SECTION 1
GENERAL

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SECTION 1 GENERAL

1.1 Introduction

This manual is designed as an operating guide for the pilot of the GROB G120A with optional equipment installed IAW Change Note OÄM 1121-075 (Sales Designation G120A-F). It includes the material required to be furnished to the pilot by JAR PART 23. It also contains supplemental data supplied by the airplane manufacturer.

This manual constitutes an EASA approved AFM for EU registered airplanes in accordance with JAR 23.1581.

This manual must be read carefully by the owner and/or the pilot to become acquainted with proper aircraft operation. This manual is not designed as a substitute for adequate and competent flight instruction, knowledge of current airworthiness directives, applicable federal air regulations or advisory circulars. It is not intended to be a guide for basic flight instruction or a training manual and should not be used for operational purposes unless kept in a current status.

Assurance that the airplane is in an airworthy condition is the responsibility of the owner. The pilot in command is responsible for determining that the airplane is safe for flight. The pilot is also responsible for remaining within the operating limitations as outlined by placards, instrument markings, and this manual.

This manual has been divided into 8 numbered sections, each provided with a "fingertip" tab divider for quick reference. The limitations and emergency procedures have been placed ahead of the normal procedures, performance and other sections to provide easy access to information that may be required in flight.

1.2 Warnings, Cautions and Notes

The following definitions apply to warnings, cautions and notes in the flight manual:

WARNING:

means that the non-observation of the corresponding procedure leads to an immediate or important degradation of the flight safety.

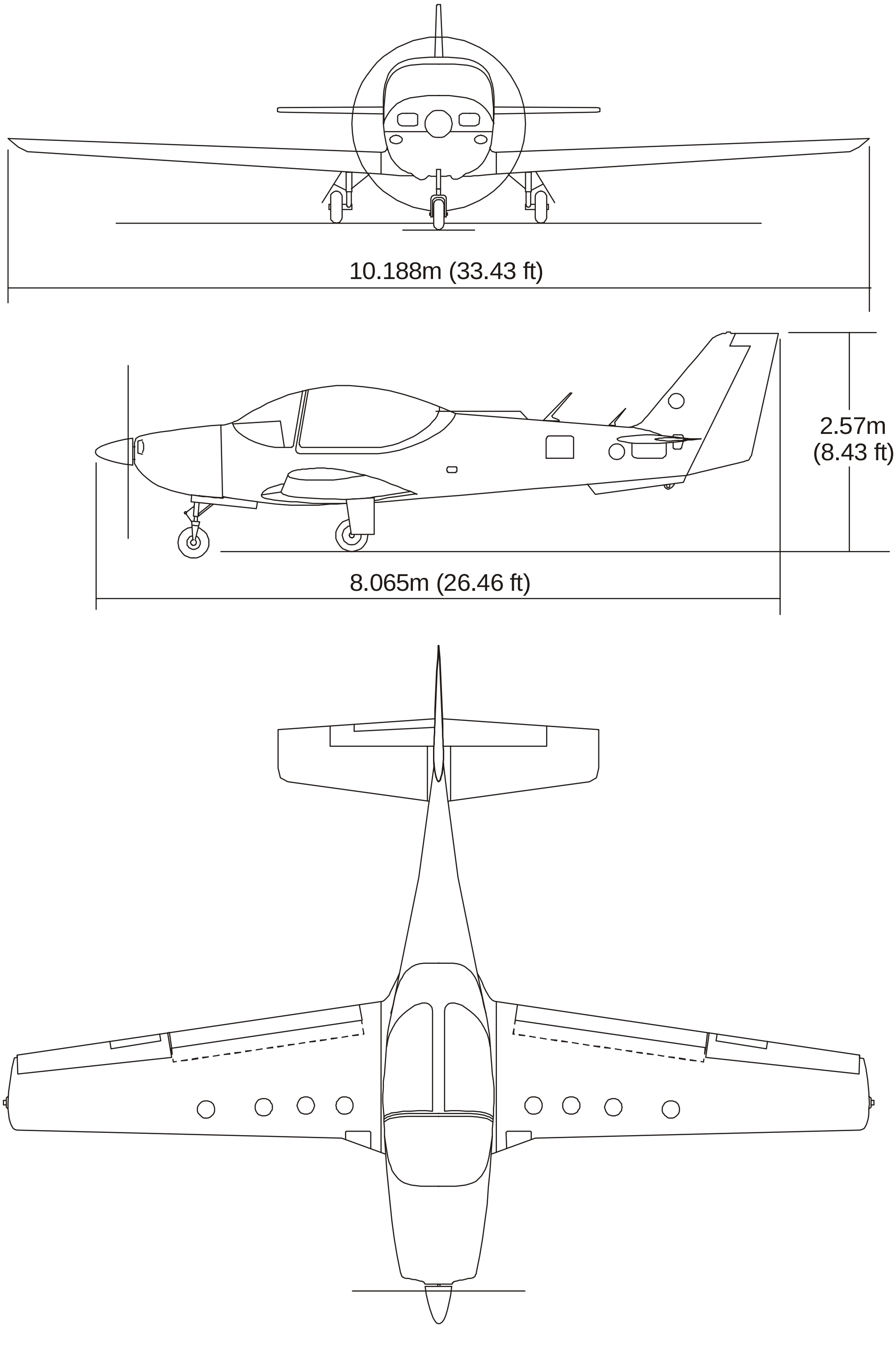
CAUTION:

means that the non-observation of the corresponding procedure leads to a minor or to a more or less long term degradation of the flight safety.

NOTE:

draws the attention to any special item not directly related to safety but which is important or unusual.

Figure 1.1 Three-View



1.3 Dimensions

Overall dimensions

Wing span	10.188 m	(33.43 ft)
Max. length	8.065 m	(26.46 ft)
Max. height	2.57 m	(8.43 ft)

Wing

Airfoil		Eppler E-884
Wing area	13.285 m^2	(142.95 sq.ft)
Dihedral		2°
Angle of incidence		0°

Ailerons

Area (each) behind hinge line	0.4575 m^2	(4.92 sq.ft)

Flaps

Area (each)	0.805 m^2	(8.665 sq.ft)

Horizontal tail

Airfoil		NACA 64-010
Overall span	3.80 m	(12.47 ft)
Area	3.04 m^2	(32.71 sq.ft)
Elevator surface	0.703 m^2	(7.56 sq.ft)

Vertical tail

Airfoil		64009
Area	1.632 m^2	(17.57 sq.ft)
Rudder area	0.761 m^2	(8.19 sq.ft)

Landing gear

Wheel track	2.42 m	(7.94 ft)
Wheel base	1.869 m	(6.13 ft)
Nose wheel		5.00 x 5
Main wheel		40/84 6.00-6

For control surface deflections, see the maintenance manual.

1.4 Engine

AVCO LYCOMING, Model AEIO-540-D4D5

6-Cylinder, direct drive, injected, horizontally opposed, air-cooled, aerobatic.

Displacement	8865 cm^3	541,5 in^3
Rated horsepower		260 HP
at rated speed		2700 RPM

1.5 Propeller

Three-blade constant speed propeller		HC-C3YR-1RF/F7663R
Propeller manufacturer		Hartzell
Diameter	1,981 m	(6,5 ft)

1.6 Fuel

Avgas 100LL

Total fuel capacity	262 l [1]) (416 lbs) (69,2 U.S.gal.)
Unusable fuel (each)	5 l (8 lbs) (1,3 U.S.gal.)
Collector tank fuel capacity(each)	8 l (12 lbs) (2,0 U.S.gal.)

1) Nominal value

1.7 Oil

Oil capacity	min	7,5 litres	8 quarts
	recommended	9,5 litres	10 quarts
	max	11,4 litres	12 quarts

The following engine oils may be used:

Average ambient air	**MIL-L-22851 Ashless Dispersant Grades**
All Temperatures	SAE 15 W 50

Also comply with the rules in AVCO LYCOMING specification No. 301 and AVCO LYCOMING Service Instruction No. 1014, latest issue.

The engine must be run for a minimum of 50 hours on aviation oil as per MIL-L-6082. Change the oil after the first 25 operating hours.

NOTE

Until oil consumption has stabilized, cruising performance must not be reduced for continous operation to below 75 % to protect the cylinder liners from damage.

First filling: Aviation Oil as per MIL -L - 6082.

1.8 Maximum Weights

	Utility	**Acrobatic**
max. takeoff weight	1490 kg (3285 lbs)	1440 kg (3175 lbs)
max. landing weight	1440 kg (3175 lbs)	1440 kg (3175 lbs)
max. zero fuel weight	1345 kg (2965 lbs)	1315 kg (2900 lbs)

WARNING

The current information in Section 6 "Weight and balance" is applicable for preflight action.

Wing loading (at max. weight)			
	ACRO	108,4 kg/m^2	(22,2 lbs/sq.ft.)
	UTILITY	112,2 kg/m^2	(23,0 lbs/sq.ft.)
Power loading (at max. weight)			
	ACRO	5,5 kg/HP	(12,2 lbs/HP)
	UTILITY	5,7 kg/HP	(12,6 lbs/HP)

1.9 Symbols, Abbreviations and Terminology

a) General Airspeed Terminology and Symbols

CAS	Calibrated Airspeed means the indicated speed of an aircraft, corrected for position and instrument error. CAS is equal to true airspeed in standard atmosphere at sea level.
KCAS	CAS, expressed in "Knots".
GS	Ground Speed is the speed of an airplane relative to the ground.
IAS	Indicated Airspeed is the speed of an airplane as shown on a pitot static airspeed indicator.
KIAS	Indicated Airspeed expressed in "Knots".
TAS	True Airspeed is the airspeed of an airplane relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.
V_A	Manoeuvre Speed is the speed below which application of full available aerodynamic control is unlikely to overstress the airplane.
V_{FE}	Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{NE}	Never Exceed Speed is the speed limit that may not be exceeded at any time.
V_{NO}	Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air and then only with caution.
V_S	Stalling Speed or the minimum steady flight speed at which the airplane is controllable.
V_{SO}	Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration.
V_X	Best Angle-of-Climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

b) Meteorological Terminology

ISA	International Standard Atmosphere in which: the air is a dry perfect gas the temperature at sea level is 15°C (59°F) the pressure at sea level is 1013.2 hpa (mb) (29.92 inches HG) the temperature gradient from sea level to the altitude at which the temperature is -56.5°C (-69.7°F) is -0.00198°C (-0.003566°F) per foot and zero above that altitude.
OAT	Outside Air Temperature.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric subscale has been set to 1013.2 hpa (mb) (29.92 in. HG).
Pressure Altitude	Altitude measured from standard sea level pressure (29.92 in. HG or 1013.2 hpa (mb)) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this handbook altimeter instrument errors are assumed to be zero.
Station Pressure (QFE)	Actual atmospheric pressure at field elevation.

c) Power Terminology

Maximum Power	Maximum power permissible for takeoff.
Maximum Continuous Power	Maximum power permissible continuously during flight.
Maximum Climb Power	Maximum power permissible during climb.
Maximum Cruise Power	Maximum power permissible during cruise.
Best Power Mixture	Mixture for 83ºC rich side of EGT.
Economy Mixture	Mixture slightly rich of peak EGT for smooth running.
Endurance Mixture	Mixture for peak EGT.
BHP	Brake Horse Power.
CHT	Cylinder Head Temperature.
EGT	Exhaust Gas Temperature.

d) Airplane Performance and Flight Planning Terminology

Climb Gradient	The demonstrated ratio of the change in height during a portion of a climb, to the horizontal distance traversed in the same time interval.
Demonstrated Crosswind Velocity	The demonstrated crosswind velocity is the velocity of the crosswind component for which adequate control of the airplane during take-off and landing was actually demonstrated during certification tests.

e) Weight and Balance Terminology

Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Arm	The horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Moment	The product of the weight of an item multiplied by its arm.
Center of Gravity (C.G.)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
C.G. Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the the total weight.
C.G. Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Unusable Fuel	Fuel remaining after a runout test has been completed in accordance with governmental regulations.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil according to the actual weighing report.
Maximum Takeoff Weight	Maximum weight approved for the start of the takeoff run (according to the operating category of the aircraft).

1.10 Conversion Factors

MULTIPLY	BY	TO OBTAIN
atmospheres [atm]	760	mm Hg
	29.92	in Hg
	1.0133	bar
	1.033	kg/cm^2
	14.70	lb./sq.in.
	2116	lb/sq.ft.
bars [bar]	0.98692	atm
	14.503768	lb./sq.in.
centimeters [cm]	0.3937	in.
	0.032808	ft.
cubic centimeters [cm^3]	0.03381	fl.oz.
	0.06102	cu.in.
	3.531×10^{-5}	cu.ft.
	0.001	l
	2.642×10^{-4}	U.S.gal.
cubic feet [cu.ft.]	28317	cm^3
	0.028317	m^3
	1728	cu.in.
	0.037037	cu.yd.
	7.481	U.S.gal.
	28.32	l
cubic feet per minute [cu.ft./min.]	0.058860	l/sec.
	0.028317	m^3/min.

MULTIPLY	BY	TO OBTAIN
cubic inches [cu.in.]	16.39	cm^3
	1.639×10^{-5}	m^3
	5.787×10^{-4}	cu.ft.
	0.5541	fl.oz.
	0.01639	l
	4.329×10^{-3}	U.S.gal.
	0.01732	U.S.qt.
cubic meters [m^3]	61024	cu.in.
	1.308	cu.yd.
	35.3147	cu.ft.
	264.2	U.S.gal.
feet [ft.]	30.48	cm
	0.3048	m
	12	in.
	0.33333	yd.
	1.894×10^{-4}	st.M.
	0.00508	m/sec.
gallons. Imperial [Imperial gal.]	277.4	cu.in.
	1.201	U.S.gal.
	4.546	l
gallons. U.S. liquid [U.S.gal.]	231	cu.in.
	0.1337	cu.ft.
	4.951×10^{-3}	cu.yd.
	3785.4	cm^3
	3.785×10^{-3}	m^3
	3.785	l
	0.83268	Imperial gal.
	128	fl.oz.

MULTIPLY	BY	TO OBTAIN
grams [g]	0.001	kg
	2.205×10^{-3}	lb.
grams per cubic centimeter [g/cm^3]	1000	kg/m^3
	0.03613	lb./cu.in.
	62.43	lb./cu.ft.
horsepower [hp]	33000	ft.-lb./min.
	550	ft.-lb./sec.
	76.04	m·kg/sec.
	1.014	PS
	0.7458	kW
horsepower. metric	75	m·kg/sec.
	0.9863	hp
	0.7355	kW
inches [in.]	25.40	mm
	2.540	cm
	0.0254	m
	0.08333	ft.
	0.027777	yd.
inches of mercury at 0°C [in.Hg]	0.033421	atm
	0.4912	lb./sq.in.
	70.73	lb./sq.ft.
	345.3	kg/m^2
	2.540	cm Hg
	25.40	mm Hg
kilograms per cubic meter [kg/m^3]	0.06243	lb./cu.ft.
	0.001	g/cm^3

MULTIPLY	BY	TO OBTAIN
kilograms [kg]	2.204622	lb.
	1000	g
kilograms per square centimeter [kg/cm^2]	0.9678	atm
	14.22	lb./sq.in.
	2048	lb.sq.ft.
kilograms per square meter [kg/m^2]	2.896×10^{-3}	in.Hg
	1.422×10^{-3}	lb./sq.in.
	0.2048	lb./sq.ft.
kilometers [km]	1×10^{-5}	cm
	3280.8	ft.
	0.6214	st.M.
	0.53996	NM
kilometers per hour [km/h]	0.9113	ft./sec.
	58.68	ft./min.
	0.53996	kts
	0.6214	mph
	0.27778	m/sec.
	16.67	m/min.
kilowatts [kW]	1.3596	PS
	1.341	hp
knots [kts]	1	nautical mph
	1.689	ft./sec.
	1.1516	statute mph
	1.852	km/h
	0.51444	m/sec.

MULTIPLY	BY	TO OBTAIN
litres [l]	1000	cm^3
	61.02	cu.in.
	0.03531	cu.ft.
	33.814	fl.oz.
	0.264172	U.S.gal.
	0.2200	Imperial gal.
	1.05669	qt.
litres per second [l/sec.]	2.12	cu.ft./min.
meters [m]	39.37	in.
	3.280840	ft.
	1.0936	yd.
	6.214×10^{-4}	st.M.
	5.3996×10^{-4}	NM
meter-kilograms [m·kg]	7.23301	ft.-lb.
	86.798	in.-lb.
meters per second [m/sec.]	3.280840	ft./sec.
	196.8504	ft./min.
	2.237	mph
	3.6	km/h
miles. statute [st.M.]	5280	ft.
	1.6093	km
	1609.3	m
	0.8684	NM

MULTIPLY	BY	TO OBTAIN
miles per hour [mph]	44.7041	cm/sec.
	4.470×10^{-1}	m/sec.
	1.467	ft./sec.
	88	ft./min.
	1.6093	km/h
	0.8684	kt
nautical miles per hour [NMph]	51.446	cm/sec.
	5.145×10^{-1}	m/sec.
	1.688	ft./sec.
	101.271	ft./min.
	1.852	km/h
millibars [mb]	2.953×10^{-2}	in.Hg
millimeters [mm]	0.03937	in.
millimeters of mercury at 0°C [mm Hg]	0.03937	in.Hg
nautical miles [NM]	6080	ft.
	1.1516	st.M.
	1852	m
	1.852	km
ounces. fluid [fl.oz.]	29.57	cm^3
	1.805	cu.in.
	0.0296	l
	0.0078	U.S.gal.
pounds [lb.]	0.453592	kg
	453.6	g

MULTIPLY	BY	TO OBTAIN
pounds per cubic inch [lb./cu.in.]	1728	lb./cu.ft.
	27.68	g/cm^3
pounds per square foot [lb./sq.ft.]	0.01414	in.Hg
	4.88243	kg/m^2
	4.725 x 10^{-4}	atm
pounds per square inch [psi or lb./sq.in.]	5.1715	cm Hg
	2.036	in.Hg
	0.06804	atm
	0.0689476	bar
	703.1	kg/m^2
quart. U.S. [qt.]	0.94635	l
	57.749	cu.in.
revolutions per minute [RPM or rev./min.]	0.1047	rad./sec.
square centimeters [cm^2]	0.1550	sq.in.
	0.001076	sq.ft.
square feet [sq.ft.]	929	cm^2
	0.092903	m^2
	144	sq.in.
	0.1111	sq.yd.
	2.296 x 10^{-5}	acres
square inches [sq.in.]	6.4516	cm^2
	6.944 x 10^{-3}	sq.ft.
square kilometers [km^2	0.3861	(st.M.)^2
square meters [m^2]	10.76391	sq.ft.
	1.196	sq.yd.

