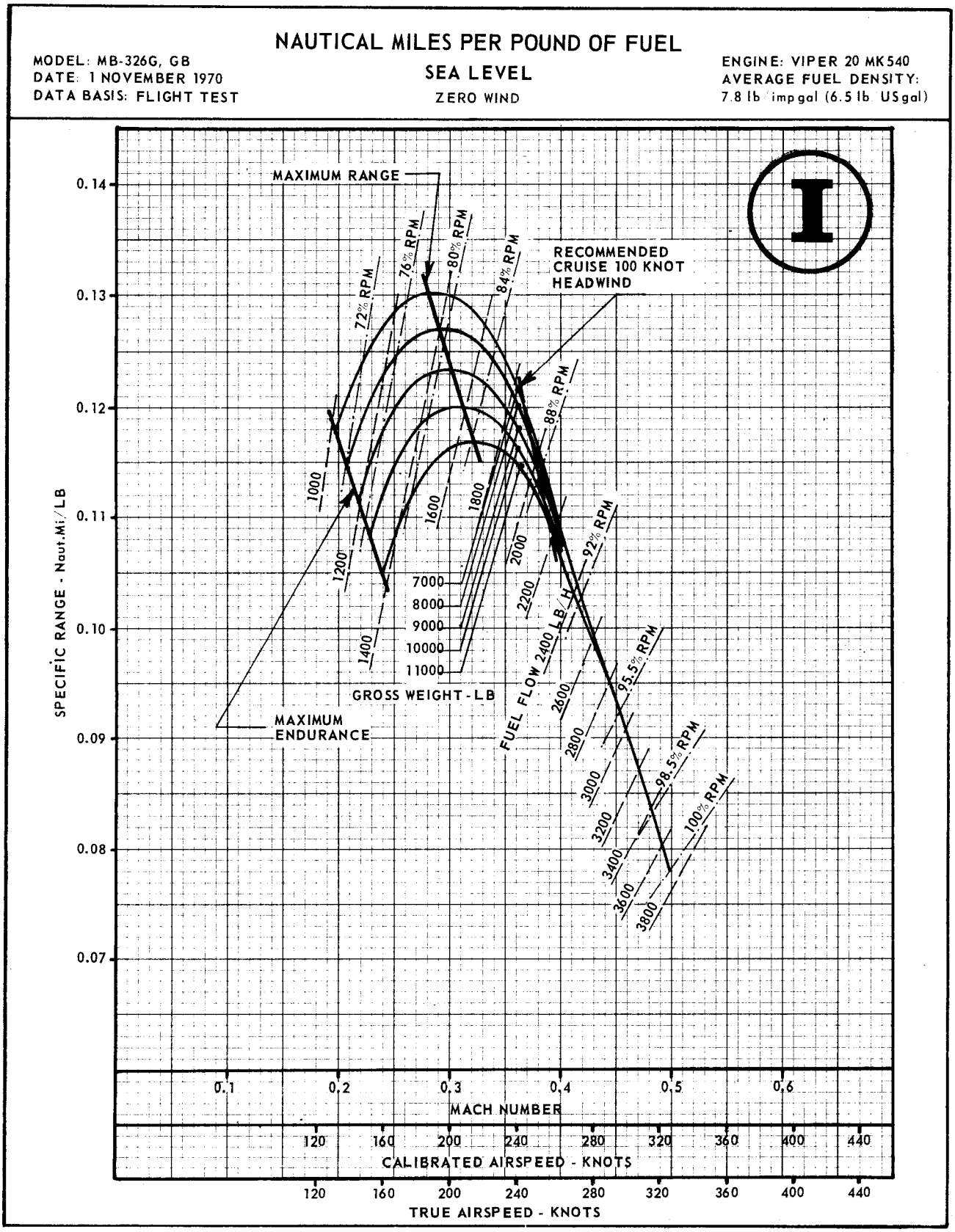


Figure A4-9 (Sheet 1 of 8)

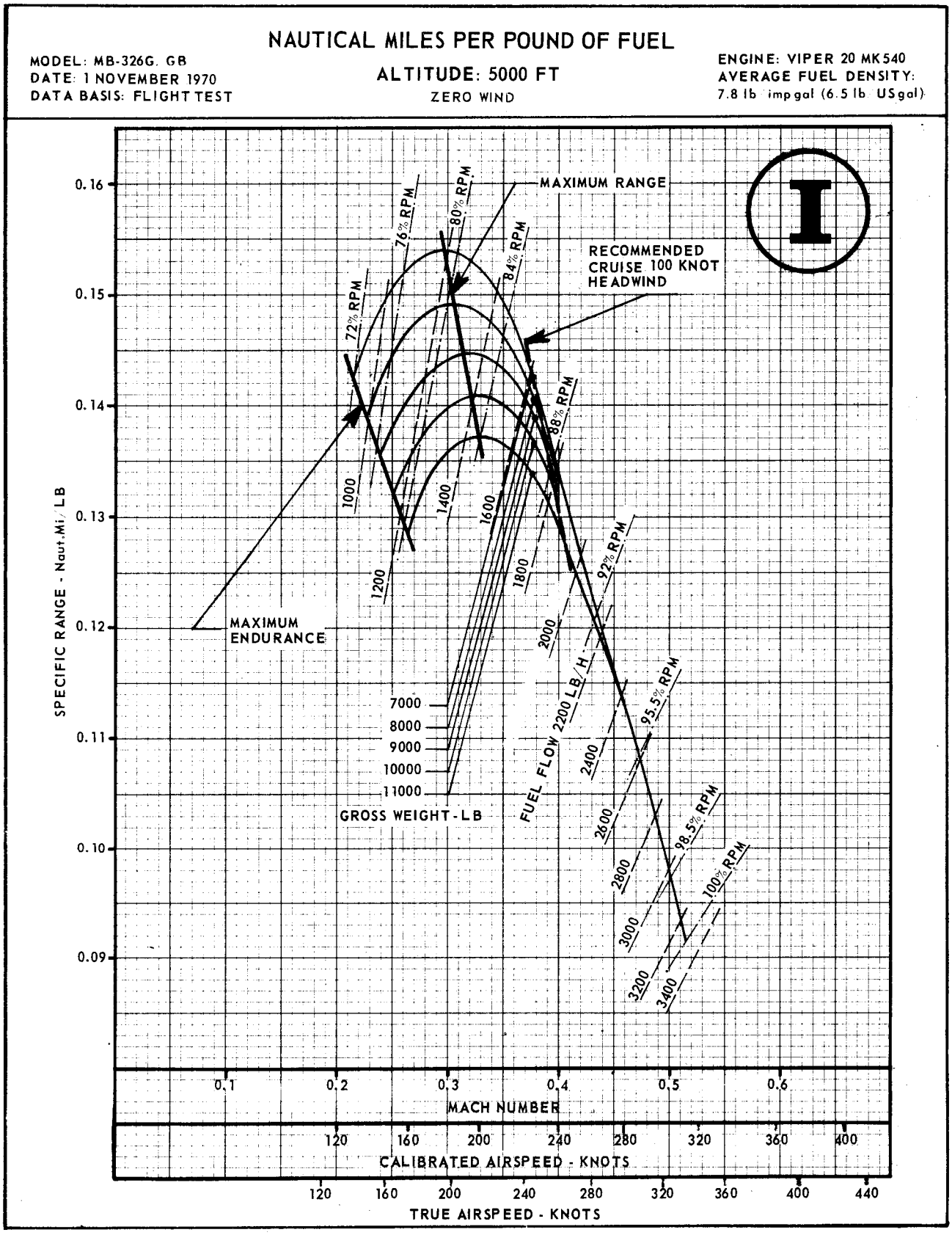


Figure A4-9 (Sheet 2 of 8)