MULTIPLY	BY	TO OBTAIN
square miles [sq.mi.]	2.590	km
yards [yd.]	0.9144	m
	3	ft.
	36	in.

SECTION 2
LIMITATIONS

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SECTION 2 LIMITATIONS

2.1 General

This section provides the "EASA approved" operating limitations, instrument markings, color coding and placards of Limitations necessary for the safe operation of the airplane and its systems.

Limitations associated with those optional systems and equipment which require handbook supplements can be found in Section 9 (Supplements).

2.2 Airspeed Limitations

Design speeds	KIAS	Remarks
V_A *Design Manoeuvre Speed:* *Acro* *Utility*	 165 145	Do not apply full control movements above this speed.
V_{LO} *Maximum landing gear operation*	136	Do not exceed this speed during gear operation.
V_{LE} *Maximum speed landing gear ext.*	160	Do not exceed this speed with landing gear extended.
V_{FE} *Maximum flaps extended speed*	114	Do not exceed this speed with flaps extended beyond T/O position
$V_{FE-T/O}$ *Maximum speed with flaps in T/O position*	150	Do not exceed this speed with flaps in T/O position
V_{NE} *Never exceed speed:* *up to 13100 ft* *13101 to 16400 ft* *above 16400 ft*	 235 214 200	Do not exceed this speed in any operation.
V_{NO} *Maximum structural cruising speed*	172	Do not exceed this speed except in smooth air and then only with caution.

2.3 Airspeed Indicator Markings

Marking	KIAS	Meaning
White arc	58 - 114	Flap down Operating Range
Green arc	70 - 172	Normal Operating Range
Yellow arc	172 - 235	Caution Range "Only in smooth air"
Red radial line	235	Never Exceed

2.4 Power Plant Limitations

a) Number of engines 1

b) Engine manufacturer .... Lycoming

c) Engine model.................... AEIO-540-D4D5

d) Engine operating limits

rated output power.................... 260 HP

rated output rotation speed

during take-off and climb ....Max. 2700 RPM

Max. continuous rotation speed.................... 2700 RPM

e) Oil press [PSI]

minimum (idle)....................25 psi

normal (green band) .... 60-90 psi

maximum....................115 psi

f) Fuel press [PSI]

minimum (idle)....................12 psi

normal (green band) .... 14-45 psi

maximum....................45 psi

g) Oil temperature [°C] [ºF]

minimum (not for continuous operation)...........40 – 60ºC................ (104-140ºF)

normal (green band) ....60 – 118ºC.............. (140-245ºF)

maximum..........118ºC.......... (245ºF)

h) Max. cont manifold pressure

1800 RPM	23,8 in.Hg
1900 RPM	24,6 in.Hg
2000 RPM	25,6 in.Hg
2100 RPM	27,1 in.Hg
2200 RPM and +	Full throttle

i) Cylinder head temperature [°C] [ºF]

minimum	66ºC	(150ºF)
normal (green band)	66 – 260ºC	(150-500ºF)
maximum	260ºC	(500ºF)

j) Fuel

Octane grade min. .... AVGAS 100LL

k) Fuel flow(l/hr), [pph], [gal/hr]

minimum			
normal	34 – 83 l/hr	(54-131 pph)	(9-22 US gal/h)
maximum	102 l/hr	(161 pph)	(27 US gal/h)

l) Oil specification

(see chapter 1.7) .... MIL-L-22851A or –6082C

m) Number of propellers 1

n) Propeller manufacturer .... Hartzell

o) Propeller model HC-C3YR-1RF/F7663R

p) Propeller diameter .... 1,981 m (6,5 ft.)

q) Propeller rotation speed limitations

during take-off .... 2700 RPM

maximum continuous .... 2700 RPM

r) Do not fly more than ten seconds in the following attitudes:

- Vertical flight, steep dive
- Zero G periods
- Wing-down or knife-edge flights

s) Best speed for operation of Fire Extinguisher .... 95 KIAS MAX

2.5 Engine

	Red line Limit	**Yellow band** Caution	**Green band** Normal	**Yellow band** Caution	**Red line** Limit
Tachometer [RPM]			1800 - 2700		2700
Oil temperature [°C] (ºF)		40 - 60 (104-140)	60 - 118 (140-245)		118 (245)
Oil pressure [psi]	25	25-60	60-90	90-115	115
Cylinder head temperature [°C] (ºF)		0 - 66 (32-150)	66 - 260 (150-500)		260 (500)
Suction gauge in. Hg	4.4		4.4 to 5.2		5.2

2.6 Weight Limits

	Utility	Acrobatic
Maximum take-off Mass	1490 kg / 3285 lbs	1440 kg / 3175 lbs
Maximum landing Mass	1440 kg / 3175 lbs	1440 kg / 3175 lbs
Maximum baggage compartment Mass	50 kg / 110 lbs	0
Max zero Fuel Weight	1345 kg / 2965 lbs	1315 kg / 2899 lbs

No baggage for Acrobatic and spin manoeuvres!

2.7 Center of Gravity Limits

Reference data:

Reference point: .... at Wing leading edge = ... QE 2335 mm (QE 91.9 in.)

Datum.. QE 0

Mean aerodynamic chord (MAC), (lµ).................... .... = 1,347 m (53.0 in.)

LEMAC (lµ)......................... .... = QE 2,366 m (QE 93.1 in.)

Horizontal reference: .... Edge of canopy sill

	UTILITY	lµ [%]	Moment [kg m] / [lbs.in.]	Distance from Datum [mm] / [in.]
Forward limit				
	at 1490 kg (3285 lbs)	**24.6**	**4021/ 348923**	**2698/ 106.2**
	at 1350 kg (2976 lbs)	**23.90**	**3629 / 314861**	**2688 / 105.8**
	at 1100 kg (2425 lbs)	**24.13**	**2960 / 257050**	**2691 / 106.0**
Aft limit				
	at 1490 kg (3285 lbs)	**28,9**	**4105/ 356294**	**2755 / 108.5**
	at 1300 kg (2867 lbs)	**29.8**	**3597 / 312216**	**2767 / 108.9**
	at 1100 kg (2425 lbs)	**29.8**	**3044 / 264083**	**2767 / 108.9**

	ACROBATIC	lµ [%]	Moment [kg m] / [lbs.in.]	Distance from Datum [mm] / [in.]
Forward limit				
	at 1440 kg (3175 lbs)	**24.4**	**3881 / 336868**	**2695 / 106.1**
	at 1350 kg (2976 lbs)	**23.9**	**3629 / 314861**	**2688 / 105.8**
	at 1100 kg (2425 lbs)	**24.1**	**2960 / 257050**	**2691 / 106.0**
Aft limit				
	at 1440 kg (3175 lbs)	**28.2**	**3707 / 342583**	**2741 / 107.9**
	at 1280 kg (2823 lbs)	**28.5**	**3520 / 305731**	**2750 / 108.3**
	at 1100 kg (2425 lbs)	**28.5**	**3025 / 262628**	**2750 / 108.3**

2.8 Manoeuvre Limits

The airplane is approved for aerobatic manoeuvres, provided it is loaded within the approved weight and center of gravity limits (see page 2-6).

The approved manoeuvres are:

Aileron Roll, Barrel Roll, Half Roll and Pull Through, Horizontal Eight, Lazy Eight, Loop, Outside Turn, Immelmann, Slow Roll, Hammerhead or Stall Turn, Tail Slide, Chandelle, Split-S, Clover-Leaf and inverted flights. Entry speed according to flight manoeuvre (see placard page 2-15)!

NOTE

Inverted flight under full power with full collector-tank is possible for a maximum of 2 min.

For all manoeuvres, unless otherwise stated, the recommended engine power is from 2400 to 2700 RPM with full throttle. The mixture should be set to „best power mix".

NOTE

All manoeuvres with high pitch rate and/or yaw rate (more than 90°/sec) flown with high engine RPM result in high loads on propeller and crankshaft. Limit the engine to 2400 RPM when flying these manoeuvres.

If there is a danger to exceed V_{NE}, select idle throttle and high RPM for maximum drag from propeller. Use small control inputs until the speed is under control.

Use full throttle for an optimum pull out radius up to 6g for recovering to level flight. The turning radius at 6g is small, and the engine power is also required to maintain high energy despite the apparent „ground rush".

NOTE

Above V_A do not use full or rapid control deflections. Above 110 KIAS do not apply full rudder and elevator in combination.

The following manoeuvres may not be flown for more than 10 seconds:

- Vertical flights or steep dives
- Inverted steep dives
- Zero g Flight

During these manoeuvres the oil system will not scavenge correctly and engine damage can result. Normally the oil pressure flickers between 10 and 30 PSI when changing from normal flight to inverted flight. However, if the oil pressure should fall 20 PSI below normal value, immediately revert to normal flight. If the oil pressure does come back to normal (green arc) when in normal flight, land the airplane and have the inverted flight oil system examined.

The approved flight manoeuvres are listed in Chapter 4 "Normal Procedures". Entry speed according to flight manoeuvre!

WARNING

At airspeeds in excess of V_A do not apply abrupt and full control inputs!

Intentional spinning with extended flaps is prohibited!

Power-on spins, Power-on tailslides and snap (flick) manoeuvres are prohibited!

2.9 Maximum Altitudes

max operating altitude: .... 18000 ft.

for take-off and landing .... 8000 ft.

2.10 Flight Manoeuvre Load Factors

Flaps UP Acro .... + 6 g .... - 4 g

Flaps UP Utility .... + 4,4 g .... -1,76 g

Flaps DOWN .... + 3,80 g .... - 0,0 g

2.11 Seating Capacity

Number: 2

The primary seat is the RH seat.

If the aircraft is flying single-seated, use only the RH seat.

2.12 Kinds of Operation Limits

VFR Day and Night and IFR.

Flight into known or forecast icing conditions is prohibited.

The composition of the aircraft crew must comply with national regulations. The crew must be qualified to operate the required equipment as listed.

Kinds of Operation Equipment List

	VFR-Day	VFR-Night	IFR
Communications (ATA-23)			
1. Communication Radio (VHF) COM I	1 (0)	1 (0)	1
2. Communication Radio (VHF) COM II	0 (1)	0 (1)	1
3. Communication Radio (UHF) COM III	0	0	0
4. Audio Control Panel	1	1	1
Electrical Power (ATA-24)			
1. Battery	1	1	1
2. Alternator	1	1	1
3. Ampere/Volt meter	1	1	1
4. Central Warning Light Panel	1	1	1
Fire Protection (ATA 26)	0	0	0
Fire Detection System.	0	0	0
Fire Extinguishing System	0	0	0
Flight Controls (ATA-27)			
1. Flap System	1	1	1
2. Flap Position Indicator	1	1	1
3. Horizontal Stabilizer Trim System	1	1	1
4. Stall Warning Horn	1	1	1
Fuel (ATA-28)			
1. Electrical Fuel Pump	1	1	1
2. Fuel Quantity Indicator	1	1	1
3. Fuel Pressure Indicator	1	1	1
Ice and Rain Protection (ATA-30)			
1. Pitot Heat	0	0	1
2. Alternate Static Air Source	0	0	1
Instruments (ATA-31)			
1. Clock	0	0	1
Lights (ATA-33)			
1. Cockpit and Instruments (Required Illumination)	0	1	1
2. Anti-Collision Lights	2	2	2
3. Landing Light	0	0	1
4. Position Light	0	3	3
5. Handheld Light	0	0	1

	VFR-Day	VFR-Night	IFR
Navigation (ATA-34)			
1. Altimeter	1	1	2
2. Airspeed	1	1	1
3. Magnetic Compass	1	1	1
4. Outside Air Temperature	0	0	1
5. EHSI 1	0	0	1
6. EHSI 2	0	0	1
7. Electric Horizon	0	0	1
8. Vertical Speed Indicator	0	0	1
9. DME	0	0	1
10. Transponder (ATC)	0	1	1
11. ADF	0	0	1*
12. GPS	0	0	1*
13. Localizer	0	1	1
14. Glide slope	0	0	1
15. Marker	0	0	1
16. Pneumatic Horizon	0	0	1
Engine Indicating (ATA-77)			
1. Tachometer Indicator	1	1	1
2. Cylinder Head Temperature	0	0	0
3. Exhaust Gas Temperature	0	0	0
4. Manifold Pressure	1	1	1
5. Fuel Flow Meter	1	1	1
6. Fuel Pressure (primary)	0	0	1
Engine Oil (ATA-79)			
1. Oil Temperature Indicator	1	1	1
2. Oil Pressure Indicator	1	1	1

* as required by operation

NOTE

The valid operational requirements have priority over this list. The zeros (0) used in the above list mean that the equipment and/or system was not required for that kind of operation.

2.13 Fuel Limitations

Total capacity (nominal)..262 litres

(416 lbs)............ (69,2 U.S. gal.)

Collector tank fuel capacity...8 litres

(12 lbs) .... (2,0 U.S. gal.)

Unusable fuel...10 litres

(16 lbs) .... (2,7 U.S. gal.)

Usable fuel ....252 litres

(400 lbs)............. (66,6 U.S. gal.)

Tank asymmetry...max. 25 litres

(40 lbs) .... (6,7 U.S. gal.)

2.14 Placards

On the RH and LH cabin wall:

Limitations for		Acro	Utility
Max. weight		1440 kg / 3175 lbs	1490 kg / 3285 lbs
Max. flight manoeuvring load factors	Flaps Up	+6g / -4g	+4.4g / -1.76g
	Flaps Down	+3.8g / -0.0g	+3.8g / -0.0g
Never exceed speed V_{NE}		235 KIAS	215 KIAS
Max. normal operating speed V_{NO}		172 KIAS	172 KIAS
Manoeuvring speed V_A		165 KIAS	145 KIAS
Max. speed flaps TAKE-OFF V_{FE}		150 KIAS	150 KIAS
Max. speed flaps not UP V_{FE}		114 KIAS	114 KIAS
Intentional spinning with extended flaps is prohibited			

This airplane must be operated in accordance with the Airplane Flight Manual (AFM)
The applied placards are for aerobatic category, all other limitations are contained in the AFM.
The G 120A is certified for VFR-day and night and IFR operation.
Flights into known icing conditions are prohibited.

On the RH and LH canopy frame:

NO SMOKING

On the instrument panel below each ASI:

VA 165 KIAS

On the centre console below the flap selector:

V_{FE} Flaps take off 150 KIAS

Above the gear control handle:

V_{LD} Max. landing gear operating speed 136 KIAS

Adjacent to each fuel filler cap:

Octane Grade min
AVGAS 100LL
Total 131 Litres
208 lbs

On the fuel filler cap:

On the wing adjacent to the filler cap:

At the fuel selector:

Left side:

126 L usable

Right side:

126 L usable

On the rear baggage compartment wall:

Baggage max. 50 kg (110 lbs)
No baggage during acrobatic
and spin manoeuvers !

On the access panel on the cowling:

Oil Capacity:		
min.	8 quarts	(7.6 litres)
recommended	10 quarts	(9.6 litres)
max.	12 quarts	(11.35 litres)
See Flight Manual for Oil Grades		

NOTE

The engine oil gauge (dip-stick) is calibrated in quarts

On the panel of the external power socket:

E

External power supply
24V DC

On the main landing gear door or landing gear strut:

3.0 bar
(43.5 psi)

On the nose landing gear door or fork:

2.5 bar
(36 psi)

On the flaps:

NO
STEP

On the canopy lock (inside and outside):

OPEN

CLOSED

On the canopy lever (outside):

PULL TO UNLOCK ONLY

Adjacent to the red emergency exit lever:

CANOPY JETTISON
1. PULL RED HANDLE AND DISCARD
2. PULL CANOPY HANDLE THROUGH 180°
3. PULL CANOPY BACK AND PUSH UPWARDS

At the lower LH and RH fuselage by the exhaust:

On the LH and RH side of the canopy:

Aerobatic Manoeuvre	Entry Speed KIAS
Aileron Roll	160
Barrel Roll	170
Half Roll and Pull Through	100
Horizontal Eight	170
Lazy Eight	170
Loop	170
Outside Turn	170
Roll off the Top (Immelman)	170
Slow Roll	160
Stall Turn	170
Tail Slide	170
Wing Over (Chandelle)	170
Split-S	170

On top of the LH and RH canopy frame:

SPIN RECOVERY

1. Close throttle
2. Apply rudder opposite to spin direction
3. Aileron in spin direction
4. Push elevator fast forward to stop
5. When spin stops controls neutral
6. Recover from dive

If spin does not stop first pull elevator to stop, than push elevator fast forward to stop.
Start recovery in case of appearance of spiral characteristic.

NOTE

No other intentional aerobatic manoeuvres are allowed.

NOTE

For flights in UTILITY category, the max bank angle is limited to 90º.
Intentional spinning in UTILITY category is prohibited.

On the instrument panel:

FUEL FLOW
-Full Throttle, max RPM
-Take off / climb VY

Std.-Alt.	FF LPH
0	94
2000	88
4000	82
6000	76
8000	71
10000	67
12000	62

V_{NE} VARIATION WITH ALTITUDE

Alt ft	V_{NE} KIAS
up to 13100	235
up to 16400	214
above 16400	200

MAX CONTINUOUS MANIFOLD PRESSURE

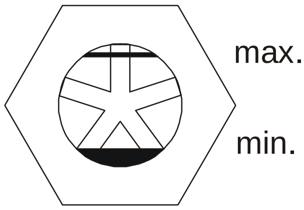
RPM	MP
1800	23.8
1900	24.6
2000	25.6
2100	27.1
2200 and above	Full Throttle

On both sides of the canopy lower corners (internal and external):

EXIT

On the right side of the fuselage:

Hydraulik Level



Fluid Mil-H-5606

At the hydraulic accumulator pressure gauge:

HYD ACCU EMER EXT
Normal Press
1250 - 2000 PSI

At the gear emergency handle:

EMERGENCY GEAR DOWN

HYDR-CB	PULL
LDG GEAR-Lever	DOWN
EMER LDG-valve	LIFT KNOB & TURN CLOCKWISE
CHECK	3 GREEN

Below the right and left wing at the root rib:

Main Tank Drain 2 x

Collector Tank Drain 2 x

Vent Drain 2 x

Below the left wing at the root rib, forward:

Pitot-Static Drain

2.15 Color

Paint the GROB G 120A in accordance with the color specification ***GPS 1078/1***. Changing the paint colour and the paint thickness is only permissible after prior approval by the manufacturer of the airplane.