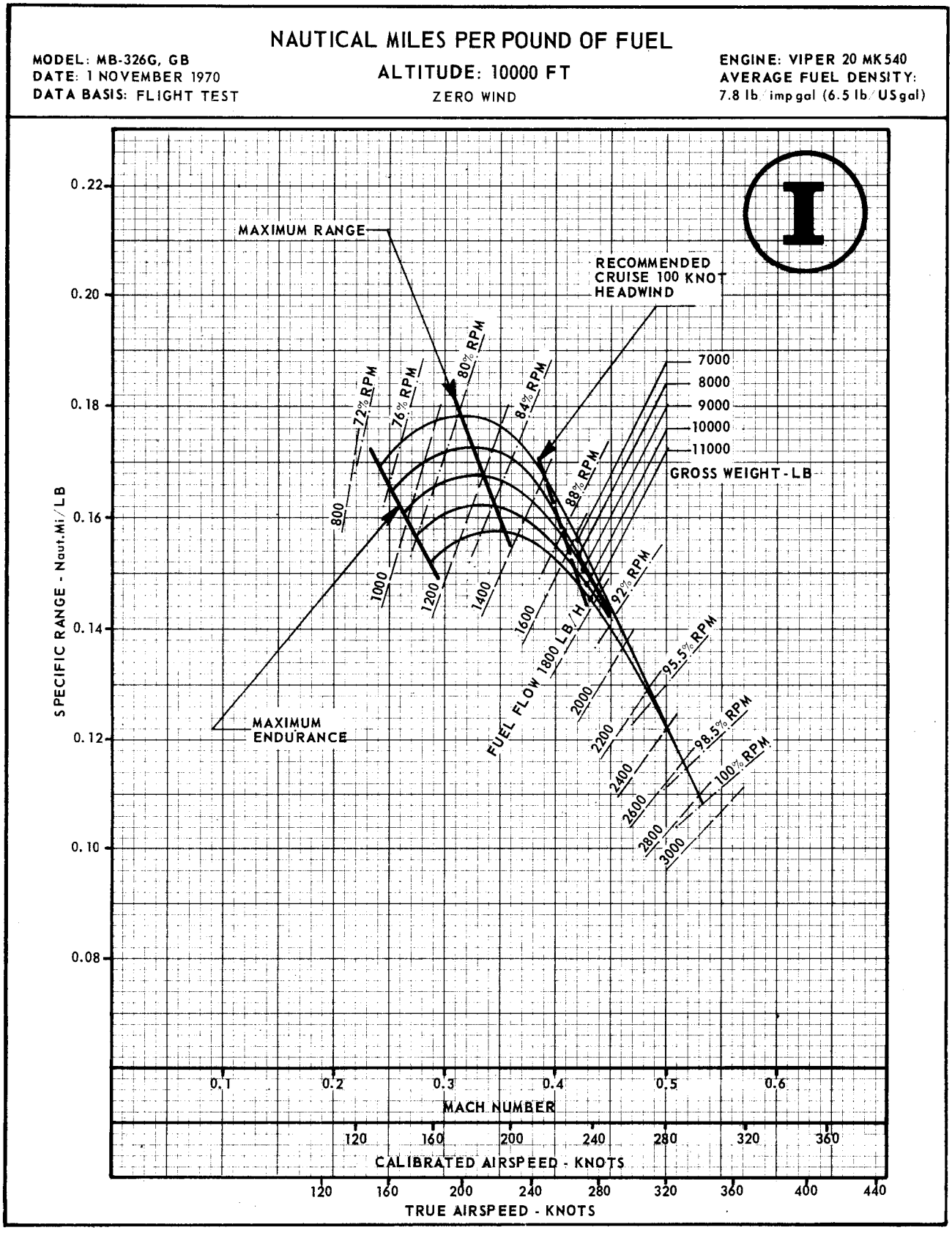


Figure A4-9 (Sheet 3 of 8)

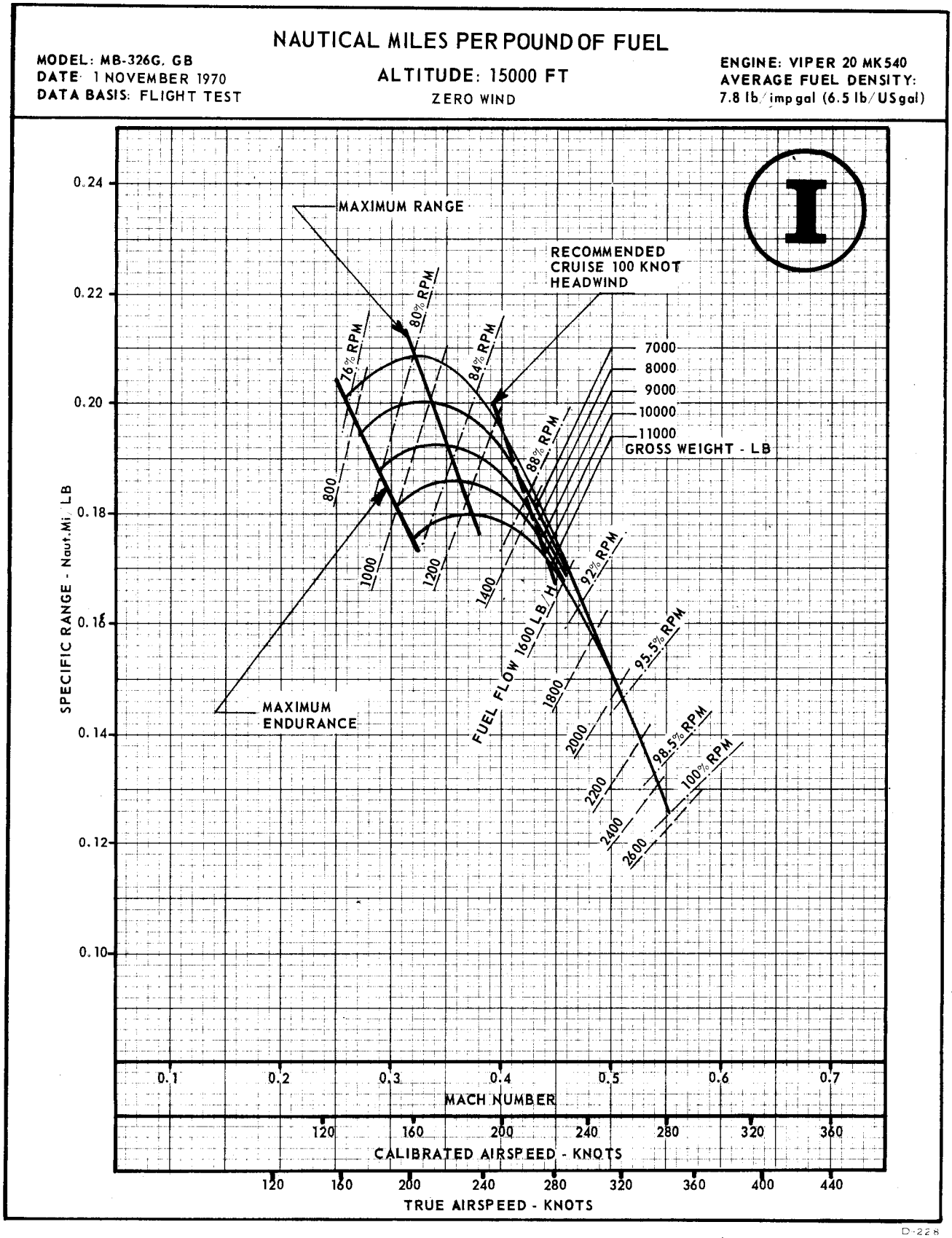


Figure A4-9 (Sheet 4 of 8)

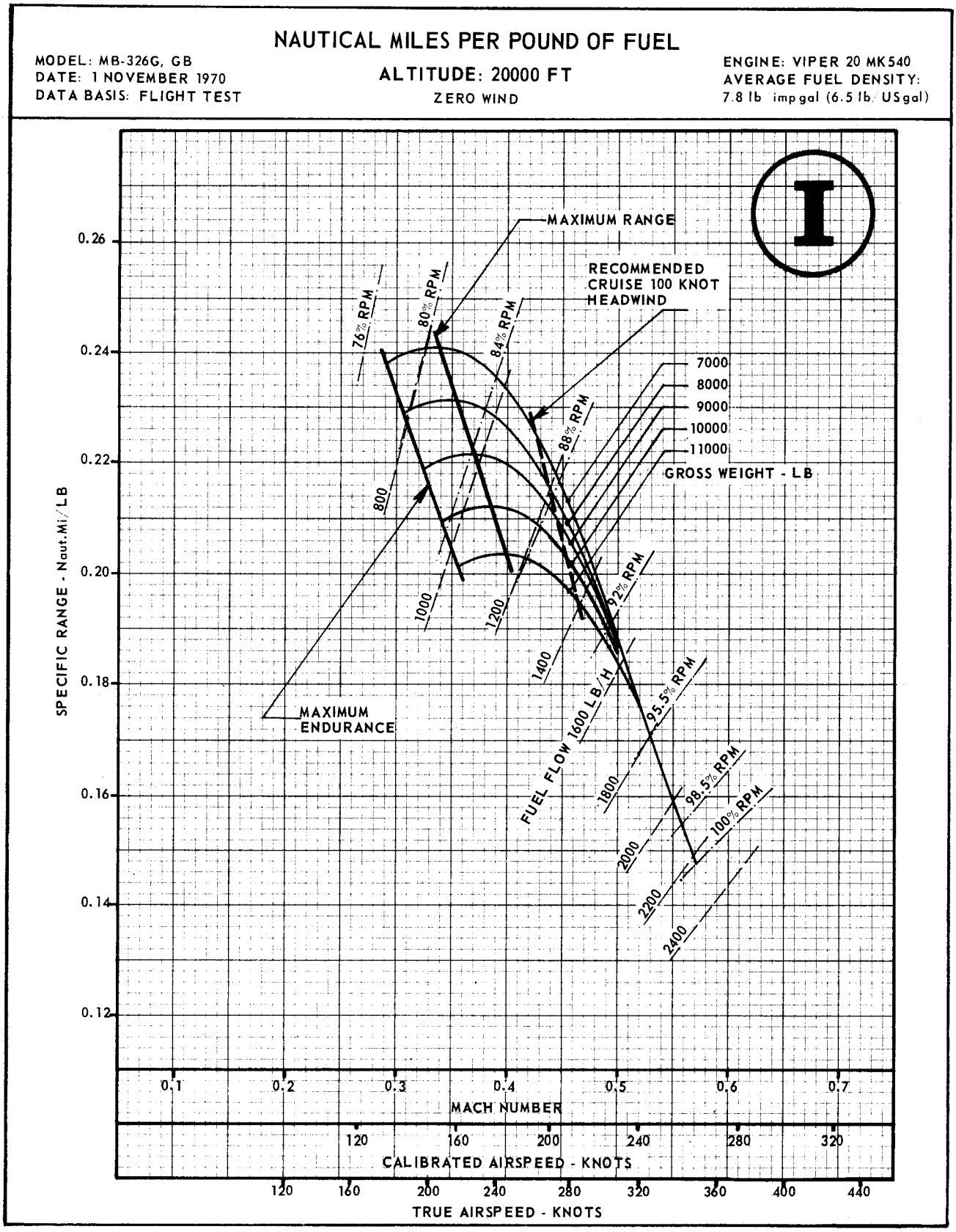


Figure A4-9 (Sheet 5 of 8)

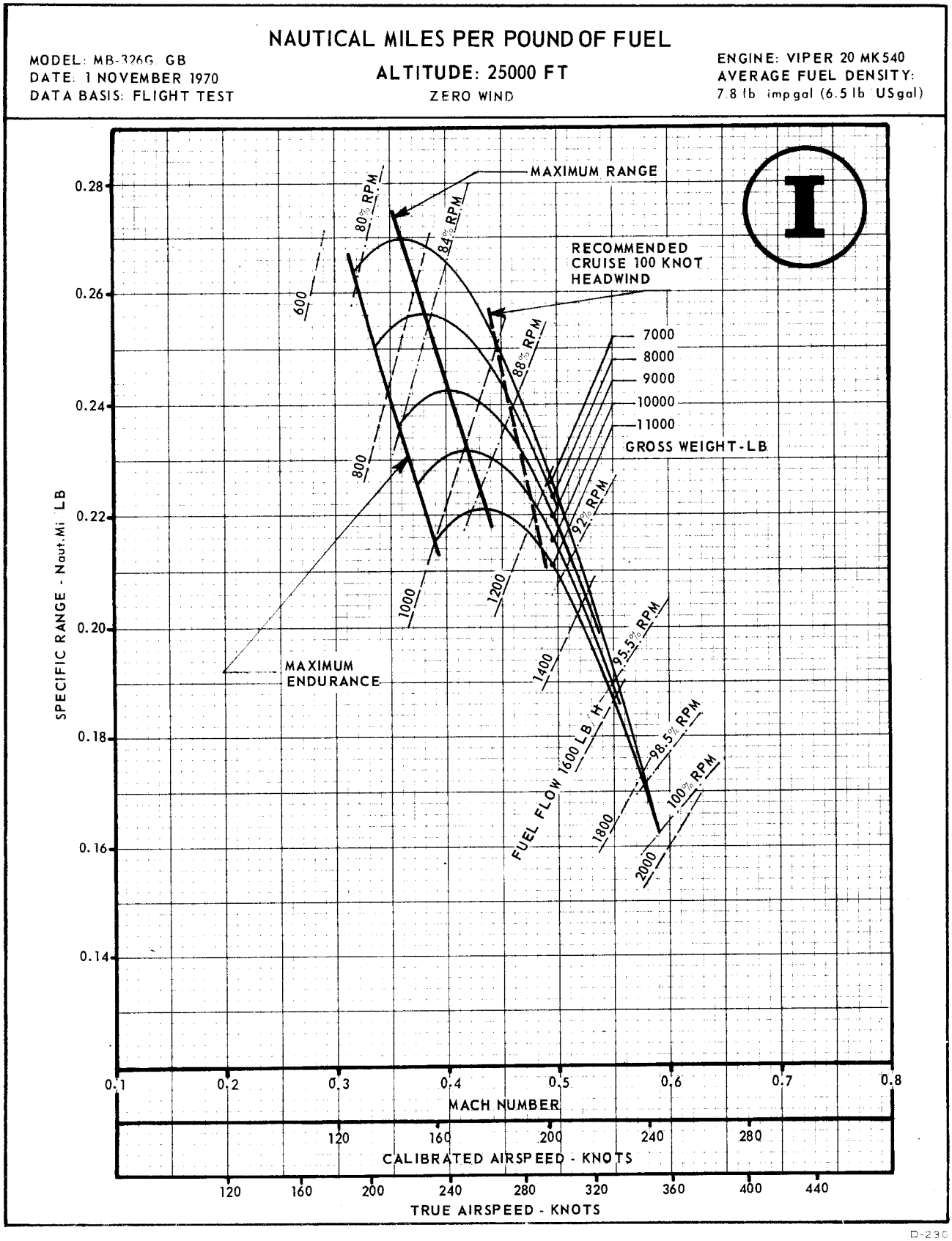


Figure A4-9 (Sheet 6 of 8)

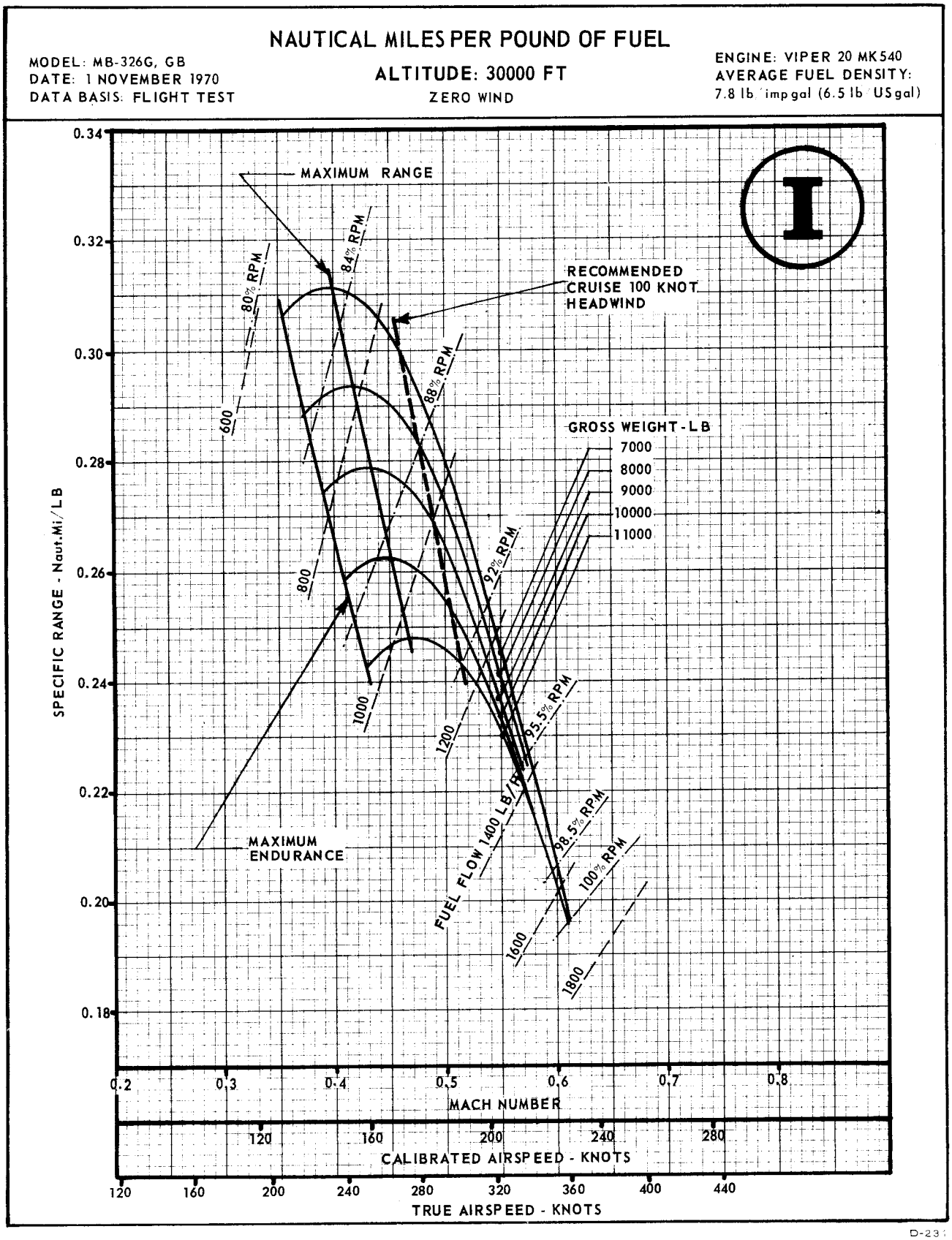


Figure A4-9 (Sheet 7 of 8)