2.16 Starter Limitations

Start-Sequence	Starter ON	Cooling down
1	10 sec	1 min
2	10 sec	1 min
3	10 sec	15 min

2.17 Limitations in the Use of Sunglasses

The instruments are readable in all normal conditions. Some types of sunglasses may affect the readability of instruments in extreme conditions. Pilots must make sure that the glasses they use do not affect the readability of the instruments.

SECTION 3
EMERGENCY PROCEDURES

Table of Contents

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SECTION 3 EMERGENCY PROCEDURES

3.1 General

This section contains procedures in the form of checklists and amplified emergency procedures for coping with an emergency situation.

Emergency situations due to aircraft or engine malfunctioning are extremely rare, as long as the preflight inspection and maintenance tasks have been carried out properly. Inflight emergencies due to inclement weather conditions are very seldom and can practically be precluded as long as the flight has been carefully planned in advance and changes in the weather duly anticipated.

Should, however, an emergency situation arise, the procedures must be in accordance with the directives of this section to the extent necessary to overcome the situation.

All data of this section are referred to a flight mass of 1440 kg (3175 lbs) unless other masses are stated.

If the emergency situation does not allow to burn fuel until the landing mass is 1440 kg or less, proceed as for a flight mass of 1440 kg.

WARNING:

A WARNING means that the non-compliance with the instruction will lead to an immediate or considerable impairment to flight safety.

CAUTION:

A CAUTION means that the non-compliance with the instruction will lead to a slight or progressive impairment to flight safety.

NOTE:

A NOTE draws the users attention to any special item not directly related to safety but which is important or unusual.

3.2 Airspeeds for Emergency Operations at 1440kg

Engine Failure after Take Off (Landing gear ext.) **KIAS**

Max. performance gliding speed (flaps UP) 90

Max. performance gliding speed (flaps T/O) 80

Recommended speed for emergency gear lowering 85

Recommended min. approach speeds (power OFF)

Flaps retracted 85

Flaps extended (TAKE OFF – LAND – FULL) 80

3.3 Emergency Procedures Check List

3.3.1 ENGINE FAILURE

During TAKE OFF (on ground)

1. Throttle .... IDLE
2. Brakes .... AS REQUIRED

Actions in case the aircraft is departing from the runway:

3. Mixture .... LEAN CUT-OFF
4. Fuel tank selector .... OFF
5. Ignition .... OFF
6. Battery & Alternator .... OFF

During TAKE OFF (airborne) and Flight

Engine power insufficient to continue flight.

1. Airspeed .... TRIM FOR BEST GLIDE (SEE 3.2)
2. Electr. fuel pump .... ON
3. Fuel tank selector .... CHECK
4. Ignition .... BOTH
5. Fuel pressure .... CHECK
6. Alternate Air .... ON
7. Mixture .... CHECK
8. Propeller .... HIGH RPM
9. Throttle .... CYCLE

If there is no improvement:

10. Mixture .... LEAN CUT-OFF
11. Fuel tank selector .... OFF
12. Ignition .... OFF
13. Electr. fuel pump .... OFF

When landing is assured:

14. Landing gear .... AS REQUIRED
15. Flaps .... LAND OR FULL
16. Emergency radio call .... IF POSSIBLE
17. Seat belts .... TIGHT AND LOCKED
18. Battery & Alternator .... OFF

WARNING

Land as straight ahead as possible; make only small directional changes to avoid obstacles. Make a normal or belly landing as decided due to situation.

Engine Shut-down During Flight

After all actions to regain normal engine operation are unsuccessful:

1. Airspeed .... TRIM FOR BEST GLIDE (SEE 3.2)
2. Fuel tank selector .... OFF
3. Mixture...LEAN CUT-OFF
4. Ignition.. OFF
5. Power-off landing..EXECUTE

Engine Restart

1. Fuel tank selector .... FULLEST TANK
2. Propeller .... HIGH
3. Throttle .... ¼ OPEN
4. Battery & Alternator .... ON
5. Ignition..BOTH
6. Electr. fuel pump...ON

If propeller is windmilling:

7. Mixture..RICH

If propeller is not windmilling:

8. Ignition..START
9. Mixture..OPEN UNTIL ENGINE RUNS SMOOTHLY
10. Electrical fuel pump .... OFF

NOTE

Expect a short delay until full power is available, if the engine was failed because of an empty fuel tank.

3.3.2 EMERGENCY LANDINGS

Power Off Landing

According to actual situation select most suitable emergency landing area.

1. Airspeed .... TRIM FOR BEST GLIDE (SEE 3.2)
2. Seat belts and harness .... TIGHT
3. Emergency radio call .... ANNOUNCE
4. XPDR & ELT .... EMERG MODE /ON
5. Fuel tank selector .... OFF
6. Mixture .... LEAN CUT-OFF
7. Ignition .... OFF
8. Electrical fuel pump .... OFF
9. Flaps .... AS REQUIRED
10. Landing gear .... AS REQUIRED
11. Battery & Alternator .... OFF

   Refer to Fig. 3.1 for best gliding distance.

Power On Landing

1. Emergency landing area .... SELECT
2. Emergency radio call .... ANNOUNCE
3. XPDR & ELT .... AS REQUIRED
4. Fly over selected area to check condition .... IF POSSIBLE
5. Seat belts and harness .... TIGHT
6. Flaps .... AS REQUIRED
7. Landing gear .... AS DECIDED
8. Battery & Alternator .... OFF
9. Mixture (if off-field-landing, before touch-down) .... LEAN CUT-OFF
10. Brakes .... AS REQUIRED
11. Fuel tank selector .... OFF
12. Engine .... IGNITION OFF

Ditching

1. Radio .... MAYDAY
2. XPDR & ELT .... EMERG MODE /ON
3. Heavy objects .... SECURE
4. Landing Gear .... UP
5. Flaps .... AS REQUIRED
6. Seat belts and harness tight .... CHECK
7. Approach in prevailing
   - strong wind and high seas .... AGAINST THE WIND
   - gentle wind and strong swell .... PARALLEL TO SWELL
8. Touch down .... AT MIN. SPEED
9. Canopy .... OPEN
10. Seat belts and harness .... RELEASE
11. Airplane .... ABANDON
12. Life jackets and dinghy .... INFLATE

CAUTION

Do not operate over water and outside gliding range of landable terrain unless wearing life jackets and with a dinghy on board for each crew member.

3.3.3 FIRE

In the event of smoke or fire, prepare to land the aircraft without delay while completing fire suppression and/or smoke evacuation procedures. If it cannot be visually verified that the fire has been completely extinguished, whether the smoke has cleared or not, land immediately at the nearest suitable airfield or landing site.

Engine Fire During Start or Take Off (not airborne)

Indications: FIRE warning light, flames in the engine compartment

1. Fuel tank selector .... OFF
2. Electr. fuel pump .... OFF
3. Mixture .... LEAN CUT-OFF
4. Throttle .... FULL FORWARD
5. Ignition .... OFF
6. Engine fire extinguisher push-button (Lighted) .... PUSH
7. All electrical switches .... OFF
8. Leave a/c and combat fire

Engine Fire in Flight

Indications: FIRE warning light, flames, smoke, smell or ext. signal or call

Consider immediate power on landing, if appropriate.

1. Fuel tank selector .... OFF
2. Propeller lever .... FULL BACK
3. Airspeed .... 95 KIAS
4. Electr. fuel pump .... OFF
5. Mixture .... LEAN CUT-OFF
6. Throttle .... FULL FORWARD
7. Cabin heating: Distribution Control Lever .... OFF
8. Cabin heating: Temperature Control Lever .... FULLY COLD

If FIRE warning persists for 30 secs:

9. Engine fire extinguisher push-button (Lighted) .... PUSH
10. Ignition .... OFF

Cont. with 3.3.2 “Power off emergency landing

NOTE

After Engine Fire, do not attempt an air restart.

If after operating the fire extinguisher there is a smell or visible smoke in the cockpit, open the canopy for additional ventilation. The canopy can be easily opened below 95 KIAS.

Electrical Fire in Flight

1. Alternator .... OFF
2. Battery .... OFF
3. Vents .... CLOSED
4. Cockpit fire extinguisher .... OPERATE

NOTE

Ventilate cabin after using fire extinguisher in closed cabin. The canopy can be easily opened below 95 KIAS.

5. Avionic master .... OFF
6. All other switches, including all avionics switches .... OFF
   (except ignition switch)

If fire is extinguished and electric power is required to continue the flight:

7. Battery .... ON
8. Alternator .... ON
9. Turn on all other switches as well as all circuit breakers in slow sequence until the short circuit is identified.

   Deselect the failed system and land as soon as practical.

Cabin Fire in Flight

1. Battery & Alternator .... OFF
2. Vents .... CLOSED
3. Cabin heating .... OFF
4. Fire extinguisher .... OPERATE

NOTE

Ventilate cabin after using extinguisher in closed cabin.

5. Land as soon as possible

Wing Fire in Flight

1. Position lights .... OFF
2. Anti-Collision lights .... OFF
3. Perform side slip to keep flames away from cabin
4. Other fuel tank .... CHECK OR CHANGE
5. Emergency landing .... PERFORM

3.3.4 ICING

Inadvertent Flight Into Icing Conditions

1. Pitot heat .... ON
2. Propeller lever .... FULL FORWARD
3. Alternate air (observe manifold pressure!) .... ON
4. Cabin heating to windshield only.. ON
5. Alternate Static .... ON
6. Reverse heading and / or altitude to leave icing conditions.
7. Prepare for landing at nearest airfield if ice cannot be removed.
8. If there is fast ice build up, search for emergency landing location.
9. In case of icing on wing leading edges, higher stall speeds have to be expected. The stall warning may give no or an incorrect warning.

- In case of an incorrect stall warning PULL STALL WARNING CB

NOTE

Warning on annunciator panel and voice warning remain active.

WARNING

Leave area with icing conditions immediately after first signs of icing. Expect higher stall speeds. Stall warning may be incorrect or absent. Add 5-10 KTS to approach and landing speed.

3.3.5 LANDING GEAR PROBLEMS

Landing Gear Retraction Failure

Indication: red gear unsafe light on or no landing gear operation

1. GEAR CTRL circuit breaker...CHECK
2. GEAR IND circuit breaker...CHECK
3. GEAR EMERGENCY handle at “NORMAL” ....CHECK

if red gear unsafe light still ON:

4. LDG GEAR lever ....CYCLE

if red gear unsafe light still ON:

5. LDG GEAR lever .... DN
6. GEAR down and locked...CHECK

.... (confirmed by external observer, if unsure)

Land as soon as practical on a suitable airfield.

CAUTION

Plan for significantly reduced range with GEAR DOWN.

Landing Gear Extension Failure / Nose Gear Unsafe

Indication: no Green Light

1. HYDR circuit breaker............................PULL during preparation of maneuvers
2. HYDR circuit breaker.. PUSH IN
3. Normal acceleration.........................APPLY MODERATE NEGATIVE G-LOAD

If unsuccessful:

4. Throttle + Propeller .... IDLE + LOW
5. Flaps .... T/O
6. Airspeed ....REDUCE TO STALL WARNING

Low airspeed and low propeller stream will allow the nose-gear to lock in DN position.

If unsuccessful, continue with proc. EMERGENCY LANDING GEAR EXTENTION.

Landing Gear Extension Failure / One or Both Main Gear Unsafe

Indication: no Green Light, one or both

1. HYDR circuit breaker ....PULL during preparation of maneuvers
2. HYDR circuit breaker ....PUSH IN
3. Normal acceleration.........................APPLY MODERATE NEGATIVE G-LOAD

If unsuccessful:

4. Limited airspeed .... 160 KIAS
5. Normal acceleration......................... APPLY MODERATE POSITIVE G-LOAD

If unsuccessful:

6. Yaw the airplane.........................FIRST INTO THE UNLOCKED GEAR, THEN INDUCE OSCILLATION. SIMULTANOUS NORMAL ACCELERATION MAY HELP

If unsuccessful, continue with proc. EMERGENCY LANDING GEAR EXTENTION.

Emergency Landing Gear Extension

1. Recommended airspeed... 85 KIAS
2. Flaps .... UP
3. Engine ....POWER FOR LEVEL FLIGHT
4. Bottle Pressure ....CHECK
   .... (1250 up to 2000 psi)
5. HYDR circuit breaker ....PULL
6. LDG GEAR lever .... DN
7. EMERG LDG GEAR valve.........................LIFT KNOB & TURN CLOCKWISE
8. Gear locked ....CHECK 3 green

   It will take about 13 seconds until gear is DN and locked.

If unsuccessful, repeat maneuvers as specified above under 3. through 6. for LANDING GEAR EXTENSION FAILURE / NOSE GEAR UNSAFE or / ONE OR BOTH MAIN GEAR UNSAFE, respectively.

CAUTION

If bottle pressure is below 1250 psi do not use Emergency System! When emergency extension system has been used, it has to be checked after landing prior to next flight

Emergency Gear Up Landing

1. Cockpit ....SECURE LOOSE ITEMS
2. Seat belts ....TIGHT AND LOCKED
3. Flaps ....LAND
4. Approach speed .... 80 KIAS

if landing is assured:

5. Electr. fuel pump .... OFF
6. Fuel tank selector .... OFF#
7. Mixture ....LEAN CUT-OFF
8. Ignition.. OFF
9. Battery & Alternator .... OFF

Landing With Flat Nose Gear Tire or Nose Gear Unsafe

1. Approach..NORMAL
2. Seat belts ....TIGHT AND LOCKED
3. Flaps .... T/O

CAUTION

A smooth flare and smooth nose up touch down followed by a controlled delay of the nose drop during roll should be attempted, which is facilitated with flaps T/O.

4. Touch-down..MAIN WHEELS FIRST
5. Mixture ....LEAN CUT-OFF
6. Elevator ....PULL to keep nose up
7. Electr. fuel pump .... OFF
8. Ignition.. OFF
9. Fuel tank selector .... OFF
10. Battery & Alternator .... OFF

NOTE

Do not retract the gear; if there is an indication of a blown tire.

Landing With Flat Main Landing Gear Tire or One or Both Main Gear Unsafe

1. Approach .... NORMAL
2. Seat belts .... TIGHT AND LOCKED
3. Flaps .... T/O

CAUTION

A smooth flare and smooth nose up touch down followed by a controlled delay of wing and tail drop during roll should be attempted, which is facilitated with flaps T/O.

4. Touch down on good wheel first and keep bad wheel from ground contact as long as possible.
5. Use good wheel brake to maintain direction and to delay tail drop.
6. Mixture.. LEAN CUT-OFF
7. Electr. fuel pump.. OFF
8. Ignition.. OFF
9. Fuel tank selector .... OFF
10. Battery & Alternator .... OFF

3.3.6 SPIN RECOVERY

SIMPLE PROCEDURE FOR USE AFTER LESS THAN 1,5 TURN SPINNING ONLY

1. Throttle .... CLOSED
2. Rudder .... FULLY OPPOSITE TO SPIN DIRECTION
3. Pause
4. Elevator .... SLOWLY RELEASE
5. Aileron .... NEUTRAL
6. Rudder when spin stops .... NEUTRAL

Recover from dive.

NOTE

To recover from all types of spins (except inverted), use the procedure as described in chapter 4.6 and on placard (page 2-16).

CAUTION

Altitude loss for recovery after spinning stops will be about 1000 ft.

3.3.7 ABANDONING THE AIRCRAFT BY PARACHUTE /CANOPY EMERGENCY JETTISON

1. Engine .... SHUT-DOWN
2. Red locking lever .... PULL
3. Open canopy handle and push backwards and up through the 90° position until it releases (approx. 170° position)
4. Push the canopy simultaneously backwards and upwards.
5. Safety harness .... RELEASE
6. Cockpit .... ABANDON
7. Parachute .... ACTUATE WHEN CLEAR OF THE A/C

3.3.8 ROUGH ENGINE OR POWER LOSS

1. Alternate air .... ON (PULL)
2. Mixture .... FULL RICH
3. Propeller .... HIGH RPM
4. Electr. fuel pump .... ON
5. Ignition .... CHECK, BOTH
   SELECT "GOOD" MAGNETO
6. Fuel selector .... CHECK
7. If roughness not cured .... LAND AS SOON AS POSSIBLE

The cause of engine roughness is not normally obvious. The following list of possibilities should be checked in the order listed.

Iced Air Intake Filter

Indication: RPM drop at constant power setting

1. Alternate air .... ON (PULL)
2. Mixture .... ADJUST

Fouled Ignition Plugs

Indication: regular misfiring, power loss

1. Engine power .... 75% BHP
2. Mixture.. BEST POWER RANGE
3. Cylinder head temperature .... CHECK WITHIN LIMITS

Continue flight, if the engine is running smooth.

Land at the nearest airfield, if the engine is running rough.

Magneto Failure

Indication: rough running, misfiring, RPM drop

1. Mixture..RICH
2. Throttle ....CYCLE
3. Ignition.. CHECK, BOTH
   SELECT “GOOD” MAGNETO
4. Mixture..ADJUST
5. Power setting..AVOID POWER ABOVE 65% FOR LONG PERIODS
6. CHT and EGT..MONITOR

Land at the nearest airfield.

CAUTION

If one MAG is U/S, there will be a DEAD-CUT during MAG-CHECK.

NOTE

With only one MAG SYSTEM in operation; higher EGT is normal.