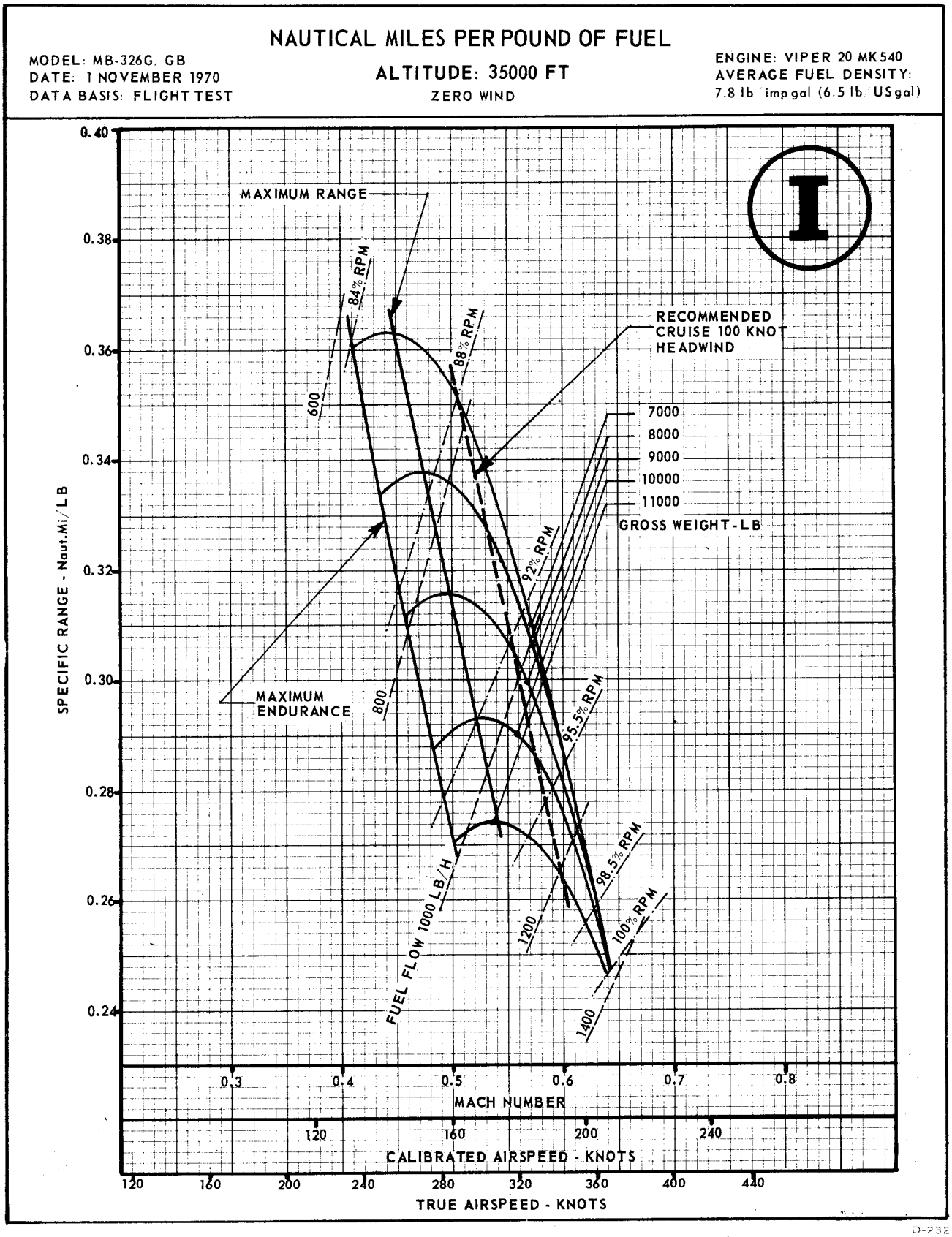


Figure A4-9 (Sheet 8 of 8)

CONSTANT ALTITUDE CRUISE 99% MAXIMUM RANGE

The 99% Maximum Range Charts (figures A4-10 and A4-11) are used to obtain near maximum range for a given quantity of fuel while maintaining speeds higher than those required for peak maximum range. From these charts the pilot can determine:

1. Cruise speed,
2. cruise distance for a given fuel quantity or fuel required to fly a given distance,
3. time elapsed during cruise,
4. wind correction to range.

The calibrated airspeed given must be used to obtain the distance shown. These charts are based on standard temperature at the indicated altitudes. Although fuel flow and true airspeed vary with atmospheric conditions, these variations are proportional to temperature and air miles per pound of fuel remains the same at any given calibrated airspeed, elapsed time given, however, becomes less accurate as temperature deviates from standard.

USE OF CONSTANT ALTITUDE CRUISE CHART

To find cruise distance and time elapsed, the charts are entered with known values of fuel available for cruise, cruise altitude and winds. To find fuel required for a desired distance or time, an estimated quantity of fuel is used to compute tentative distance and time, which are in turn used to compute a fuel quantity. This process is repeated, if necessary, using computed fuel for the next estimate, until the estimated and computed values approximate each other.

CONSTANT ALTITUDE CRUISE 99% MAXIMUM RANGE

EXAMPLE BASED ON FIGURES A4-10 AND A4-11

DATA:

Initial Gross Weight: 10000 lb
Cruise Altitude: 30000 ft
Cruise Fuel: 1500 lb
Wind: Average 20 knot headwind
Aircraft configuration: F

FIND:

Cruise speed, Ground Distance, Time Elapsed.

PROCEDURE:

1. Determine Average Gross Weight:
   Initial Gross Weight: 10000 lb
   Cruise Fuel: 1500 lb
   Final Gross Weight: 10000-1500 = 8500 lb
   Average Gross Weight: $\frac{10000 + 8500}{2}$ = 9250 lb
2. Enter figure A4-10 at Average Gross Weight = 9250 lb (A)
   a. Move horizontally to Altitude = 30000 ft (B)
   b. Drop vertically to Fuel Used = 1500 lb (C)
   c. Move horizontally to Family of Configuration Line = F (D), then drop to Distance scale and read Distance = 415 Naut.Mi (E)
3. Enter figure A4-11 at Average Gross Weight = 9250 lb (F)
   a. Move horizontally to Altitude = 30000 ft (G)
   b. Drop vertically to Family of Configuration Line = F (H), then move to the left to Mach Number scale and Mach Number = .52 (I) (Read Cruise Speed = 193 knots CAS from figure A1-4)
   c. Move to the right from (H) to distance = 415 Naut.Mi (J) Move up to the time scale and read time = 1.3 hours = 78 min (K)
   d. Continue up to wind velocity = 20 knots (L) Move to the left to Range Increment = 25 Naut.Mi (M).
4. Since the wind is a headwind subtract the Range Increment to the no-wind reading of (E) above: Ground Distance = 415 - 25 = 390 Naut.Mi.

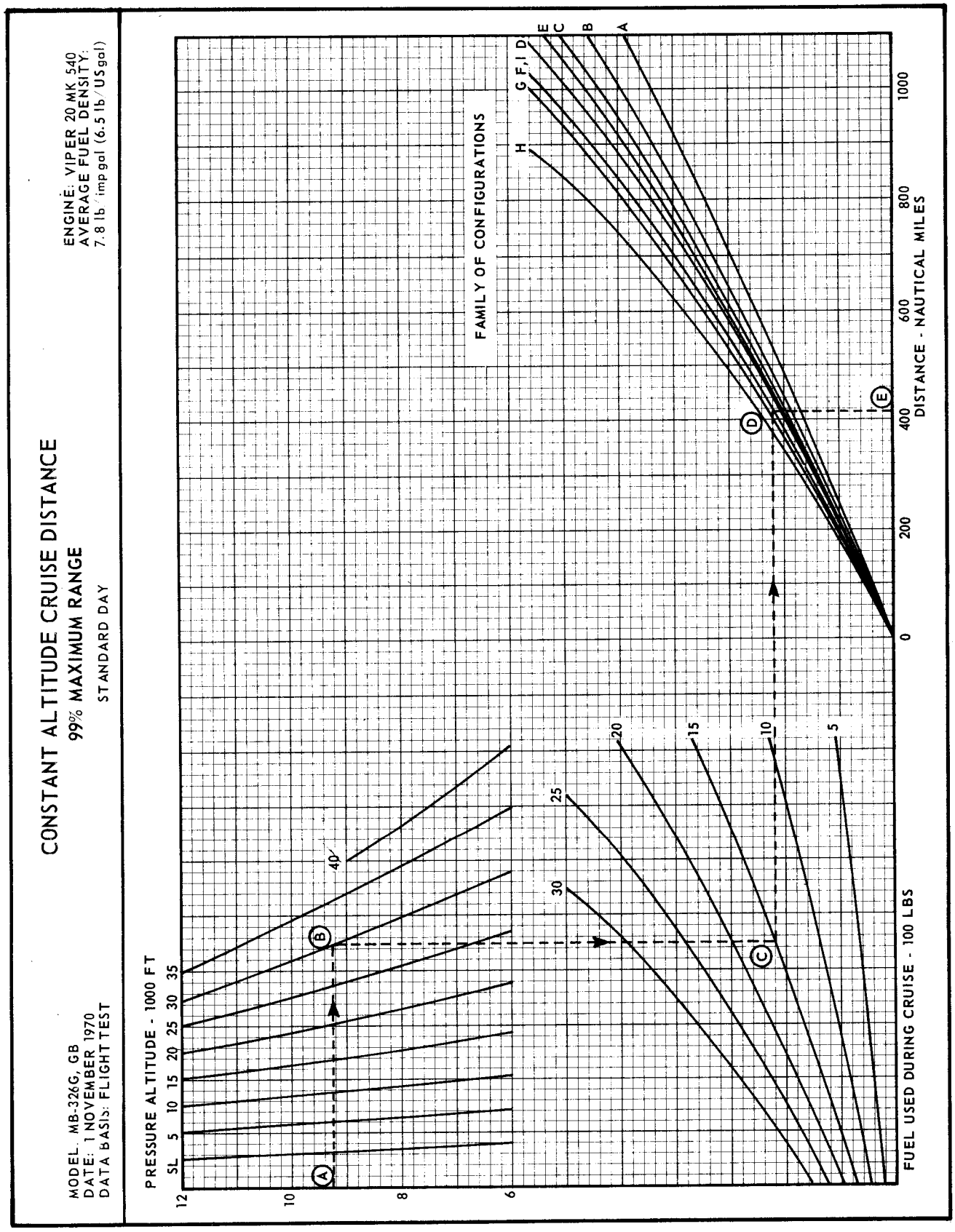

CONSTANT ALTITUDE CRUISE DISTANCE
99% MAXIMUM RANGE
STANDARD DAY
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
ENGINE: VIPER 20 MK 540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)
PRESSURE ALTITUDE - 1000 FT
SL 5 10 15 20 25 30 35
FAMILY OF CONFIGURATIONS
A
B
C
D
E
G F, I
H
DISTANCE - NAUTICAL MILES
0 200 400 600 800 1000
FUEL USED DURING CRUISE - 100 LBS
12 10 8 6
40
30
25
20
15
10
5
A
B
C
D
E