Blocked Fuel-Injection-Nozzle

Indication: rough running, power loss, backfiring

1. Mixture..ENRICH
2. Throttle ....ADJUST
3. Land at the nearest airfield.

3.3.9 FAILURE OF THE PROPELLER GOVERNOR

The result is loss of control over the RPM by the RPM lever and constant speed operation

Indication: The most likely result is RPM overspeed

1. Throttle ....IDLE
2. Airspeed .... LOW

Continue flight with partial throttle for landing at the nearest airfield.

3.3.10 INFOS, STATUS, WARNINGS AND CAUTIONS - ANNUNCIATOR PANEL

Refer to chapter 7

Info:	Line 1	white
Status:	Line 2	green
Cautions:	Line 3-6	amber
Warnings:	Line 7-8	red

INFO indication, ANNUNCIATOR PANEL position

-1A

TEST

- TEST
  Test Button

-1B

FDR

- FDR
  White Info light

-1C

RESET

- SPARE
  Reset Button

STATUS indication, ANNUNCIATOR PANEL position

-2A

EXTERNAL POWER STATUS

- EXT PWR
  Green status light ON

-2B

FUEL PUMP STATUS

- FUEL PUMP
  Green status light ON

-2C

SPARE

- SPARE
  Green status light

CAUTION indication, ANNUNCIATOR PANEL position

-3A

SPARE

- SPARE
  Amber caution light

-3B

LOW VACUUM CAUTION

- VAC LOW
  Amber caution light ON

-3C

P/S HEAT CAUTION

- P/S HEAT
  Amber caution light ON

+ voice warning "CHECK HEAT

1. P/S HEAT switch .... CYCLE TO ON
2. P/S HEAT circuit breaker .... CHECK IN

If the CB pops out again or the annunciator panel caution remains, assume a failed P/S heating system. Land as soon as possible or fly to an area or altitude without icing conditions.

-4A

SPARE

- SPARE
  Amber caution light

-4B

FUEL LH LEVEL CAUTION

- FUEL LH LVL
  Amber caution light ON

+ voice warning "CHECK FUEL"

Fuel quantity in LH collector tank below 5 litres

1. Attitude .... STRAIGHT AND LEVEL
2. Fuel tank selector ....OTHER TANK
3. Fuel quantity and balance.. CHECK

-4C

FIRE FAULT

- FIRE FAULT
  Amber caution light ON

Fault in the Fire Detection system

The fire detection system is not available.

-5A

BUS TIE CAUTION

• BUS TIE Amber caution light ON	+ voice warning "CHECK ELECTRIC"

BUS TIE caution light ON means, main bus and avionic bus 2 are supplied by alternator, battery bus and avionic bus 1 by battery. The battery is not being charged!

1. BUS TIE ....MAN
2. Voltmeter .... CHECK

If BUS TIE caution light is still ON, voltmeter reading is 24,5-29V DC and the ammeter has a normal indication on the +side:

3. Land as soon as practical.

If BUS TIE caution light is still ON, voltmeter reading is <24,5V DC and the ammeter shows a discharge (-side):

4. Electrical systems........................REDUCE TO MINIMUM FOR SAFE FLIGHT
   (AIRCOND SWITCH OFF and GEAR EXTENSION by EMERGENCY)
5. Land as soon as practical.

CAUTION

With BUS TIE switch in MAN and "ALT OFF" light ON, main bus and avionic bus 2 are supplied by battery. If ammeter shows high current, select BUS TIE switch to OFF.

-5B

FUEL RH LEVEL CAUTION

- FUEL RH LVL
  Amber caution light ON

+ voice warning “CHECK FUEL”

Fuel quantity in RH collector tank below 5 litres

1. Attitude .... STRAIGHT AND LEVEL
2. Fuel tank selector ....OTHER TANK
3. Fuel quantity and balance.. CHECK

-5C

HYDRAULIC PUMP CAUTION

- HYDR PUMP
  Amber caution light ON

Result: Possible overheating of hydraulic pump.

1. HYDR circuit breaker..PULL
2. BE PREPARED FOR EMERGENCY GEAR EXTENSION

-6A

BATTERY OFF CAUTION

- BATT OFF
  Amber caution light ON

+ voice warning “CHECK ELECTRIC”

1. BATT ....CHECK ON

If caution light remains ON:

2. BATT .... OFF
3. Land as soon as practical

Batt. RCCB is OPEN, battery not connected to BATT BUS-

-6B

FLAP ASYMMETRY CAUTION

- FLAPS
  Amber caution light ON

1. Flaps asymmetry
2. Flap position .... CHECK

-6C

HYDRAULIC SYSTEM PRESSURE CAUTION

- HYDR PRESS
  Amber caution light ON

On ground:

Delay take-off until bottle pressure is within 1250 to 2000 psi and amber caution light is OFF

In flight:

1. HYDR circuit breaker ....CHECK IN
2. GEAR CTRL circuit breaker ....CHECK IN
3. Hydraulic pump ....CHECK RUNNING

If amber caution light is not OFF within 25 sec., assume leakage in emergency landing gear extension system and proceed as follows:

1. HYDR Ctrl circuit breaker ....PULL

Prior to landing:

2. HYDR Ctrl circuit breaker .... PUSH IN
3. Proceed immediately with normal landing gear extension.

WARNING indication, ANNUNCIATOR PANEL position

-7A

ALTERNATOR FAILURE

- ALT OFF
  Red warning light ON

+ voice warning "CHECK ELECTRIC"

Indication: voltmeter reading <24,5V DC

1. Alternator .... OFF
2. Electrical systems .... REDUCE TO MINIMUM FOR SAFE FLIGHT
   (BUS TIE as required, AIRCOND SWITCH OFF and GEAR EXTENSION by EMERGENCY)
3. Land as soon as practical

ALT RCCB is OPEN, eng.-driven ALT is not connected to the DC-system

-7B

FUEL PRESSURE WARNING

- FUEL PRESS
  Red warning light ON

+ voice warning "CHECK FUEL"

1. Electr. fuel pump .... CHECK
2. Attitude .... STRAIGHT AND LEVEL
3. Fuel tank selector .... SELECT OTHER TANK
4. Fuel quantity and balance .... CHECK
5. Fuel pressure .... CHECK
6. Fuel flow .... CHECK

If warning persists, prepare for EMERGENCY LANDING

Fuel pressure downstream of the engine-driven fuel pump is below 14,5 psi.

-7C

STARTER WARNING

• STRTR Red warning light ON	+ voice warning “CHECK ELECTRIC”

The starter is still engaged while the engine is running or supplied by current; this may overheat the starter.

On ground:

1. Engine .... SHUT-DOWN

During flight:

1. Land as soon as possible
2. Engine .... SHUT-DOWN AS SOON AS POSSIBLE

CAUTION

It is possible that the starter may cause mechanical damage if it is engaged with the engine running. If warning light comes on during flight, consider an emergency landing.

-8A

VOLTAGE WARNING

• VOLT Red warning light ON	+ voice warning “CHECK ELECTRIC”

1. Ammeter.. CHECK

If ammeter reading negative:

2. Alternator..RESET
   by “PULL and PUSH” the circuit breaker “ALT FIELD”
   and/or by recycling the alternator ("OFF and ON")

if unsuccessful:

3. Alternator.. OFF
4. Electrical systems........................REDUCE TO MINIMUM FOR SAFE FLIGHT
   (BUS TIE as required, AIRCOND SWITCH OFF
   and GEAR EXTENSION by EMERGENCY)
5. Land as soon as practical

-8B

LOW OIL PRESSURE WARNING

• OIL PRESS Red warning light ON	+ voice warning "CHECK OIL"

1. Oil press .... CHECK
2. Oil temperature.. CHECK

If oil pressure is low (out of green arc) and oil temperature "NORMAL":

- Land at the nearest airfield.

If a complete loss of oil pressure with increasing oil temperature is observed:

- Reduce engine power to minimum,
- Look for an emergency landing field,
- Use minimum power to attain the emergency landing field,
- The propeller drag will be less than the normal constant speeding propeller drag.

NOTE

In some cases (failure of aerobatic oil system) it is possible to recover oil system by roll into inverted flight and back to normal flight.

WARNING

Expect engine failure any time with LOW OIL PRESSURE.

-8C

STALL WARNING

• STALL Red warning light ON	+ aural warning

The max. safe angle-of-attack is exceeded, decrease AOA by:

1. Attitude .... REDUCE
2. Airspeed .... INCREASE
3. Normal acceleration.. REDUCE
4. Engine power .... INCREASE

3.3.11 OTHER ELECTRICAL SYSTEM FAILURES

Ammeter Indication High

Indication: ammeter reading >10 Amp. for a relatively long period of time

1. Voltmeter .... CHECK

If voltage 24-29V DC:

1. Battery .... OFF
   (Alternator remains active)
2. Nevertheless land as soon as possible

If voltage >29V DC:

1. Alternator .... OFF
2. Electrical systems .... REDUCE TO MINIMUM FOR SAFE FLIGHT
   (BUS TIE as required, AIRCOND SWITCH OFF and GEAR EXTENSION by EMERGENCY)
3. Land as soon as possible.

CAUTION

With BUS TIE in AUTO, deselecting the alternator will automatically disconnect main bus and avionic bus 2 from the battery. Battery will be discharged at high rate. Lower the landing gear and reduce electrical systems to those required for save flight.

Ammeter Reading Negative

1. Alternator .... RESET
   by “PULL and PUSH” the circuit breaker “ALT FIELD” and/or by recycling the alternator ("OFF and ON")

if unsuccessful:

2. Alternator .... OFF
3. Electrical systems .... REDUCE TO MINIMUM FOR SAFE FLIGHT
   (BUS TIE as required, AIRCOND SWITCH OFF and GEAR EXTENSION by EMERGENCY)
4. Land as soon as practical.

Battery CB Popped

1. Battery .... OFF
2. Alternator .... OFF
3. BUS TIE .... OFF
4. BATT circuit breaker .... PUSH IN
5. Battery .... ON
6. Alternator .... ON

If BATT CB pops again:

7. Battery .... OFF
8. Alternator .... ON
9. Land as soon as possible

Alternator CB Popped

1. Battery .... OFF
2. Alternator .... OFF
3. BUS TIE .... OFF
4. Alternator circuit breaker .... PUSH IN
5. Alternator .... ON

If Alternator CB pops again:

6. Alternator .... OFF
7. Battery .... ON
8. Land as soon as practical.

Avionic Bus Failure / Use of EMER AVIONIC Switch

NOTE

Failed avionic bus CB not popped.

CAUTION

DO NOT OPERATE THE EMER AVIONIC SWITCH BEFORE YOU HAVE PULLED THE FAILED AVIONIC BUS CB. (YOU MAY BLOW THE EMERGENCY BUS FUSE)

1. FAILED AVIONIC BUS CB .... PULL
2. AVIONIC MASTER SWITCH .... CHECK ON
3. EMER AVIONIC SWITCH .... ON
4. FUNCTIONING AVIONIC BUS CB .... PULL

NOTE

With the EMER AVIONIC switch ON, the avionic bus 1 is supplied direct from the battery RCCB and Avionic Bus 2 is supplied direct from the Alternator RCCB.

3.4 Amplified Emergency Procedures

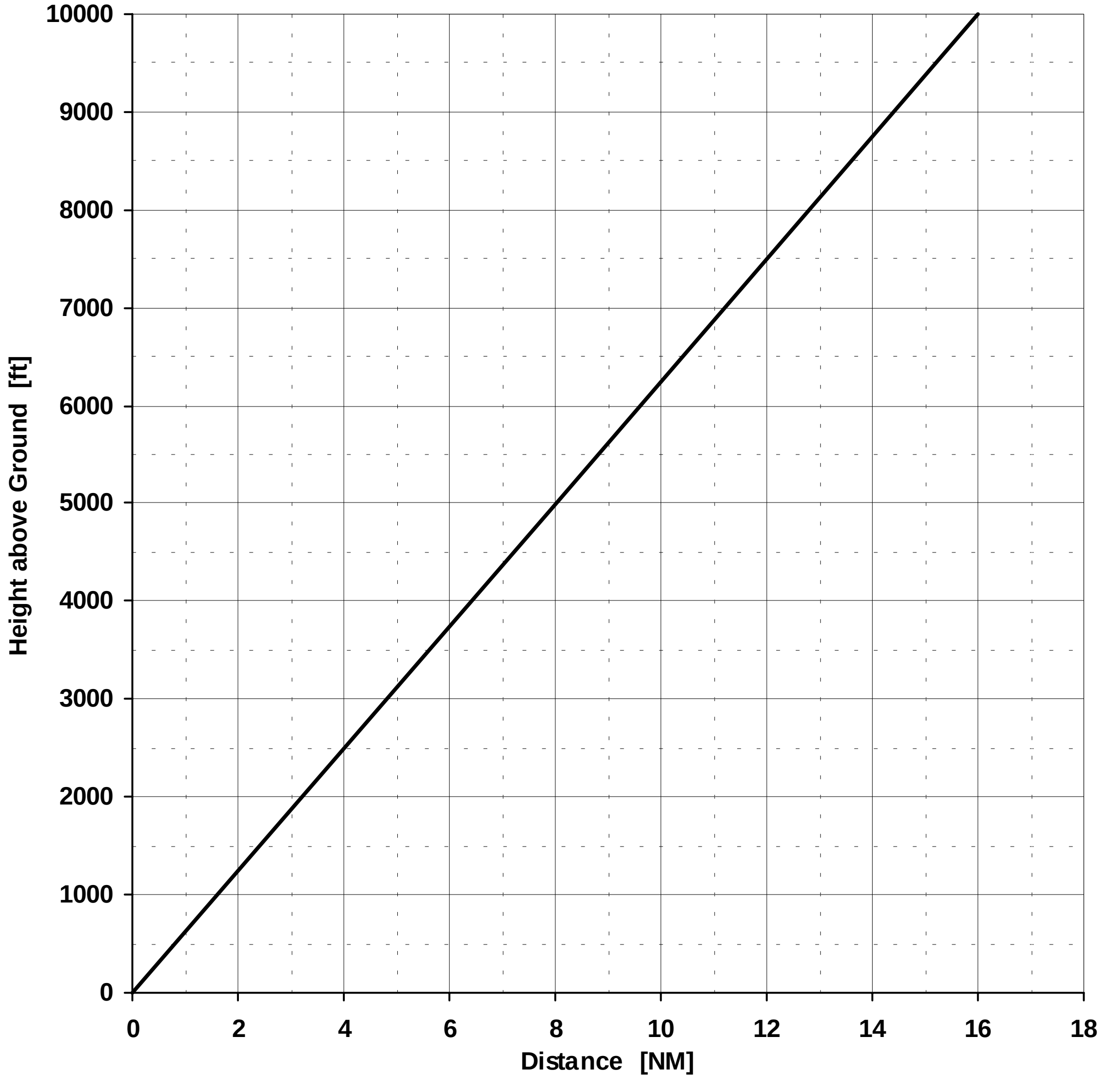
Engine Failures

If engine failure occurs before take off, it is most important to stop the airplane on the remaining runway. The check list procedures enhance safety, should an emergency of this kind occur.

If engine failure occurs after take off, the first requirement is to lower the nose, and because speed may have been lost during recognition of the failure it may be necessary to lower the nose more than expected. It is vital to regain safe glide speed promptly. In most cases proceed to a straight ahead landing with slight and gentle corrections to avoid obstacles. Altitude and speed are rarely sufficient to carry out the necessary 180° turn in glide flight to return to the runway. The check list procedures assume that sufficient time remains to switch off the fuel supply and ignition prior to touchdown.

If engine failure occurs in flight the best glide flight speed (see also Fig. 3.1) must be attained as quickly as possible. During glide approach to a suitable landing location attempt to establish the cause of engine failure. If time permits, attempt to restart the engine with the aid of the check list procedures. Should the engine fail to restart, execute a power off emergency landing. Should the restart be successful and the cause is not identified, further failures are likely and the continuation of the flight should be planned accordingly.

Fig. 3.1 Maximum Glide Distance



	Airplane Mass		Best Glide Speed
Conditions :	[kg]	[lbs]	[KIAS]
- Windmilling Propeller	1490	3285	92
- Flaps up	1440	3175	90
- No Wind	1300	2866	86
	1200	2646	82
	1100	2425	79

Emergency Landing Procedures

Power OFF Landing

If all attempts to restart the engine have failed and an emergency landing is imminent, select a suitable landing location and prepare for landing in accordance with the check list procedures "Power Off Landing".

Power ON Landing

Before attempting to land with engine power outside of an airfield, fly over the most suitable landing area at a safe height, but low enough to be able to inspect the condition of the field and to spot possible obstacles. Proceed in accordance with the check list "Power On Landing".

Ditching

In preparing for ditching strap down heavy objects in the baggage compartment. Transmit "Mayday" on frequency 121.5 MHz announcing position and intended action. Set transponder to 7700. Do not attempt to flare prior to touchdown, since it is difficult to assess the height of the aircraft above water.

Electrical Considerations

During an emergency landing, switch off all systems and equipment not necessary for emergency landing.

Landing Without Elevator Control

The G 120A can be controlled from a descending attitude into a normal landing attitude by use of the elevator trim. This applies to all flap settings; a flap setting of LAND - FULL is preferable. For landings with lost elevator control, it is recommended to choose an airfield with sufficient length. Execute an approach with a RPM setting of approx. 2500 RPM. Control flaring with elevator trim and reduce power to idle shortly prior to touch down or shortly thereafter. This ensures good controllability of the nose-down pitching moment resulting from power reduction. This procedure should be practised beforehand at a safe altitude.

Landing Without Aileron Control

With a malfunction of the ailerons it is possible to initiate and end turns with rudder only. If doing so, speed should not drop below 110 KIAS in a turn and not below 90 KIAS in landing configuration. If the speed drops during turning, increase speed before rolling out of the turn. Roll rate can be increased by setting the throttle to IDLE position. If practicable, avoid flying turns with more than 30° bank. The approach should be conducted with the throttle at IDLE and flaps in “UP” position at a speed of about 100 KIAS. The landing runway selected should be as wide and as long as possible. This procedure should be practised at a safe height before actually attempting to land.

Engine Fire

Although the possibility of an engine fire in flight is extremely remote, proceed in accordance with the check list if the situation occurs and then proceed with an emergency landing. The fire extinguisher will only operate with the fuel tank selector set to OFF. Never attempt to restart the engine under such conditions.

NOTE

In case of an engine fire, do not shut off the fuel selector immediately. In most cases, an engine fire will be identified by a FIRE warning, smoke and strong smell. If the pilot deems, that a greater danger could develop due to engine-shut-down than from an engine fire, he has to decide on when to shut down the engine.

Electrical Fire

The first sign of a fire in the electric system is normally the smell of burning or smouldering insulation. Proceed in accordance with the check list "Electrical Fire in Flight".

Icing

Inadvertent flight into icing conditions.

Flying into icing conditions is generally prohibited. Should this happen inadvertently, proceed according to the checklist and return to the area without icing, change heading and/or altitude to leave the icing area.

Spin Recovery (Unintentional Spin)

Should a spin be entered unintentionally, the following procedure for spin recovery should be initiated:

1. Throttle .... CLOSED
2. Rudder .... FULLY OPPOSITE TO
3. Aileron .... IN SPIN DIRECTION
4. Elevator .... FAST FORWARD TO STOP

If spin does not stop:

4a. Elevator .... PULL BACK TO STOP

4b. Elevator .... PUSH FAST FORWARD TO STOP

5. When spin stops .... CONTROLS NEUTRAL

Recover from dive.

Anticipated altitude loss during spin recovery is 1000 ft.

NOTE

When applying this procedure, even the most critical forms of spin can be brought to an end.

The normal control technique to recover from a normal (intended) spin, is described in chapter 4.6.

Abandoning the Aircraft by Parachute / Canopy Emergency Jettison

The actual jettisoning of the canopy and the subsequent abandonment of the aircraft is initiated by pulling the red locking lever. The canopy handle is pulled and pushed backwards and up through the 90° position until reaching the stop (approx. 170° position). This releases the attachment points on the guide rail. The canopy must now be pushed backwards using some force and at the same time pushed upwards. The safety harness must then be released and the cockpit abandoned.

Rough Engine or Loss of Power

Air Filter Icing

Loss of power can be caused by ice in the air filter.
(monitor the manifold pressure!).

- Select the alternate air and set a suitable mixture.

Fouled Ignition Plugs

Slight engine roughness can be caused by one or more of the ignition plugs being coked or leaded up. Remedy by turning the ignition switch briefly from the "BOTH" position to either "L" or "R". A perceptible drop in power when operating on a single magneto is a sign that an ignition plug or magneto is defective. Since an ignition plug defect is more probable, it is good practice to set the mixture to the lean value as recommended for cruising. Should this not remedy the situation within a few minutes, select a somewhat richer mixture to obtain smoother engine operation. If everything else fails, get expert advice at the nearest airfield and keep the ignition switch in the "BOTH" position, unless exceptional engine roughness necessitates using only a single magneto.

Magneto Failure

Sudden engine roughness or misfiring are usually a sign of a defective magneto. Switching the ignition switch from "BOTH" to either "L" or "R" will indicate which of the two magnetos is not working properly. If this is the case, switch to the good magneto and have repair done at the nearest airfield.

Blocked Fuel-Injection-Nozzle

In case of blocked fuel injection nozzles, as indicated by a rough running engine, enrich the mixture. Also, readjustment of the power setting or selection of partial power may become necessary. Land at the nearest airfield.

Failure of the Propeller Governor

If the propeller governor fails, the propeller moves to a minimum pitch position. This causes an increase in engine RPM and a possible overspeed.

The engine RPM is to be controlled by means of the throttle and doesn’t work as constant speed propeller.

Low Oil Pressure

If low oil pressure occurs in conjunction with normal oil temperature, this is indicating the possibility of the oil gauge or the relief pressure valve being defective. In this case, landing at the nearest airfield is recommended to have the system inspected to find out the cause of the trouble. Should a complete loss of oil pressure occur together with an increase in oil temperature, this is reason enough to suspect an imminent engine failure. Therefore, reduce engine power without delay and search for a suitable landing field for an emergency landing, using only minimum power to attain the field.

Electrical System Failure

Trouble in the electrical system can be noticed by regularly monitoring the ammeter, voltmeter readings and annunciator panel, however, it is normally difficult to find out the exact cause of such disturbances.

Electrical system failures usually fall under two categories:

- excessive charging or
- inadequate charging.

The following sections describe how to remedy both of these problems.

Excessive Charging

Should the ammeter read an excessive charging current, the alternator circuit breaker must be pulled, electrical load reduced to the minimum required and flight terminated as soon as possible.

Alternator Failure

When the red alternator warning light is on, this means that the alternator is not working and the battery is the only electrical power source. In this case, all consuming devices not essential for safe flight operations must be switched off to save the battery. Gear should be lowered in time in accordance with “Emergency Landing Gear Extention” to save the battery. Electrical power must be saved for later operation of the flaps. Terminate flight as soon as possible.

Starter Relay Failure

Should the STRTR warning lamp (starter relay control lamp) remain "ON" after the engine is running, shut-down the engine immediately. Should a starter relay failure occur during flight, Battery and Alternator must be switched OFF and the flight must be terminated as soon as possible.

Electr. Fuel Pump Failure

If no increased fuel pressure visible, this may be an indication of an electrical fuel pump failure. Terminate flight as soon as possible and check for fault.

3.5 Emergency Equipment

Audio System – Loss of Power

Standard Audio System (GMA 340).

A failsafe circuit connects the pilot's headset and microphone directly to COM 1 if the power is interrupted or the unit is turned off.

Emergency Hammer with Harness Cutter

An emergency hammer with harness cutter is installed on the right side of left seat-back which is near at hand for the pilot and which can be pulled out of the holding device, if required.

If it is not possible to open the sliding canopy in an emergency, the glass has to be smashed with the carbide tip of the emergency hammer.

A harness cutter is on the lower end of the emergency tool with which the harness can be cut through, in case harness buckle cannot be opened.

Cabin Fire Extinguisher

A Fire Extinguisher is secured in the aft part of the middle console between the seats. The mounting prevents inadvertent operation but allows removal with one hand. Extinguishant is discharged by removing the safety pin and squeezing the trigger on the operating head.

SECTION 4
NORMAL PROCEDURES

Table of Contents

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SECTION 4 NORMAL PROCEDURES

4.1 General

This section describes the recommended procedures for normal operations of the GROB G 120A from Serial Numbers 85035 to 85052. It presents all of the required procedures. Normal procedures associated with those optional systems and equipment which require handbook supplements are provided in section 9 "Supplements". Pilots should familiarize themselves with the procedures given in this section in order to become proficient in normal operations of the airplane. The first portion of this section consists of a short form checklist which supplies an action sequence for normal operations of the airplane. The remainder of the section is devoted to amplified normal procedures which provide detailed information and explanations of the procedures and how to perform them. This portion of the section is not intended for use as an in-flight reference due to the lengthy explanations. The short form checklist should be used for this purpose.

All data of this section are referred to a flight mass of 1490 kg (3285 lbs) for the utility and 1440 kg (3175 lbs) for the acrobatic airplane unless other masses are stated.

4.2 Airspeeds for Normal Operations

Unless stated otherwise the following airspeeds apply to maximum permissible takeoff and landing weight, but can also be used for a lower weight. To achieve the performance stated in section 5, however, the speed as indicated for the corresponding weight must be selected.

TAKE OFF **KIAS**

- Climb speed under normal takeoff conditions up to 50 ft Flaps T/O 80
- Opt. climb speed Flaps UP 102
- Opt. climb speed Flaps UP at 10000 ft ISA V_Y 90
- Recommended speed for best angle of climb at sea level Flaps T/O 80

LANDING **KIAS**

- Approach speed for normal landing, flaps LDG 80
- Minimum balked landing speed, flaps LDG.. 80
- Maximum demonstrated crosswind at takeoff and landing................................ 25

CRUISE **KIAS**

- Speed limit for operating in turbulent air, V_{NO} 172
- Maximum Manoeuvre speed, V_A acrobatic 165
- Maximum Manoeuvre speed, V_A utility............ 145
- Maximum flaps extended speed, LDG & Full, V_{FE} 114
- Maximum flaps extended speed, T/O, $V_{FE-T/O}$ 150
- Maximum landing gear lowering speed, V_{LO} 136
- Maximum landing gear extended speed, V_{LE} 160

4.3 Approved Manoeuvres

Manoeuvres	Entry Speed [KIAS
Aileron Roll	160
Barrel Roll	170
Half Roll and Pull Through	100
Horizontal Eight	170
Lazy Eight	170
Loop	170
Outside Turn	170
Roll of the Top (Immelmann)	170
Slow Roll	160
Stall Turn	170
Tail Slide	170
Wing Over (Chandelle)	170
Split – S	170
Clover-Leaf	170

NOTE

No other intentional acrobatic manoeuvres are allowed.

WARNING

Do not make full or abrupt control movements above V_A !

WARNING

Do not fly more than ten seconds in the following attitudes: Vertical flight, steep dive; Zero G periods; Wing-down or knife-edge flights.

In these modes the oil system will not scavenge and engine damage can occur. Normally oil pressure will "flicker" from10 to 30 psi when transitioning from upright to inverted flight; however, return immediately to normal attitude anytime oil pressure drops 20 psi below normal.

If inverted oil pressure fails to rise, land aircraft and troubleshoot inverted oil system.

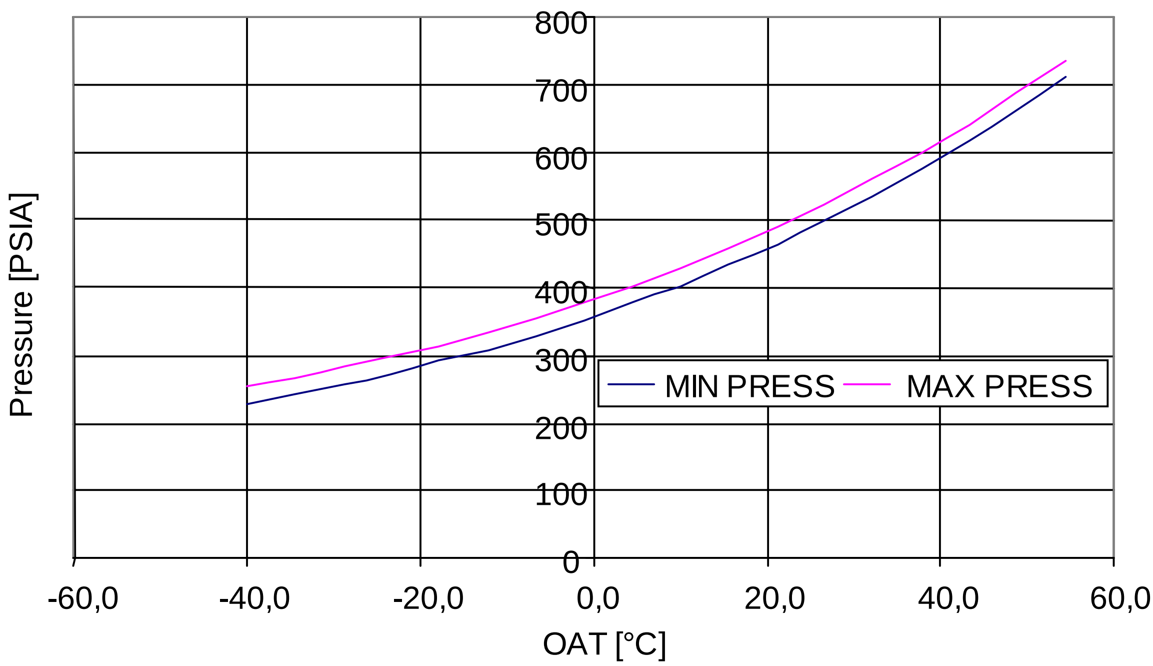


Fig. 4.1 Fire Extinguisher Bottle Pressure vs Temperature

4.4 Normal Procedures Checklist

4.4.1 PREFLIGHT INSPECTION

a) Cockpit

For night operation check required equipment (see chapter 2, Kinds of operation equipment list); functioning flashlight available.

1. Pilots license and aircraft papers .... CHECKED
2. Checklist .... IN COCKPIT

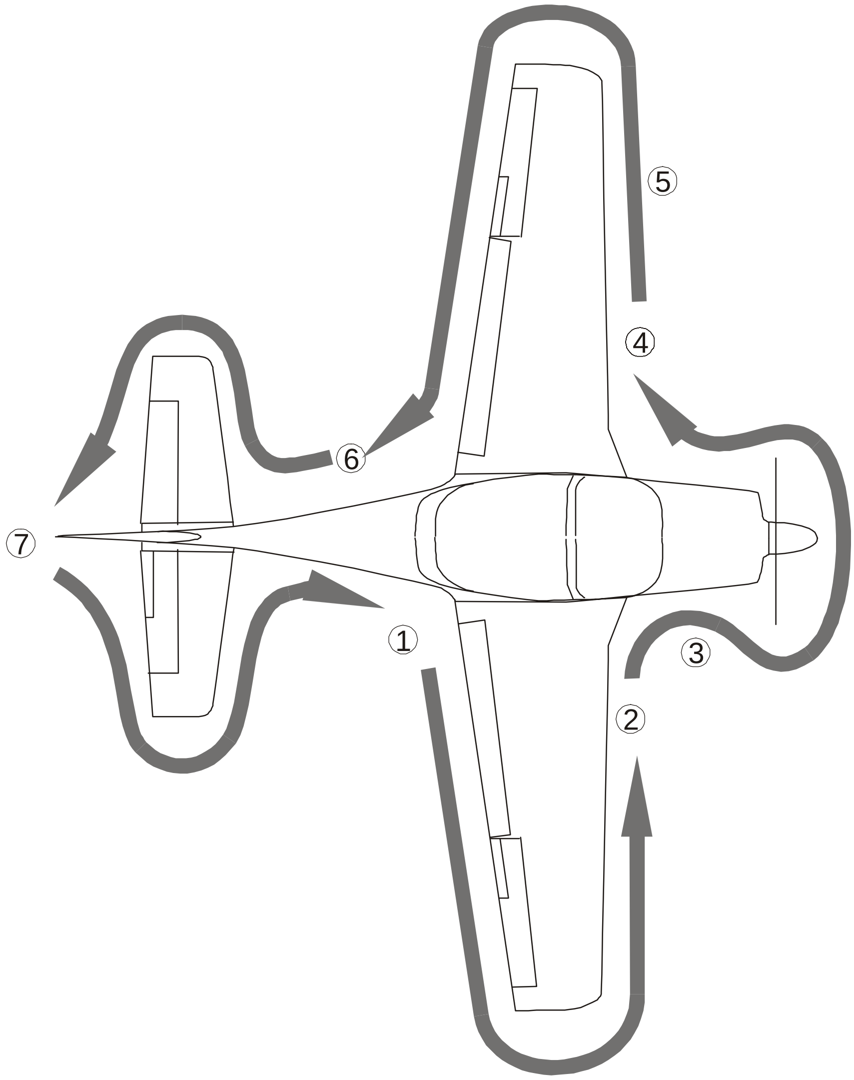
CAUTION

During acrobatic manoeuvres do not take the control locks and the towbar in plane, no baggage allowed!

3. Parking brake .... AS REQUIRED
4. Ignition .... OFF
5. Canopy .... CHECK CLEAN AND UNDAMAGED
6. Circuit breakers .... IN
7. All switches .... OFF
8. Battery .... ON
9. Fuel quantity gauge .... CHECK
10. Battery .... OFF
11. Throttle .... IDLE
12. Mixture .... LEAN
13. Foreign objects .... REMOVE
14. ELT in position .... ARMED
15. Engine fire extinguisher bottle .... PRESSURE CORRECT (see graph)
16. Hydraulic accumulator .... GAUGE IN GREEN RANGE

b) Walk-Around Inspection

Fig. 4.2. Visual Inspection



1 RIGHT WING

1. Check panel for landing gear .... CHECK
2. Flap and hinges .... CHECK
3. Aileron and hinges .... CHECK
4. Tie-down and Control lock .... REMOVE
5. Position light .... CHECK
6. Anti-Collision light .... CHECK
7. Wing tip .... CHECK
8. Wing surface condition .... CHECK
9. Stall warning .... CHECK
10. Fuel filler cap .... CHECK TIGHT
11. Standing water in filler well .... REMOVE
12. Fuel quantity .... CHECK
13. Fuel vent .... CHECK
14. Fuel vent .... DRAIN
15. Fuel tank .... DRAIN (2X)
16. Collector tank .... DRAIN

2 RIGHT MAIN LANDING GEAR

1. Tire, wheel and brake .... VISUAL INSPECTION
2. Wheel chock .... REMOVE
3. Slip mark (red paint) .... VISUAL INSPECTION
4. Tire pressure .... CHECK

3 NOSE SECTION

1. Cowling properly attached .... CHECK
2. Air inlet .... FREE
3. Landing light .... CHECK
4. Propeller .... CHECK CONDITION
5. Spinner .... CHECK FOR CRACKS

6. Nose gear strut .... CHECK STROKE
7. Tire and wheel .... VISUAL INSPECTION
8. Tire pressure .... CHECK
9. Towbar .... REMOVE
10. Oil quantity .... CHECK

4 LEFT MAIN LANDING GEAR

1. Tire, wheel and brake .... VISUAL INSPECTION
2. Slip mark (red paint) .... VISUAL INSPECTION
3. Wheel chock .... REMOVE
4. Tire pressure .... CHECK

5 LEFT WING

1. Fuel vent .... CHECK
2. Fuel vent .... DRAIN
3. Fuel tank .... DRAIN (2X)
4. Fuel quantity .... CHECK
5. Wing surface .... CHECK CONDITION
6. Fuel filler cap .... CHECK TIGHT
7. Standing water in filler well .... REMOVE
8. Pitot tube cap .... REMOVE
9. Pitot-Static tube .... CHECK CLEAN
10. Pitot heat .... CHECK
11. Wing tip .... CHECK
12. Tie-down and Control lock .... REMOVE
13. Position light .... CHECK
14. Anti-Collision light .... CHECK
15. Aileron and hinges .... CHECK
16. Flap and hinges .... CHECK

6 FUSELAGE

1. Damage .... CHECK
2. All antennas .... CHECK

7 EMPENNAGE

1. Fins and control surfaces .... CHECK
2. Mass balances .... CHECK
3. Trim tab .... CHECK
4. Tie down and Control lock .... REMOVE

8 EXTERNAL POWER SUPPLY (Only if required)

1. Battery and Avionic Master switch .... OFF
2. Polarity of power supply plug .... CHECK
3. Power supply .... CONNECT

4.4.2 BEFORE ENGINE START

1. Preflight check .... COMPLETE
2. Baggage compartment, all items safely secured .... CHECKED
3. Fuel and oil levels .... CHECKED
4. Seat belts and harnesses on empty seat .... FASTEN
5. Pedals .... ADJUSTED
6. Seat belts and harnesses .... APPLIED AND FASTENED
7. Canopy closed and locked .... CHECK
8. Parking brake .... SET
9. Primary flight controls .... FREE TO MOVE PROPER DIRECTION

NOTE

In extreme cold weather, it is necessary to preheat the engine!