Figure A4-10

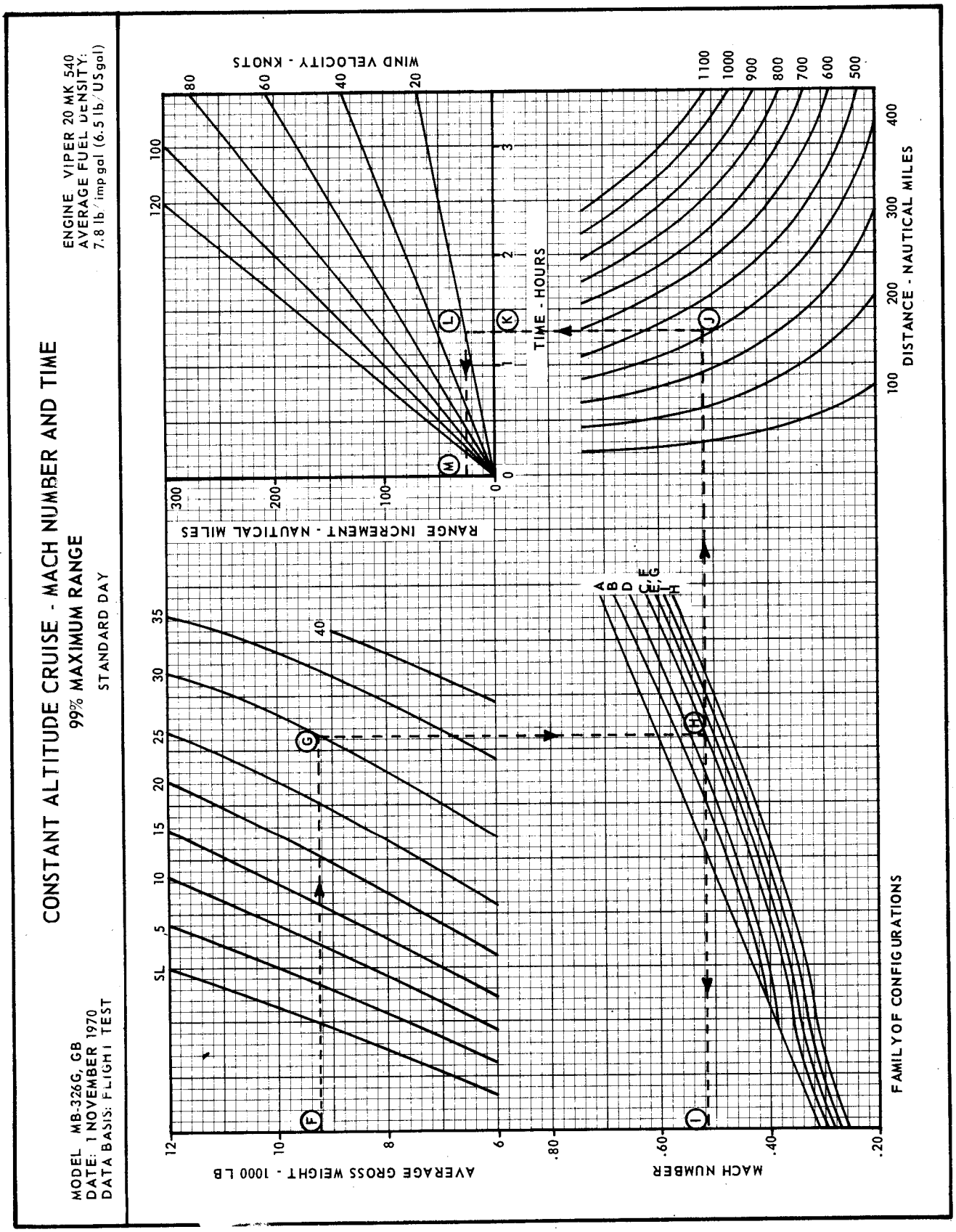


Figure A4-11

Pages A4-93 thru A4-109 deleted

PART V - ENDURANCE

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Title	Page
General Information on Maximum Endurance	A5-1
Maximum Endurance Charts	A5-2

GENERAL INFORMATION ON MAXIMUM ENDURANCE

Endurance is the maximum flying time that may be attained with the available quantity of fuel. Maximum endurance is therefore obtained by flying at the condition that gives the lowest fuel flow.

The fuel flow is given by the product of specific fuel consumption ($c_t = \frac{lb}{lb.h}$) by the engine net thrust T:

(1) $C_h = c_t \cdot T$

The thrust required for level flight, T, can be expressed in accordance with relationship (3) obtained in page A4-1:

(2) $T = W \cdot \frac{C_D}{C_L}$

W = Aircraft gross weight

C_L = Lift coefficient

C_D = Drag coefficient

The equation for fuel flow can thus be written as:

(3) $C_h = c_t \cdot W \cdot \frac{C_D}{C_L}$ (dimensionally expressed in lb/h)

Specific endurance is dimensionally expressed in flying hours per pound of fuel. It is therefore given by the reciprocal of the fuel flow:

(4) Specific $= \frac{hours}{lb} = \frac{1}{C_h} = \frac{1}{c_t} \cdot \frac{1}{W} \cdot \frac{C_L}{C_D}$

Maximum endurance is therefore obtained at the maximum value of this expression.

For a given gross weight W of the aircraft, if the engine specific fuel consumption c_t remained constant, the maximum endurance would be obtained, for any altitude, exactly at the angle of attack that requires the minimum thrust in level flight.

The angle of attack for minimum thrust actually corresponds, for equation (2), to the point of the aerodynamic polar where efficiency ($E = \frac{C_L}{C_D}$) is maximum.

The calibrated airspeed for flying at the angle of attack for minimum thrust obviously depends upon the aircraft gross weight: more precisely it should increase with the gross weight square root.

In practice the following conditions are encountered:

a. The specific fuel consumption c_t = lb/h, as pointed out in Part IV of this Appendix is not constant with varying airspeed, flying altitude and engine setting: particularly, although the altitude parameter does not appear in equation (4), the reduction of c_t following the increase of altitude is so significant that the maximum endurance generally occurs around 35,000 ft.

b. The Mach Number to which there corresponds the minimum thrust required for level flight, is a point identified on the fundamental thrust-airspeed plots. This point is characterized by a propulsive indifference which involves, at the least perturbation of flight path (like gusts), a continuous action from the pilot to adjust engine setting.

This action renders piloting uncomfortable and especially results in a considerable increase in the actual fuel consumption value.

The missions where maximum endurance flight is required are therefore normally accomplished at a slightly higher speed (10% max.) than the optimum theoretical value.

c. The practical value recommended in this manual is a mean value that may be used with no appreciable penalty for any weight of the aircraft.

MAXIMUM ENDURANCE CHARTS

Refer to figures A5-1 and A5-2.

USE OF MAXIMUM ENDURANCE CHARTS

Loiter time available for a given quantity of fuel is read from the chart at the intersection of a line representing average gross weight and loiter altitude, and a line representing loiter fuel. To find fuel used during a specified loiter time, the chart is entered with an estimated average gross weight, required altitude and time. If the required fuel indicated results in an average gross weight which is appreciably different from the estimated weight, the computation is then reworked using the new gross weight.