10. Fuel tank selector .... FULLEST TANK
11. Trim .... NEUTRAL
12. Throttle, RPM, mixture lever .... CHECK FREE MOVEMENT AND TRAVEL
13. Operating levers .... SET FRICTION

14. Avionic master .... OFF
15. EMER Avionic .... OFF / GUARDED

WARNING

Always switch off the avionics master switch during start up for better service life of avionics equipment.

16. Battery .... ON
17. Alternator .... OFF
18. Annunciator Panel .... PRESS TEST BUTTON
ALL LIGHTS ON, AUDIO ON (two cycles)
19. Bus Tie .... MAN
20. Oil press warning lamp (check 3 sec after Batt on) .... CHECK ON
21. Engine instruments .... CHECK
22. Fuel quantity for the planned flight .... ADEQUATE

4.4.3 ENGINE START

1. Mixture lever .... LEAN
2. Throttle .... APPROX. 30%
3. Prop lever .... HIGH
4. Electr. fuel pump .... ON
5. Mixture lever (for approx.: cold engine 5 – 10 sec
warm engine 1 – 2 sec) .... FULL RICH
6. Mixture lever .... LEAN
7. Electr. fuel pump .... OFF (SEE NOTE)

NOTE

To start a warm engine or in high ambient temperatures switch ON the electr. fuel pump just before start to prevent fuel vaporization in the fuel system.

8. Anti-Collision lights .... ON
9. Brake pedals .... PRESSED
10. Propeller area .... CLEAR

11. Ignition .... START
(accord. to starter limitations) and set to “BOTH”, after engine fires
12. Mixture lever .... RICH
13. Throttle .... SET 1000 – 1200 RPM
14. Oil pressure .... CHECK

WARNING

If the oil pressure does not reach 25 PSI (yellow arc) within 30 sec, stop the engine. Do not restart until the cause has been rectified.

WARNING

If the starter warning light remains ON after starter switch is released, switch the Master OFF to prevent a cable fire or starter damage and stop the engine.

15. Electr. fuel pump .... OFF

WARNING

If the engine dies after the electric fuel pump is first switched OFF, a technical defect of the mechanical fuel pump is possible. Do not fly the airplane until the fault has been rectified.

16. Alternator .... ON
17. Alternator warning light .... CHECK “OFF”

NOTE

With a negative ammeter value, “PULL and PUSH” the circuit breaker “ALT FIELD” to “RESET” the alternator, and/or recycle the alternator ("OFF and ON")

CAUTION

If the red alternator warning light remains ON, shut down the engine and have the fault investigated.

18. External power .... DISCONNECTED

4.4.4 ENGINE START WHEN FLOODED

1. Throttle .... FULL OPEN
2. Electr. fuel pump .... OFF
3. Mixture .... LEAN
4. Elevator .... PULL BACK
5. Brake pedals .... PRESS ON

WARNING

Make sure the aircraft is secure and that there are no obstacles in front of it! The engine can develop full power immediately.

6. Engine .... START

NOTE:

Operate the starter (according to the starter limitations, see page 2-17) until the engine is running, then set the mixture lever forwards and pull back the throttle. If necessary, switch on the electr. fuel pump immediately! (precautionionary to avoid formation of vapor bubbles)

4.4.5 AFTER START CHECKS

1. Throttle .... MAX. 1500 RPM
2. Mixture lever .... ADJUST FOR SMOOTH RUNNING
3. Engine instruments .... CHECK
4. Bus Tie .... AUTO
5. Ammeter .... CHECK CHARGING

NOTE:

With a negative ammeter value, “PULL and PUSH” the circuit breaker “ALT FIELD” to “RESET” the alternator, and/or recycle the alternator ("OFF and ON")

6. Avionic master .... ON
7. Annunciator panel .... CHECK
8. Avionic units .... ON
9. Avionic frequencies, volume, test position .... SET / CHECK
10. Flight instruments .... CHECK / ADJUST
11. Electr. horizon .... UNCAGE
12. FLAPS .... FULL CYCLE

4.4.6 TAXI CHECKS

1. Landing light .... AS REQUIRED
2. Taxi light .... AS REQUIRED
3. Taxiing area........................ CHECK
4. Parking brakes........................ RELEASE
5. Brake operation .... CHECK
6. Nose wheel steering ....CHECK USING RUDDER

NOTE

For tight turns during taxiing use the wheel brakes as necessary.

7. Compass .... CHECK
8. Gyroscopic instruments .... CHECK
9. Controls........................ CHECK FOR FULL AND FREE MOVEMENT
10. Fuel supply .... CHECK LH / RH TANK

4.4.7 BEFORE TAKE OFF

1. Parking brake .... SET
2. Oil temperature........................CHECK ABOVE 40ºC (104ºF)
3. Propeller lever ....HIGH RPM
4. Power lever ....SET 2000 RPM
5. Ignition set to R........................ RPM MUST DROP
6. Ignition set to BOTH .... CHECK 2000 RPM
7. Ignition set to L .... RPM MUST DROP
   - Maximum RPM drop ....175 RPM
   - Minimum RPM drop ....50 RPM
   - Maximum RPM drop difference........................50 RPM
8. Ignition set to BOTH .... CHECK 2000 RPM
9. Propeller lever .... CYCLE FULL RANGE
10. Propeller lever ....HIGH RPM
11. Alternate Air........................ ON CHECK RPM DROP 20 to 70 RPM

12. Alternate air knob .... FULLY IN AND LOCKED
13. Throttle* (*may be performed during “take off” check)................................FULL
14. RPM*... 2550-2680 CHECK
15. Fuel flow according to placard / AFM* .... CHECK
16. Engine Instruments* .... CHECK
17. Suction .... CHECK
18. Throttle (at min. oil temperature 40ºC (104ºF)) ....SET TO IDLE
CHECK 600 – 700 RPM
19. Throttle .... SET 1000 TO 1500 RPM

CAUTION

During long engine runs on the ground do not run the engine below 1000 RPM. Lean mixture for clean SMOOTH engine running.

During engine runs in excess of 20 minutes reduce the electrical load on the alternator to avoid excessive heat built-up. The following systems should be switched OFF on ground:

- Landing, Taxi light
- Pitot heat
- Aircondition vent low

20. Seat belts ....CHECK FASTEN / TIGHT
21. Canopy...CHECK CLOSED
22. Fuel tank selector ....FULLEST TANK
23. Tank asymmetry...MAX. 25 litres (40 lbs)
24. Elevator trim .... SET TO TAKEOFF
25. HYDR ACCU EMER EXT ....CHECK 1250-2000 psi
26. Mixture lever...ADJUST
27. Flaps .... T/O
28. Electr. fuel pump.. ON
29. Air-conditioning..VENT
30. Ignition.. CHECK BOTH
31. Flight instruments .... CHECK
32. Engine instruments... GREEN ARC
(EXCEPT FOR OIL)

33. Oil temperature (minimum 40ºC (104ºF)) .... CHECK
34. Pitot heat .... AS REQUIRED
35. Annunciator panel .... Only FUEL PUMP ON AND P/S HEAT, IF SELECTED OFF
36. All control surfaces (full and free movement) .... CHECK
37. Parking brake .... RELEASE

NOTE

If one wheel brake binds apply and release the parking brake again.

4.4.8 TAKE OFF

1. Brakes .... HOLD
2. Landing/Taxiing Light .... AS REQUIRED
3. Throttle* (*may be performed during “before take off” check) .... FULL
4. RPM* .... 2550 – 2680 CHECK
5. Fuel flow according to placard / AFM* .... CHECK
6. Engine Instruments* .... CHECK
7. Brakes .... RELEASE
8. Rotation .... 65 KIAS

NOTE

For better take-off and climb performance the aircondition can be switched OFF.

4.4.9 AFTER TAKE OFF

1. Climb speed with take-off flaps at 50 ft. GND .... 80 KIAS
2. Landing gear .... UP
3. Flaps (>150 ft. GND and 87 KIAS) .... UP
4. Climb speed with flaps UP .... 100 KIAS
5. Electr. fuel pump (above safe height) .... OFF
6. Air-conditioning .... AS REQUIRED
7. Landing/Taxiing light .... OFF OR AS REQUIRED
8. Transponder .... AS REQUIRED

4.4.10 CLIMB

1. Climb power .... SET
2. Mixture .... ADJUST
3. Engine instruments .... CHECK

NOTE

Check the cylinderhead temperature. In the case of too high temperature, increase airspeed and/or fuel flow.

4. Airspeed .... 102 KIAS, SEE SECTION 5
5. Altimeter setting .... CHECK

4.4.11 CRUISE

1. RPM .... 1800 – 2700 RPM
2. Power .... 45% – 100%

NOTE

Do not exceed the max. cont. manifold pressure - limit (see placard).

3. Mixture setting according to engine power .... ADJUST
4. Trim .... SET

4.4.12 PERIODIC CHECKS DURING CRUISE

F	FUEL	Check quantity and balance using cockpit gauges, fuel flow meter
E	ELECTRIC	Check volts in green, amps near zero and Annunciator panel clear
E	ENGINE	Check instruments for normal readings
L	LOCATION	Check using visual, VOR and GPS, Note vector to nearest airfield

4.4.13 DESCENT

1. Altimeter .... SET
2. Power setting (avoid idle for long periods) .... AS REQUIRED
3. Mixture .... ADJUST
4. Fuel tank selector .... AS REQUIRED

4.4.14 BEFORE LANDING

1. Seat belts and harnesses .... FASTEN TIGHT
2. Electr. fuel pump .... ON
3. Air-conditioning .... VENT
4. Propeller .... HIGH
5. Mixture setting for go around .... SET
6. Landing & Taxiing light .... ON
7. Landing gear .... DN AND LOCKED
8. Flaps .... AS REQUIRED

WARNING

Maximum speed with Flaps extended: 114 KIAS

9. Recommended speed on final approach (flaps LDG) .... 80 KIAS

WARNING

In strong crosswinds, gusty conditions or in strong turbulence, as well as in rain or icing conditions, increase the approach speed.

4.4.15 GO AROUND

1. Propeller .... HIGH RPM
2. Throttle .... FULL
3. Mixture setting .... CHECK
4. Flaps retract to TAKE OFF .... CHECKED
5. Climb speed with take-off flaps .... 87 KIAS
6. Landing gear .... UP
7. Flaps .... UP
8. Climb speed with flaps UP (above 150 ft. GND) .... 102 KIAS
9. Electr. fuel pump (above safe height) .... OFF
10. Air-conditioning .... AS REQUIRED
11. Landing/Taxiing light .... AS REQUIRED

4.4.16 NORMAL LANDING

1. Flaps .... LAND
2. Landing gear .... CHECK DN AND LOCKED
3. Threshold airspeed .... 70 KIAS
4. Touchdown .... 65 KIAS
5. Nose wheel .... LOWER GENTLY
6. Brake .... AS REQUIRED

4.4.17 AFTER LANDING

1. Flaps .... UP
2. Electrical fuel pump .... OFF
3. Pitot heat .... OFF
4. Landing/Taxiing light .... OFF
5. Transponder .... STANDBY
6. Air condition .... VENT LOW

4.4.18 BEFORE LEAVING THE AIRPLANE

1. Parking brake .... AS REQUIRED
2. Air condition .... OFF
3. Avionic equipment .... OFF
4. Avionic master .... OFF
5. Magneto OFF function at 900 RPM .... CHECK
6. Throttle .... 1000 – 1200 RPM
7. Mixture .... LEAN CUT-OFF

When the engine has stopped:

8. All electrical systems .... OFF
9. Ignition .... OFF
10. Battery & Alternator .... OFF
11. Fuel tank selector .... FULLEST TANK
12. Trim .... SET FOR T/O
13. Electr. Horizon .... CAGE

4.4.19 PARKING

1. Wheel chocks .... POSITION
2. Parking brake .... RELEASE
3. Tie-downs (if required) .... INSTALL
4. Control locks .... INSTALL
5. Pitot tube cover .... INSTALL
6. Canopy .... CLOSED

4.5 Flight Characteristics

a) General

The stability and control characteristics of the aircraft are satisfactory on the ground and throughout the approved flight envelope.

b) Ground Handling

Taxi speed is controlled easily by power and wheel brakes. On level ground with no wind a little more than idle power may be required to start taxi. Once rolling on a smooth level surface the aircraft will accelerate slowly to approximately 20 KIAS.

When taxiing downhill or downwind use the brakes to control speed. Achieve directional control by using rudder which is connected to the Nose-Wheel Steering (NWS) and/or the brakes. Normally, use rudder/NWS for taxi with only minimal use of brakes. To turn tightly, use full rudder and brake to achieve the required turn radius. If the pilot uses full rudder, moderate brake and power, the aircraft has a small turn radius, but increased tire wear may occur, especially if the inner wheel is not rotating.

c) Take-Off

With no crosswind it is possible to hold the aircraft on the brakes when selecting full power. During crosswind take-offs exercise care when selecting high power settings while holding the wheelbrakes on. The rudder is effective in the slipstream from zero ground speed and the nosewheel steering is positive in keeping directional control. The aircraft accelerates to rotation speed with a slight tendency to yaw to the left.

For take-offs on grass reduce load on nose wheel as early as possible. At rotation speed of 65 KIAS (1440 kg (3175 lbs)) a slight elevator deflection will result in a gentle lift off. Select a nose-up pitch attitude of approx. 5 degree for acceleration to 80 for initial climb. Select landing gear and flaps to UP at about 150 ft. above ground and 90 KIAS. Maintain attitude and retrim during acceleration to climb speed 102 KIAS.

d) Flight Controls

In 1g flight the elevator force is light and gives precise pitch control throughout the speed range. Stick forces increase with increasing airspeed and g force.

The ailerons are light and produce good response throughout the flight envelope.

A single-handed full aileron deflection is easily possible up to the manoeuvre speed (V_A) of 160 KIAS.

The rudder is powerful at normal flying speeds and gives effective yaw control at high power and low airspeed. At high speeds the rudder can generate very high side forces which could cause an airframe overstress. For this reason do not apply full rudder above 160 KIAS.

e) Flaps

When the flaps move from UP to TAKE-OFF there is a moderate lift increase and a small increase in drag. From TAKE-OFF flap to LAND there is a minor increase in lift and a noticeable increase in drag. At FULL flap there is a large increase in drag, especially at flap limit speed V_{FE}. FULL flap also produces light to moderate airframe buffet. Retracting the flaps gives the reverse effects.

f) Engine Power Changes

Selection of high power without using corrective rudder results in left yaw and sideslip but no roll. Selecting full throttle from idle gives a noticeable nose up pitch moment, a power reduction gives a pitch down moment. The engine accelerates rapidly and closely follows throttle movement. In order to maintain balanced flight throughout the range of engine acceleration anticipate the rate of engine power change. At low airspeeds, typically in the speed range used for landing, operating the engine with the propeller lever forward will result in a net drag force from the propeller at low power. Operating the throttle slowly for smooth changes results in optimum engine response.

Power increase = stick push and right rudder

Power decrease = left rudder and slight back pressure

g) Climbing

Optimum climb performance is attained with flaps UP at 102 KIAS.

h) Speed Changes

Pitch attitude for level flight varies as the airspeed changes. At high cruise speeds the pitch attitude is approx. 0 degrees, while near the stall the attitude is approximately 15 degrees nose up. The major pitch change happens below 90 KIAS.

In level and climbing flight at low IAS use right rudder to keep straight and to counteract the rotating slipstream behind the propeller which acts on the tail surfaces. If the a/c is accelerated following climb, progressively less rudder input is required to keep the slipball centered (left foot forward). For speed reduction with constant power setting the reverse effect occurs (right foot forward).

j) Fuel Asymmetry

The maximum allowable fuel asymmetry is a total of 25 litres (40 lbs).

k) Manoeuvre Flight

The aircraft is cleared for various positive and negativee g aerobatic manoeuvres. Sufficient power is available for all aerobatics up to 12000 feet altitude.

NOTE

If control of the aircraft is lost during manoeuvre, select idle throttle, center and hold the controls firmly until controlled flight is restored.

l) Dives

As airspeed increases control forces in all three axes increase. The ailerons remain effective but need heavier forces to produce the same deflection as at normal cruise speeds. The rudder remains powerful with only small amounts necessary to keep the slip ball centered. Keep the slip ball centered during accelerations to high speed. Abrupt or excessive elevator movements at high speed can result in excessive load factors on the airframe.

m) Stalling

General

In level flight the aircraft behaviour up to the stall is normal, with control forces becoming lighter, and pitch attitude increasing. Stall warning occurs at 5 to 10 KIAS above stalling speed, with the onset of light pre-stall buffet at 5 KIAS above the stall. Pitch attitude in a power-on stall can be very nose-high. Any slight rolling instability close to the stall with flaps UP can easily be controlled with aileron and/or rudder. The 1g aerodynamic stall has the following characteristics:

1. nose pitches down gently by 5 to 10 degrees,
2. airspeed ‘jumps’ by one or two knots,
3. buffet increases to a moderate level,
4. there is a noticeable increase in the sink rate,

Refer to Section 5 Fig 5.3 for stalling speed at different weights and configurations.

Approach to stall with flaps extended is similar to the clean stall but at a lower airspeed, a slightly more nose down attitude and some airframe buffet.

The airframe buffeting close to stall with flaps FULL tends to hide the onset of pre-stall aerodynamic buffeting.

During stall a forward movement of the control column produces an immediate recovery with the aircraft automatically pitching nose down and reducing to a safe angle of attack.