MAXIMUM ENDURANCE

EXAMPLE BASED ON FIGURES A5-1 AND A5-2

DATA:

Initial Gross Weight: 10600 lb
Loiter Altitude: 25000 ft
Loiter Fuel: 1800 lb
Aircraft configuration: Armed H

FIND:

Loiter time

PROCEDURE:

1. Determine Average Gross Weight:
   Initial Gross Weight: 10600 lb
   Loiter Fuel: 1800 lb
   Final Gross Weight: 10600 – 1800 = 8800 lb
   Average Gross Weight: $\frac{10600 + 8800}{2} = 9700$ lb
2. Enter figure A5-1 at average Gross Weight = 9700 lb (A)
   a. Move vertically to Altitude = 25000 ft (B)
   b. Move horizontally to Family of Configuration Line = Armed H (C)
   c. Drop vertically to Mach Number = .37 (D) C.A.S. = 150 kts (from figure A1-4)
3. Enter figure A5-2 at average Gross Weight = 9700 lb (E)
   a. Move horizontally to Altitude = 25000 ft (F)
   b. Construct vertical line (FG)
4. Re-enter Chart at fuel Used = 1800 lb (H)
   a. Move up to Family of Configuration = 1800 lb
   b. Construct horizontal line (I J)
5. At the intersection of constructed lines (FG) and (IJ) read
   Time = 1 hour 44 minutes (K)

MAXIMUM ENDURANCE - MACH NUMBER

MODEL: MB-326G, GB
DATE 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST

STANDARD DAY

ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb. imp gal (6.5 lb US gal)

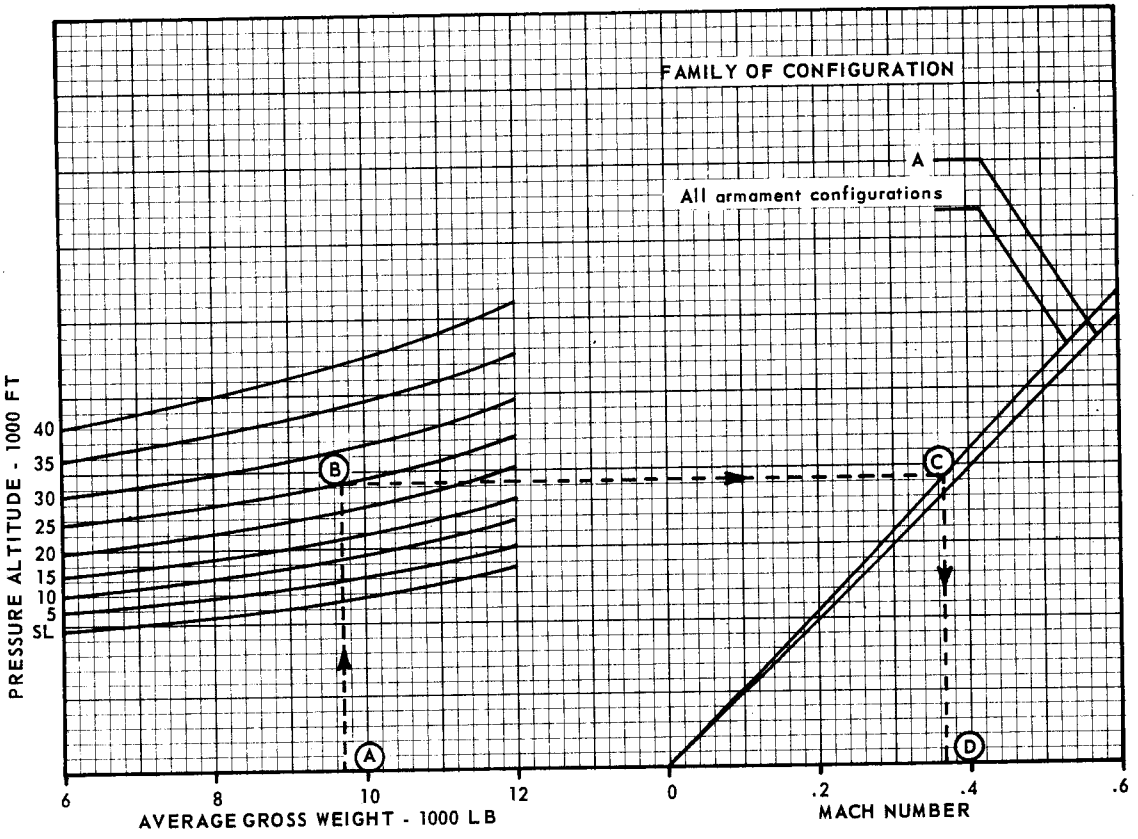


Figure A5-1

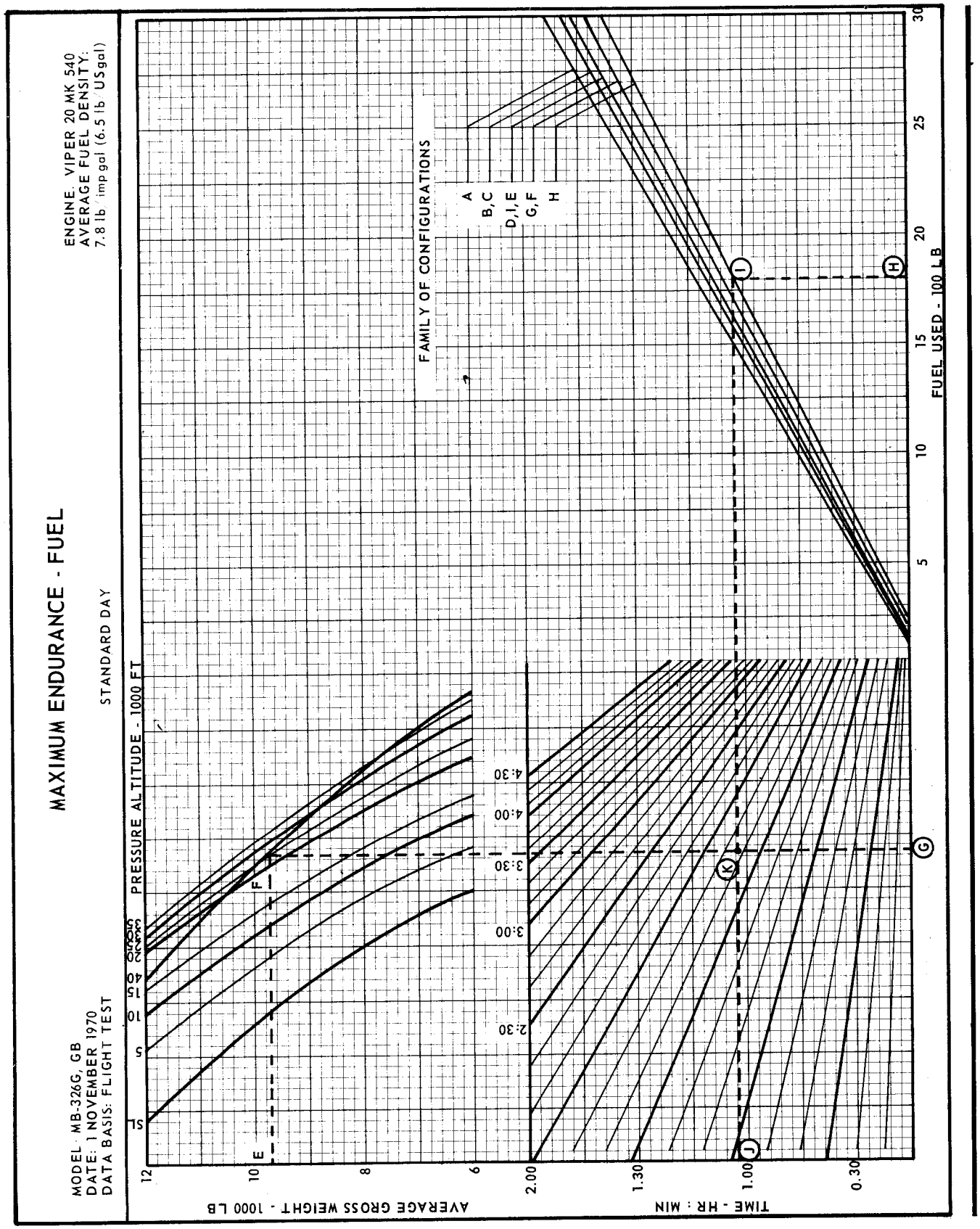


Figure A5-2

Pages A5-6 thru A5-21 deleted

PART VI - DESCENT

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Title	Page
General	A6-1
Descent with Speed Brake Extended or Retracted	A6-1

GENERAL

a) Descent profiles presented:

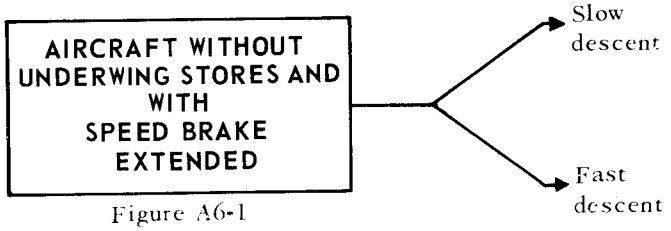


Figure A6-1

M = 0.5 from 40000 ft to 26230 ft
CAS = 200 kts from 26230 ft to sea level

M = 0.55 from 40000 ft to 20000 ft
CAS = 250 kts from 20000 ft to sea level

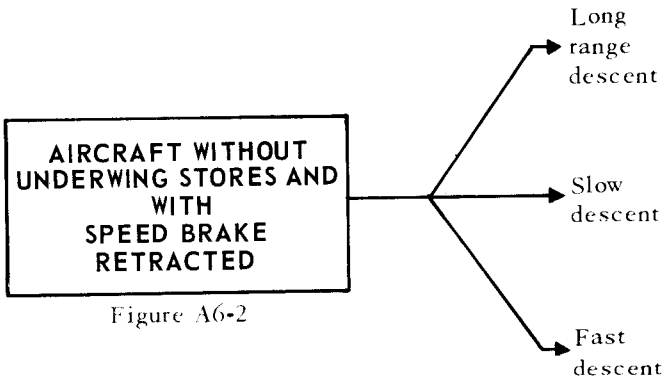


Figure A6-2

CAS = 135 kts = constant

M = 0.5 from 40000 ft to 26230 ft
CAS = 200 kts from 26230 ft to sea level

M = 0.6 from 40000 ft to 20000 ft
CAS = 275 kts from 20000 ft to sea level

Engine R.P.M. minimum required for allowing JPT to be maintained above 200°C.

b) Data presented in the charts:

- Distance travelled in descent
- Time to descend
- Fuel used in descent
- Rate of descent

The present descent profiles are based on the clean configuration of the aircraft with the engine idling. Each profile defines a descent schedule varying with the altitude of the distance travelled, the fuel used in descent, the time to descend and the rate of descent.

In the case of an aircraft with underwing stores, the proposed descent schedules are the same as for the clean aircraft. Descent will however be carried out with an adequate engine setting, slightly above idle, and this will obviously result in higher values of fuel used in descent.

DESCENT WITH SPEED BRAKE EXTENDED OR RETRACTED

Refer to figures A6-1 and A6-2.

DESCENT PERFORMANCE

EXAMPLE BASED ON FIGURE A6-1

DATA:

- Without underwing stores
- Gross Weight: 6000 ÷ 7000 lb
- Fast descent

FIND:

Distance travelled, Fuel used, Time and Rate of Descent from 25,000 ft to sea level.

PROCEDURE:

1. Enter the chart at the pressure altitude = 25,000 ft (A)
2. Proceed horizontally to "Fast descent" lines (B), (D) and (H)
3. Drop vertically to Distance travelled in descent = 21.6 N.Mi (C)
4. Drop vertically to fuel used in descent = 30 lb (E)
5. Drop vertically to time to descent = 4.2 minutes (G)
6. Drop vertically to Rate of descent = minus 4800 ft/min (I) initial rate.
7. The speed is M = 0.55 from 25,000 ft to 20,000 ft, and CAS = 250 knots, from 20,000 ft to sea level.

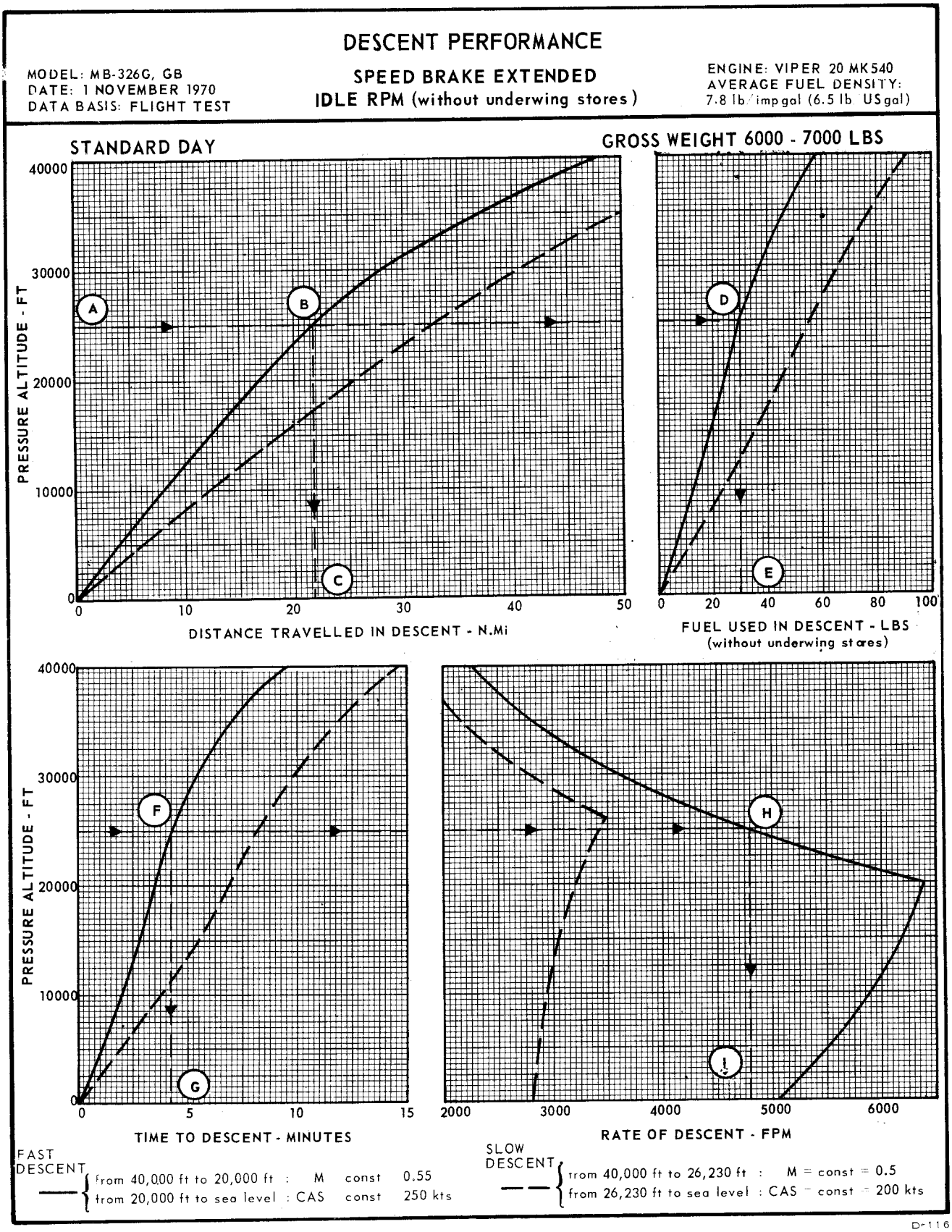

DESCENT PERFORMANCE
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
SPEED BRAKE EXTENDED
IDLE RPM (without underwing stores)
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb US gal)
STANDARD DAY
GROSS WEIGHT 6000 - 7000 LBS
PRESSURE ALTITUDE - FT
40000
30000
20000
10000
0
A
B
C
D
E
F
G
H
I
0
10
20
30
40
50
DISTANCE TRAVELLED IN DESCENT - N.Mi
0
20
40
60
80
100
FUEL USED IN DESCENT - LBS
(without underwing stores)
0
5
10
15
TIME TO DESCENT - MINUTES
2000
3000
4000
5000
6000
RATE OF DESCENT - FPM
FAST DESCENT
from 40,000 ft to 20,000 ft : M const 0.55
from 20,000 ft to sea level : CAS const 250 kts
SLOW DESCENT
from 40,000 ft to 26,230 ft : M = const = 0.5
from 26,230 ft to sea level : CAS = const = 200 kts
D-116