Applying power to recover from the 1g stall will result in yawing to the left and a nose up pitch. The controls should be applied coordinated with power, right rudder and forward stick pressure to maintain straight flight.

The 1g Stall Symptoms

Symptoms during approach to a 1g stall are summarized:

- Below 60 KIAS the aircraft becomes less responsive to control inputs, although positive control is available until stall-onset, nose-high attitude;
- Audio stall warning at 5 to 10 KIAS above stalling speed;
- Airframe and elevator buffeting starts 5 KIAS above stalling speed and intensifies as the stall develops.

The Stall can be identified by:

- Slight nose down pitch,
- Airframe buffeting,
- High rate of descent.

Stall Recovery

The recovery procedure is in the following order:

1. Reduce angle of attack, control column forward, then
2. reduce any yaw (keep slip ball centered), then
3. apply full power (counteract the nose up pitch)

When wings are unstalled:

4. Level wings with aileron and rudder,
5. recover from dive into a climbing attitude, and then
6. clean-up the aircraft when visually climbing or indicated on altimeter and VSI

NOTE

Loss of altitude during 1g stall recovery can reach up to approx. 300 ft.

Recover from dive using minimum height loss technique. Achieve this by raising nose to the pre-stall attitude with full power, avoid secondary stall. Control pitch-up caused by power increase, otherwise the aircraft may stall again.

Turning flight Stalls

Turning flight stalls do not differ in general from wings level stalls. With rudder neutral the aircraft has the tendency to decrease roll angle during stall. However, a rudder deflection during stall can result in a wing drop at stall. Direction and intensity of wing drop are depending on direction and magnitude of rudder deflection. This is the initial stage of auto rotation and can lead into a full spin if not recovered promptly. Stall recovery is as described above.

Stalling with High Engine Power

With high engine power, stalling speeds are lower and nose attitude is higher. If the ball is accurately centered at stall initiation, then there is only a slight tendency for a wing-drop. The high energy airflow over the stabilizer and elevator allows an immediate recovery from stall when moving the control column forward.

Dynamic stalls

At high angles of attack large aileron deflections can result in a reversal of the intended direction of roll. This is due to the local flow separation on the wing in the area of the downwards deflected aileron.

- At high angles of attack, use aileron and rudder coordinated and smoothly.

It is recommended to practice such manoeuvres during type training at a safe altitude (minimum about 4000 ft. GND).

4.6 Spinning

a) General

The aircraft is extremely reluctant to enter an unintentional spin. However, intentional erect and inverted spinning is permitted at all weights up to a maximum of 1440 kg (3175 lbs). If spinning is planned, make sure that there is no load in the baggage compartment and all loose items are secured, with trim set to neutral and with a maximum fuel asymmetry of 25 litres (40 lbs).

- Intentional spinning with extended flaps is PROHIBITED.
- Limit the entry speed for dynamic spins to 100 KIAS to prevent an airframe overstress.

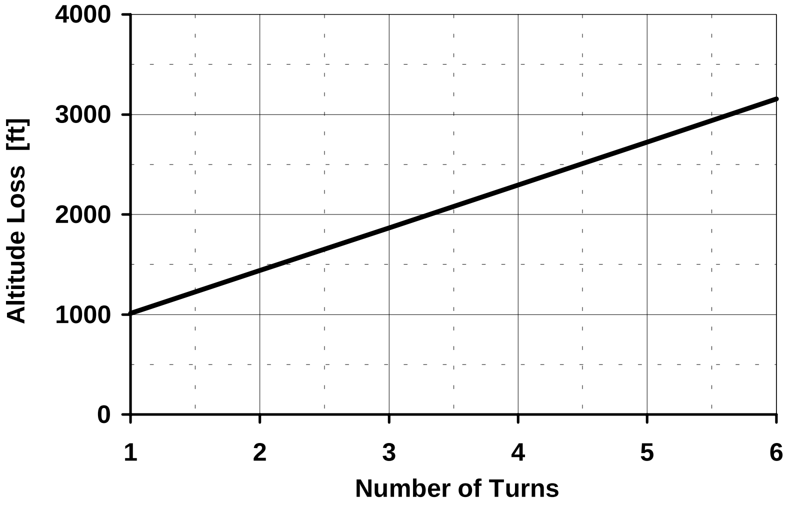
b) Erect Spinning

At 65 to 75 KIAS, throttle at idle, smoothly apply full rudder in the desired direction of spin and simultanously move control column fully back with ailerons neutral; hold aileron and elevator in this position. The spin normally takes two or three turns to become stable. Time for one turn is about 3 seconds. During the spin airspeed indication will fluctuate; the actual airspeed will be different from the indicated value due to pressure errors. The stall warning sounds throughout the spin. If the elevator is moved forward during spin, the spin rate will increase.

Incipient Recovery

The first turn of the spin is the incipient stage and moving the controls smoothly to the neutral positions during this stage will normally result in a recovery in less than half a turn. However, if the spin continues, use spin recovery procedure as described. Other spin entry procedures prolong the incipient stage.

Figure 4.3 - Altitude Loss during Spinning



Conditions: - Density Alt. 8000 ft.

- Not including recovery
- “Normal” Spin: full rudder, elevator full aft, aileron neutral
- add 1000 up to 2000 ft height for recovery

Normal spin recovery / Erect Spin

The aircraft recovers within one turn and a half after taking the following recovery actions. For altitude loss see Fig. 4.3.

1. Identify direction of spin .... TURN INDICATOR OR VISUAL
2. Throttle ....CLOSED
3. Rudder ....FULLY OPPOSITE TO SPIN DIRECTION
4. Aileron .... IN SPIN DIRECTION
5. Elevator ....FAST FORWARD TO STOP

If spin does not stop:

5a. Elevator .... PULL BACK TO STOP

- keep rudder opposite to spin direction, aileron in spin direction and hold the full pulled stick for 2 sec

5b. Elevator ....PUSH FAST FORWARD TO STOP

6. When spin stops .... CONTROLS NEUTRAL

Recover from dive.

c) Normal inverted spinning and recovery

The aircraft is cleared for inverted spinning. Recovery actions are basically the same procedure as for the erect spin.

Entry

1. Entry speed .... 100 – 120 KIAS
2. Throttle .... IDLE
3. Elevators .... FULLY FORWARD
4. Rudder .... FULL DEFLECTED
5. Ailerons .... NEUTRAL OR ‘AGAINST’ THE RUDDER

While in the inverted spin, keep rudder full deflected and stick in position.

Recovery

1. Throttle .... CLOSED
2. Rudder .... FULLY OPPOSITE TO SPIN DIRECTION
3. Pause
4. Elevator .... SLOWLY RELEASE
5. Aileron .... NEUTRAL
6. Rudder when spin stops .... NEUTRAL

Recover from dive.

When spin stops regain normal flight attitude.

NOTE

Start recovery in case of appearance of spiral characteristic.

Time for one spin is about 2 seconds. Any stick position not fully forward will increase the spin rate. Recovery is prompt. The pilot should be prepared for high „g“-load and expect a black-out during recovery.

4.7 Acrobatics

The airplane is approved for acrobatic manoeuvres, provided it is loaded within the approved weight and center of gravity limits (see Section 2 - Limitations).

The approved manoeuvres are:

Aileron Roll, Barrel Roll, Half Roll and Pull Through, Horizontal Eight, Lazy Eight, Loop, Outside Turn, Immelmann, Slow Roll, Hammerhead or Stall Turn, Tail Slide, Chandelle, Split-S, Clover Leaf and inverted flights.

NOTE

Inverted flight under full power with full collector-tank is possible for a maximum of 2 min.

For all manoeuvres, unless otherwise stated, the recommended engine power is from 2400 to 2700 RPM with full throttle. The mixture should be set to „best power mix“.

NOTE

Above V_A do not use full or rapid control deflections. Above 110 KIAS do not apply full rudder and elevator in combination.

The following manoeuvres may not be flown for more than 10 seconds:

- Vertical flights or steep dives
- Inverted steep dives
- Zero g Flight

During these manoeuvres the oil system will not scavenge correctly and engine damage can result. Normally the oil pressure flickers between 10 and 30 PSI when changing from normal flight to inverted flight. However, if the oil pressure should fall 20 PSI below normal value, immediately revert to normal flight. If the oil pressure does come back to normal (green arc) when in normal flight, land the airplane and have the inverted flight oil system examined.

a) Pre-Acrobatic Checks

1. Fuel tank selector .... FULLEST TANK
2. Fuel asymmetry .... MAX. 25 litres (40 lbs)
3. Fuel warning light .... OFF
4. Electr. fuel pump .... OFF
5. Landing gear .... UP
6. Flaps .... UP

7. Seat belts on empty seat .... FASTENED
8. Seat belts .... TIGHT AND LOCKED
9. Canopy .... CLOSED AND LOCKED
10. Loose articles .... STOWED
11. Baggage .... NO BAGGAGE
12. Annunciator panel .... NO WARNINGS
13. Height above ground .... SUFFICIENT

NOTE

If any WARNING or CAUTION (except stall WARNING) comes on during acrobatic manoeuvres, terminate manoeuvres immediately and resolve the problem.

b) High Angles of Attack

The airplane flies comfortably at high angles of attack. The symptoms of the stall are distinctly noticeable and a normal recovery can be flown easily before the full stall occurs. A 1g stalled flight condition is indicated by an audio warning message and a warning light on the Annunciator panel, which are activated if the speed is within 10 to 5 KIAS of the 1g stall speed. This is also associated with light airframe buffet which becomes moderate at the stall. The height loss in a full stall with immediate recovery can be up to 300 ft near sea level. With increasing altitude the height loss becomes greater.

c) Loop (positive G)

Recommended Entry Speed: 170 KIAS

G forces: approx. + 4g

A loop is when the aircraft is pitched up from straight and level attitude through 360 degrees of pitch, keeping the wings level throughout the manoeuvre.

The aircraft will loop from entry speeds between 140 and 230 KIAS. Use full throttle and the RPM between 2400 to 2700. The initial pull should be at 4g, reducing to match the light buffet as the speed reduces over the top of the loop.

d) Hammerhead or Stall Turn

Recommended Entry Speed: 170 KIAS

G forces: approx. + 5g

Entry and recovery position: Vertical

The stall turn is where the aircraft changes direction by 180 degrees after pointing vertically upwards and then vertically downwards. Rotation from straight up to straight down is accomplished by yawing the aircraft through 180 degrees when it is below the normal 1g flying speed.

NOTE

Normally, only attempt stall turns to the left, due to the beneficial effect of the slipstream in yawing the aircraft. Stall turns to the right are difficult to accomplish accurately.

The normal entry is from straight and level flight, 170 KIAS, use full throttle and 2400 to 2700 RPM. After pulling into the vertical, maintain the vertical attitude. As control effectiveness starts to reduce (below 65 KIAS) smoothly apply enough rudder to yaw the aircraft positively, then using full rudder to keep the yaw rate constant until just before the downwards vertical. Push the elevator as necessary to compensate for the gyroscopic forces on the airplane. Use aileron as required to stop the aircraft rolling away from the wings vertical position. Close throttle about half way through rotation, when the nose passes through the horizon, or earlier if the aircraft 'hangs'.

e) Immelmann

Recommended Entry Speed: 170 KIAS

G forces approx. + 4g

An Immelmann is half a loop flown to the inverted position and then a half roll to the erect straight and level position. Start the half roll with the nose attitude above normal inverted position, as the speed will be slower than normal.

f) Half Roll and Pull Through

Recommended Entry Speed: 100 KIAS

G forces: approx. + 4g

Enter with a half roll from the normal position to inverted flight. In the inverted position check the speed (it should be not more than 100 KIAS) and then pull through to a normal level flight position.

g) Aileron Roll

Recommended Entry Speed: 160 KIAS

G Forces: approx. + 1,5 to 0g

An aileron roll is when the aircraft rolls through 360 degrees of its longitudinal axis whilst maintaining the same nose attitude. As there is no intentional elevator movement in the manoeuvre, the nose will tend to pitch down when rolling through the inverted position, depending on the rate of roll applied and the aircraft speed. Therefore it is better to start from a slightly climbing attitude until experienced.

The aircraft normally will aileron roll with entry speeds from 100 to 160 KIAS. Before rolling pitch the nose up to about 10 to 20 degrees above the horizon and then deflect the ailerons in the required direction of roll.

h) Slow Roll

Recommended Entry Speed: 160 KIAS

G forces: approx. + 1,5g to -1,5g

A slow roll has a constant and slow roll rate through 360 degrees whilst maintaining straight and level flight. The recommended maximum entry speed is 160 KIAS. As the roll commences the ‘top’ rudder is required to stop the nose yawing downwards. Large rudder deflections are required at the 90 degrees of bank positions. As the bank increases the elevators must be used, first of all to stop the aircraft turning and then when rolling through the inverted to stop the nose pitching down below the horizon. Use a smooth but large push input to keep the aircraft in level inverted flight position; the rudder should be approximately neutral at this position. As the aircraft rolls through the 270 degree point a large ‘top’ rudder input will be required again, together with a reduced push force. Finally, the rudder, elevator and aileron will all need to be coordinated through the manoeuvre, to keep the roll rate constant, until wings level again. This is especially so when varying the rudder deflections. Achieve a climb position of approx. 10°, after that immediately apply aileron and maintain until wings level again.

i) Barrel Roll (Positive and Negative G)

Recommended Entry Speed: 170 KIAS

G forces: approx. + 3g to - 3g

A barrel roll is when the aircraft is rolled and pitched so that the manoeuvre looks like a big spiral in the horizontal from the outside and, from the inside of the cockpit, a big circle drawn with the aircraft’s nose, half above the horizon and half below, ending up with the aircraft on the entry heading.

Attempt to fly the manoeuvre so that the nose of the aircraft is passing through the horizon with the wings inverted having changed heading by 90 degrees. The wings level inverted position is the highest part of the barrel roll. The maximum nose up attitude should be the same as the nose low; this maximum attitude should be when the angles of bank are both at 90 degrees. Throughout the manoeuvre keep the rate of roll and pitch constant. This will require careful coordination of roll and correcting rudder as the speed varies.

Make sure that the airplane has enough of a high nose attitude before starting to roll inverted. If there is a danger of exceeding V_{NE} , close the throttle and use the controls carefully to recover to level flight.

j) Horizontal - Eight

Recommended Entry Speed: 170 KIAS

G forces: approx. + 3,5g

Enter a loop but stop in the 45° inverted dive attitude and immediately apply full aileron. Pay attention to the speed! At completion of this figure the recovery speed is around 160 KIAS. If exceeding the speed for full control deflections, reduce the control deflection and throttle back.

k) Tail Slide

Recommended Entry Speed: 170 KIAS

G forces: approx. +3,5g

Pull the airplane quickly into the vertical and hold the attitude. Close the throttle and hold the controls firmly. Once in the forward dive use full throttle and pull out of the dive.

l) Outside Turn

Recommended Entry Speed: 170 KIAS

G forces: approx. -2g to -3g

During a negativee steep turn the elevator forces are large. Trim should <u>not</u> be used to relieve the stick pressure, so as to maintain the full effectiveness of the elevator.

m) Lazy Eight

Recommended Entry Speed: 170 KIAS

G forces: approx. + 3g

n) Wing Over (Chandelle)

Recommended Entry Speed: 170 KIAS

G forces: approx. + 3g

o) Split-S from 45° Climb Position

Recommended Entry Speed: 170 KIAS

G forces: approx. + 4g

Pull the airplane into a 45° climb, after that immediately apply full aileron to the inverted wings level position. Maintain the attitude, this will need a moderate push force, convert the speed to maximum height and then pull through to a normal level flight position.

CAUTION

Ensure there is enough height to pull through from the inverted before pitching down, otherwise roll to a level flight attitude.

p) Clover-leaf

Recommended Entry Speed: 170 KIAS

G forces: approx. + 4g

q) Post-Acrobatic Checks

1. Attitude indicator...CHECK AND ADJUST
2. Other Gyroscopic instruments ....CHECK AND ADJUST

4.8 Normal Landing

During approach, wings level, adjust the airspeed to achieve threshold speed when reaching the runway. When just above the runway, at roundout height, smoothly reduce the throttle to idle and match the speed reduction to a gentle pitching up of the nose to reduce the rate of descent to zero as the main wheels touch the surface.

As soon as the main wheels are on the ground lower the nosewheel to the runway. Nosewheel steering is immediately effective. Aerodynamic braking is not very effective. Apply wheelbrakes gently initially to avoid locking a wheel. It is difficult to detect if a wheel is locked. Increase braking pressure as the ground speed decreases. For optimum braking performance, as the nose pitches down with first braking application, pull back progressively the control column whilst keeping the nose low with increased braking.

4.9 Cross-Wind Landing

Fly the aircraft wings level on the extended center line. Point the nose into wind to establish a track towards the runway. Keep wings level without sideslipping.

When overhead threshold, use rudder to align longitudinal axis with runway centerline. Keep wing on wind-side low to stay on centerline. The aircraft will touch down on the into-wind mainwheel.

Keep the into-wind aileron deflected to hold wing down. The airplane will settle onto both main wheels. In strong crosswinds, use full aileron deflection.

4.10 Maximum Braking Technique

For maximum performance braking or on short runways use the following technique for dry runway conditions:

As soon as the nosewheel is on the runway apply moderate braking for 3 to 4 seconds to establish braking effectiveness. As the brakes „bite“, pull the control column back towards the rear stop. Then pause braking for 2 seconds and push brakes again. Continue the 2 second ‘off’ and 2 second ‘on’ braking cycle until ground speed is as required. Do not apply continuous braking until at slow speed.

The brake cycling technique gives the best deceleration performance without overheating the brake disc. For maximum performance braking with visible water on runway surface, lift flaps and use gentle braking until below the aquaplaning speed. Then use brake cycling technique.

4.11 Mixture Setting

a) General

Leaning of fuel mixture within normal engine limits contributes for longer engine life, better performance at lower fuel consumption. Therefore, remember the following points:

- Adjust mixture in small increments only
- Never exceed the maximum cylinder head temperature of 260ºC (500ºF),
- Recommended cylinder head temperature is 204ºC (400ºF) or below for continuous operation,
- Enrich to stay within the cylinder head temperature limits,
- Perform take-off, climb and cruise at more than 75% of MCP,
- Before take-off, lean mixture to placard fuel flow for actual conditions,
- For take-offs on high altitude airfields and for climbs at greater altitudes (from approx. 5000 ft. density altitude), „FULL RICH“-mixture will result in considerable reduced power. Lean until engine runs smoothly with maximum performance,
- Never use economy mixture settings for power above 75%,
- The higher the flight altitude, the higher the benefit for a well leaned engine.

b) Leaning Procedures

1. Standard procedures with the mixture lever:

(75% power or less without flowmeter or EGT).