Figure A6-1

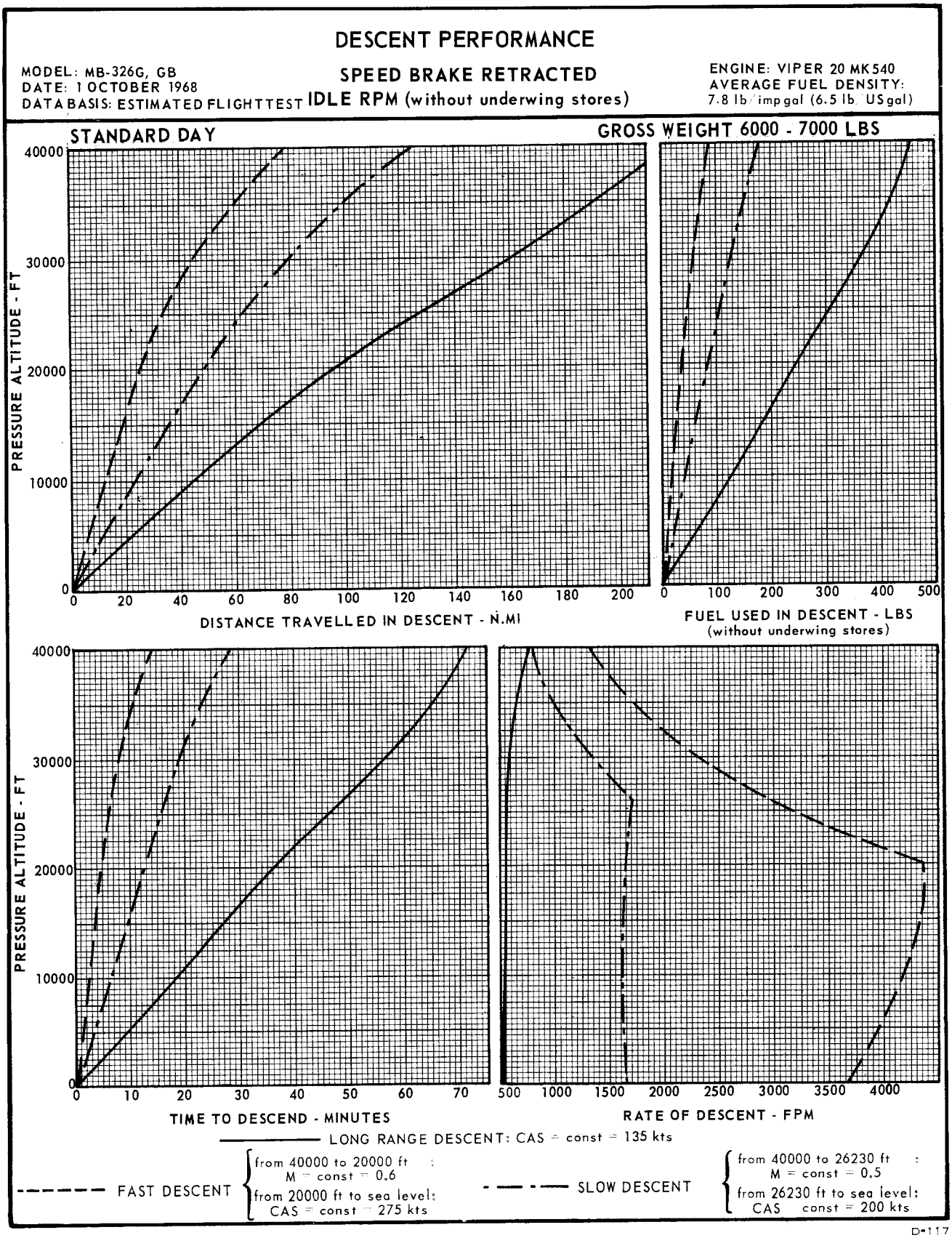

DESCENT PERFORMANCE
MODEL: MB-326G, GB
DATE: 1 OCTOBER 1968
DATA BASIS: ESTIMATED FLIGHT TEST
SPEED BRAKE RETRACTED
IDLE RPM (without underwing stores)
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/imp gal (6.5 lb/US gal)
STANDARD DAY
GROSS WEIGHT 6000 - 7000 LBS
PRESSURE ALTITUDE - FT
40000
30000
20000
10000
0
0 20 40 60 80 100 120 140 160 180 200
DISTANCE TRAVELLED IN DESCENT - N.MI
0 100 200 300 400 500
FUEL USED IN DESCENT - LBS
(without underwing stores)
PRESSURE ALTITUDE - FT
40000
30000
20000
10000
0
0 10 20 30 40 50 60 70
TIME TO DESCEND - MINUTES
500 1000 1500 2000 2500 3000 3500 4000
RATE OF DESCENT - FPM
LONG RANGE DESCENT: CAS = const = 135 kts
FAST DESCENT
from 40000 to 20000 ft : M = const = 0.6
from 20000 ft to sea level: CAS = const = 275 kts
SLOW DESCENT
from 40000 to 26230 ft : M = const = 0.5
from 26230 ft to sea level: CAS = const = 200 kts
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Figure A6-2

PART VII - LANDING

TABLE OF CONTENTS

Title	Page
General.	A7-1
Distance to Clear a 50 ft Obstacle and Stop	A7-1

GENERAL

The following information:

Total distance to clear a 50 ft obstacle and stop

Ground roll distance from touch-down to stop

is presented in the chart for the following reference conditions:

a) This chart is applicable to clean and armed aircraft in all armament configurations.

b) Pressure altitude.

c) Outside air temperature.

d) Gross weight.

e) Wind component (along the runway)

f) Runway slope.

g) Hard surface, dry runway.

h) Piloting technique: data shown in chart at figure A7-1 are based on the procedure outlined in Section II of this manual, employing the obstacle clearance and touch-down speeds (IAS) indicated in figure A7-1.

DISTANCE TO CLEAR A 50 FT OBSTACLE AND STOP

Refer to figure A7-1.

LANDING DISTANCE FOR OBSTACLE CLEARANCE AND STOP

EXAMPLE BASED ON FIGURE A7-1

DATA:

Gross weight: 6900 lb

Field pressure altitude: 0 ft

Outside air temperature: 43°C

Runway wind component: 16 knots headwind

Runway slope: +2%

FIND:

- Ground distance from touchdown to stop,
- Touchdown speed,
- Minimum total distance to clear a 50 ft obstacle and stop,
- Speed at the 50 ft obstacle.

PROCEDURE:

1. Enter the chart at 43°C of air temperature
   a. Move vertically to 0 ft pressure altitude line (A)
   b. Move horizontally to 6900 lb gross weight line (B)
   c. Drop vertically to 6900 lb gross weight line (B)
   d. Move parallel to "headwind" guide line to 16 kts (C)
   e. Drop vertically to "runway slope" chart
   f. Move parallel to "uphill" guide line to 2%
2. Read the ground distance = 810 ft (D)
3. Read the minimum total distance to clear a 50 ft obstacle and stop = 1520 ft (E)
4. Enter the chart of landing speed schedule at 6900 lb of gross weight
   a. Move vertically to "Touchdown" line (F)
   b. Move horizontally to read touchdown speed = 85 kts (IAS)
   c. Move vertically to "50 ft obstacle" line (G)
   d. Move horizontally to read speed at the 50 ft obstacle = 93 kts (IAS)

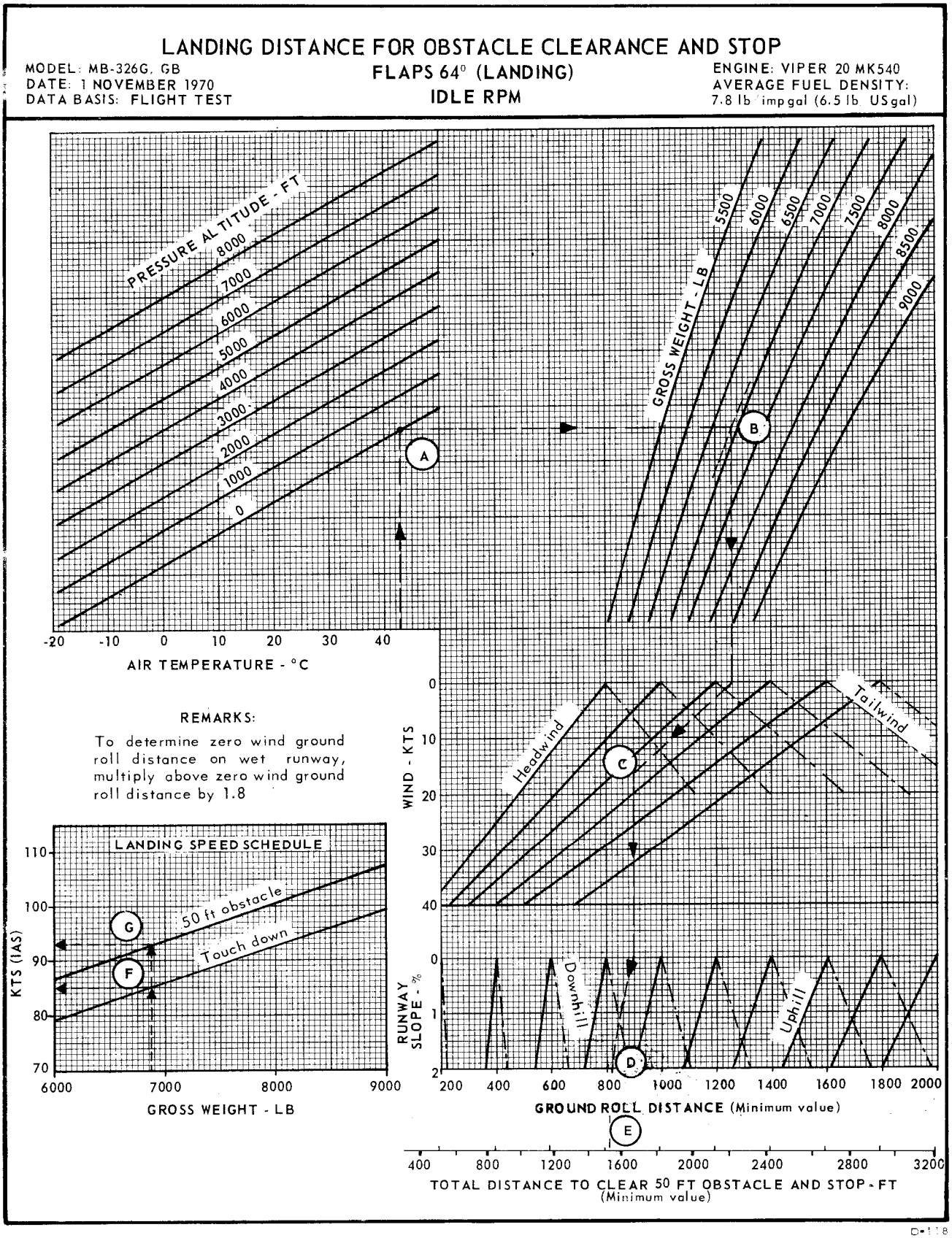

LANDING DISTANCE FOR OBSTACLE CLEARANCE AND STOP
MODEL: MB-326G, GB
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
FLAPS 64° (LANDING)
IDLE RPM
ENGINE: VIPER 20 MK540
AVERAGE FUEL DENSITY:
7.8 lb/impgal (6.5 lb/USgal)
PRESSURE ALTITUDE - FT
8000
7000
6000
5000
4000
3000
2000
1000
0
-20 -10 0 10 20 30 40
AIR TEMPERATURE - °C
A
GROSS WEIGHT - LB
5500
6000
6500
7000
7500
8000
8500
9000
B
REMARKS:
To determine zero wind ground roll distance on wet runway, multiply above zero wind ground roll distance by 1.8
LANDING SPEED SCHEDULE
KTS (IAS)
110
100
90
80
70
50 ft obstacle
Touch down
G
F
6000 7000 8000 9000
GROSS WEIGHT - LB
WIND - KTS
0
10
20
30
40
Headwind
Tailwind
C
RUNWAY SLOPE - %
2
1
0
Downhill
Uphill
D
200 400 600 800 1000 1200 1400 1600 1800 2000
GROUND ROLL DISTANCE (Minimum value)
E
400 800 1200 1600 2000 2400 2800 3200
TOTAL DISTANCE TO CLEAR 50 FT OBSTACLE AND STOP - FT
(Minimum value)

Figure A7-1