- Move the MIXTURE lever slowly from fully ‘RICH“ in the direction of „LEAN“, until the engine gives the first indication of running roughly.
- At this point make the mixture richer until the engine runs smoothly.
- Always monitor the cylinder head temperature.

2. Fuel flow method:

- Move the mixture lever slowly to the „fuel flow set point“ (see table and cockpit placard for maximum power, for other settings see section 5).
- The climb fuel flow figures are based on cooling climbs with sufficient cylinder cooling to give smooth running and economical fuel consumption.
- Always monitor the cylinder head temperature.

A smoothly running engine is more important than the fuel flow indication.

3. EGT method:

- Above 75% power - Never lean beyond 83ºC on the rich side of peak EGT (Best power mix).
- 75% power and below - Operate at peak EGT (endurance), however, power setting less than 65% are recommended.
- Always monitor the cylinder head temperature.

A smoothly running engine is more important than the EGT indication.

SECTION 5 PERFORMANCE

Table of Contents

SECTION 5 PERFORMANCE

5.1 General

The performance charts on the following pages are presented in a way that indicates the performance you can expect from the aircraft under defined conditions.

The stated performances can be expected if the correct handling procedures are followed, the aircraft is in average normal condition, and the listed conditions are available.

Cruising fuel consumption is based on the recommended lean mixture setting. Variables such as incorrect mixture setting, condition of the engine and propeller as well as turbulence and rain will affect the rate of climb and range achieved. Therefore it is important to consider all available information when calculating fuel required for a flight.

5.2 Using the Performance Tables and Charts

The performance data is presented in form of tables and graphs which consider the effect of each defined variable. Performance data is of sufficient detail to prepare flights under the listed conditions.

As first step of flight preparation, it is important to that the weight and centre of gravity is within limits. Refer to Section 6.7 for details.

For conversion from pressure in inHg to hPa and vice versa use the following table:

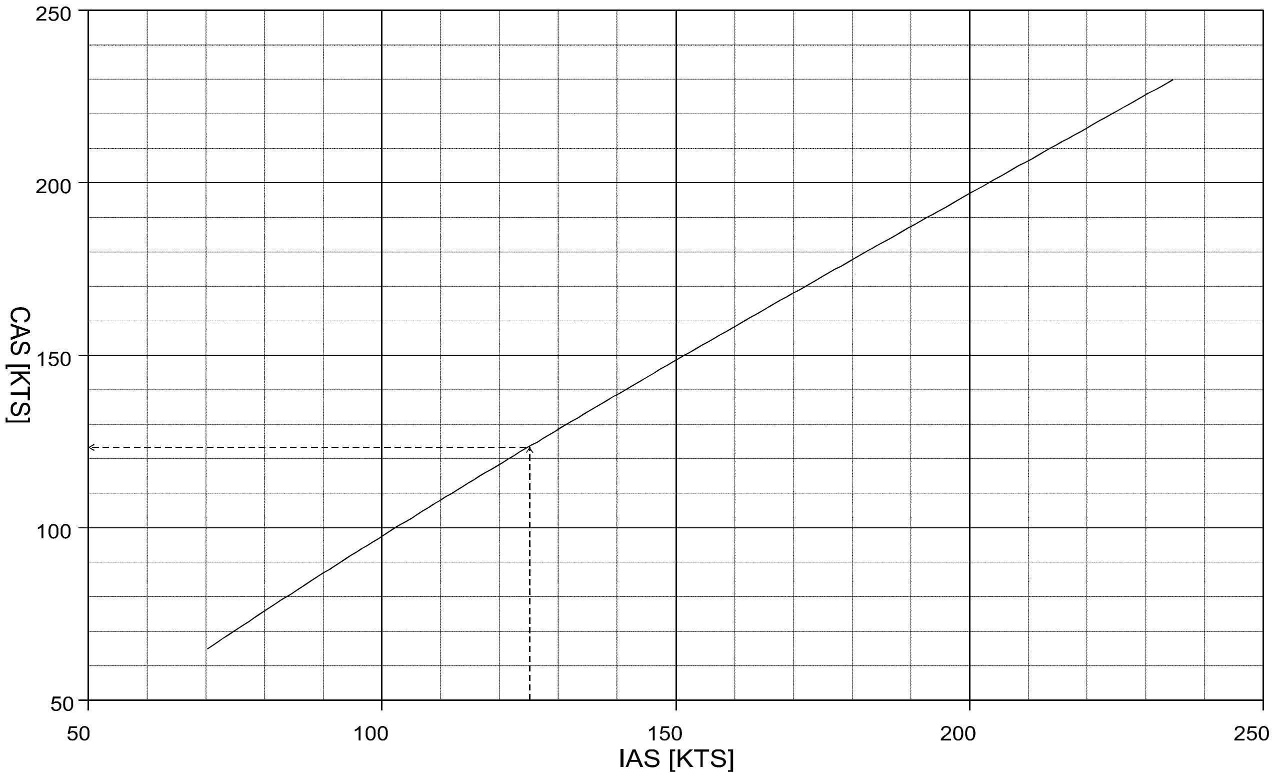
inHG	hPa	inHG	hPa	inHG	hPa
29,00	982	29,59	1002	30,18	1022
29,06	984	29,65	1004	30,24	1024
29,12	986	29,71	1006	30,30	1026
29,18	988	29,77	1008	30,36	1028
29,24	990	29,83	1010	30,42	1030
29,30	992	29,89	1012	30,48	1032
29,35	994	29,95	1014	30,54	1034
29,41	996	30,00	1016	30,60	1036
29,47	998	30,06	1018	30,65	1038
29,53	1000	30,12	1020		

Fig. 5.1 AIRSPEED CORRECTION

NORMAL Static Source

a) Airspeed Correction - Flaps Up

Conditions : Instrument Error "0"

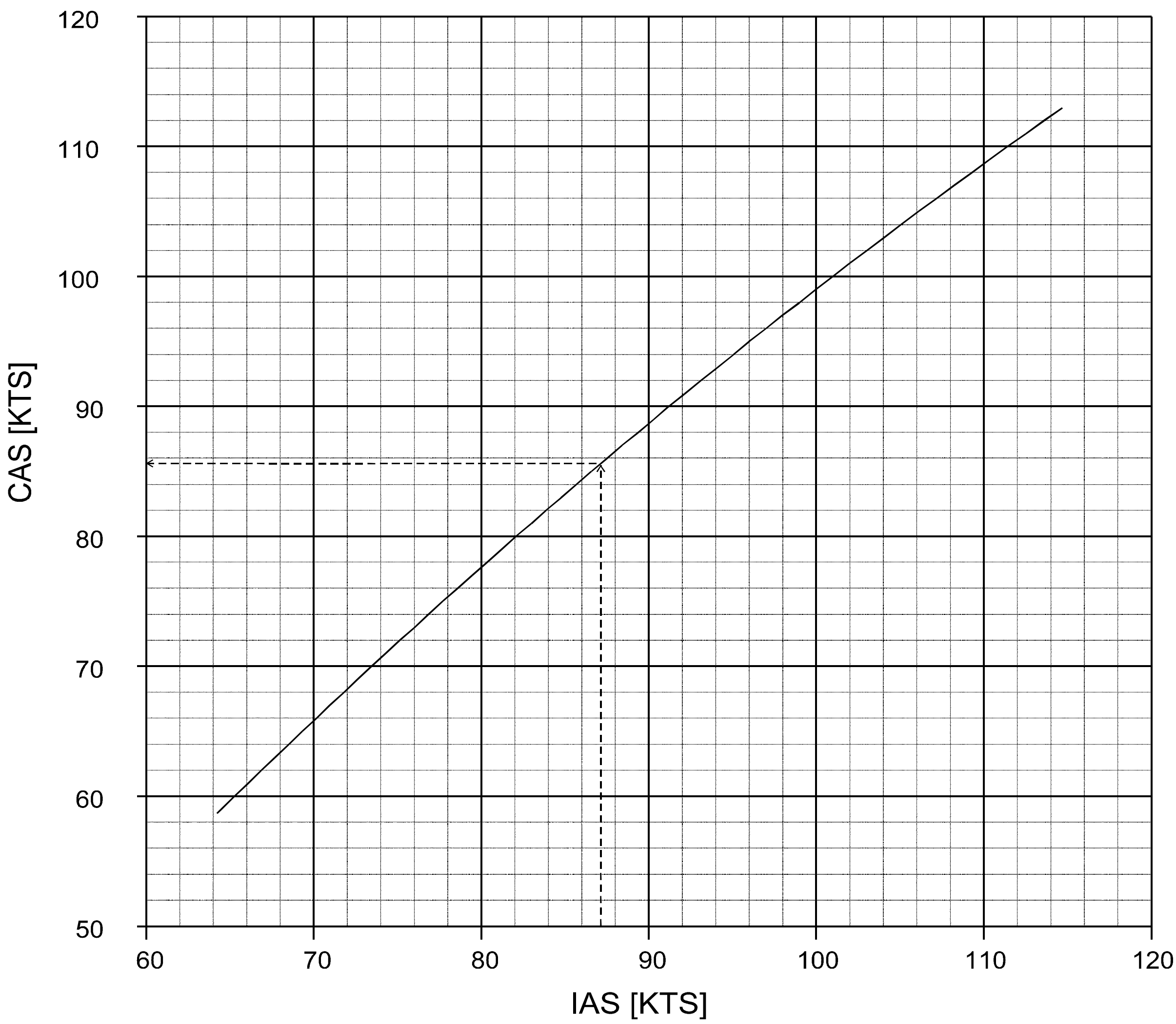


Example:

1. Find your indicated airspeed e.g. 125 kts on the horizontal axis.
2. Follow the vertical line up until it cuts the curve.
3. From this point follow the horizontal line to read the CAS (123 kts) on the vertical axis

b) Airspeed Correction - Flaps TAKE OFF

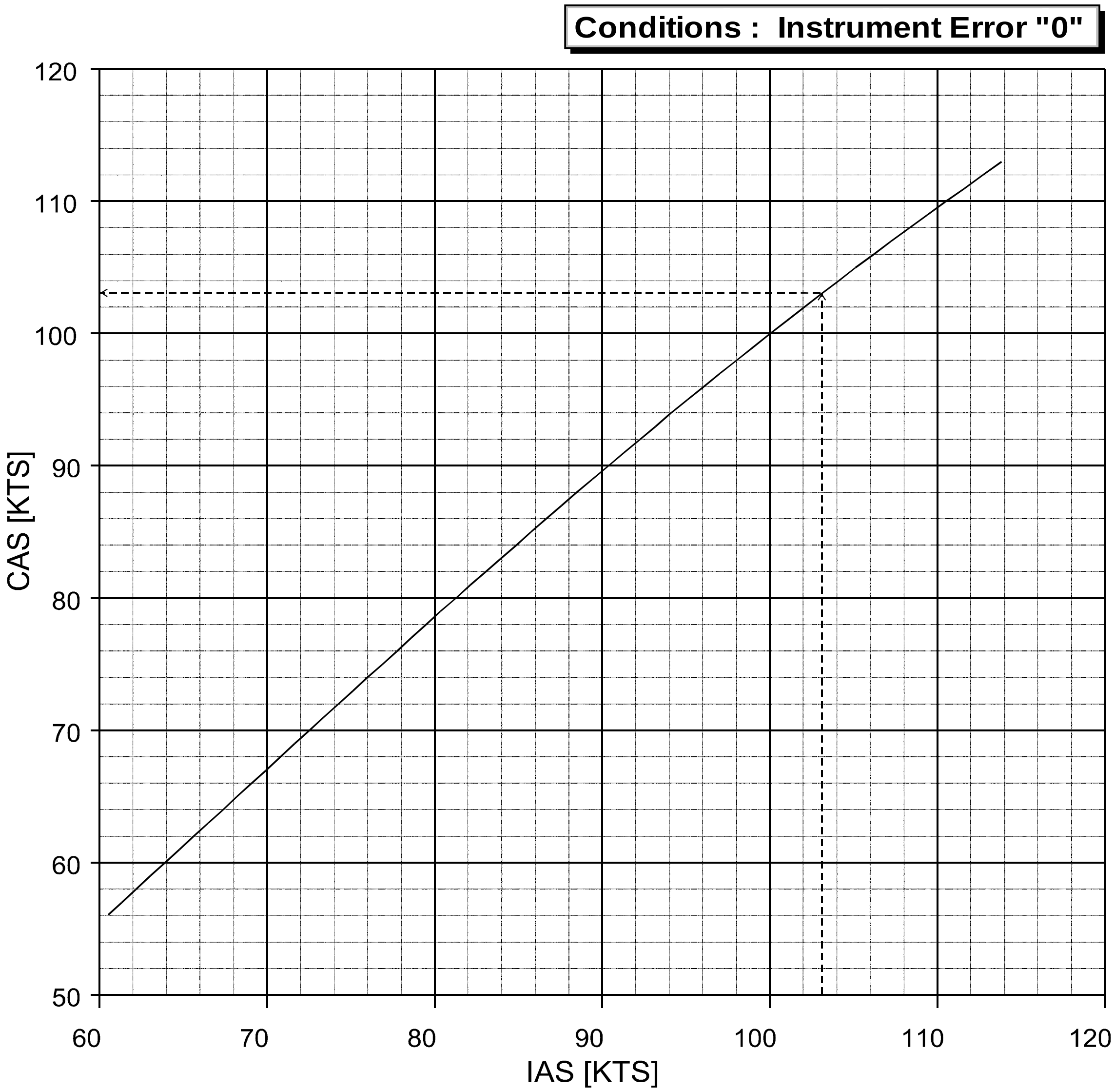
Conditions : Instrument Error "0"



Example:

1. Find your indicated airspeed e.g. 87 kts on the horizontal axis.
2. Follow the vertical line up until it cuts the curve.
3. From this point follow the horizontal line to read the CAS (just under 86 kts) on the vertical axis

c) Airspeed Correction - Flaps LAND

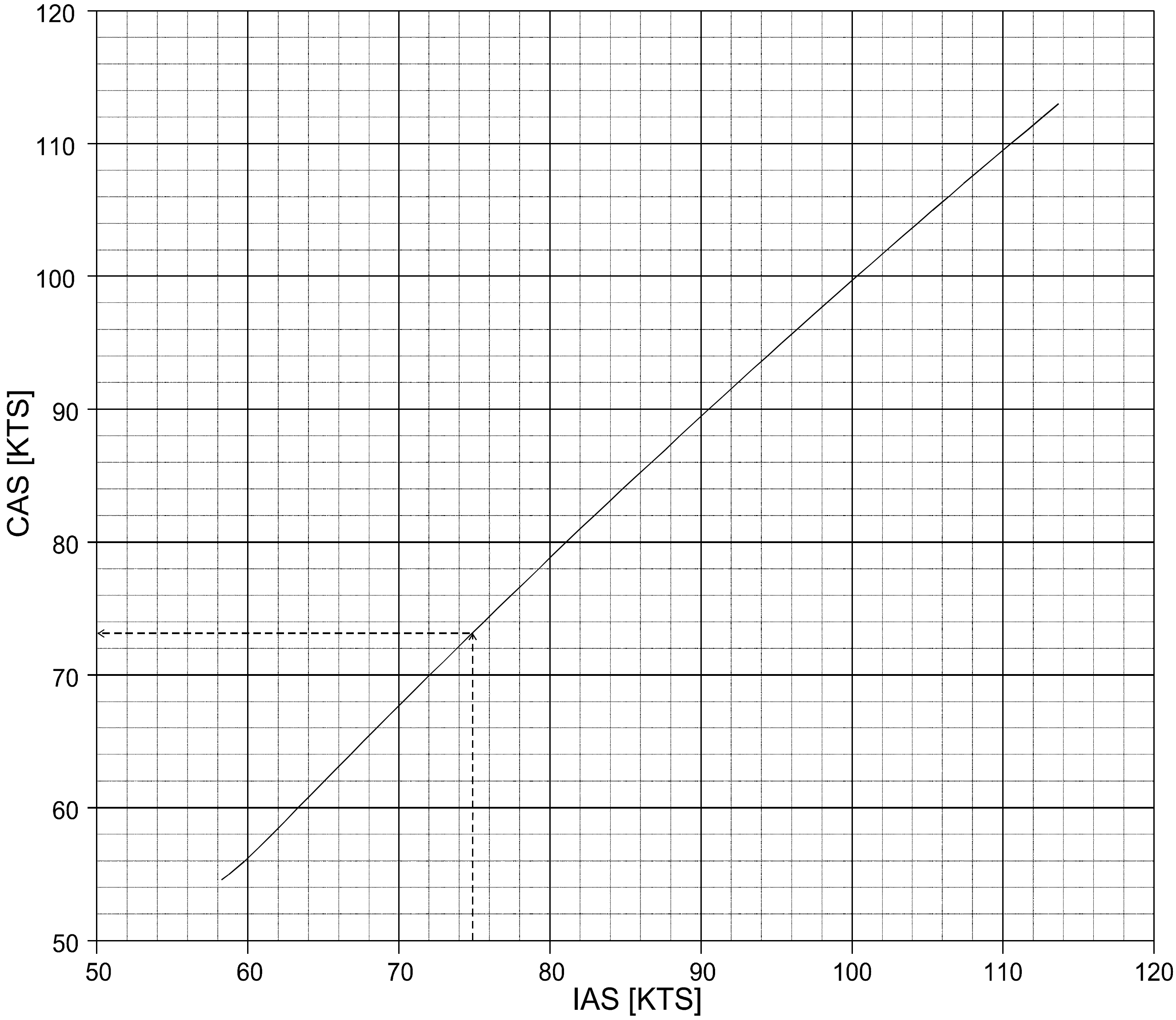


Example:

1. Find your indicated airspeed e.g. 103 kts on the horizontal axis.
2. Follow the vertical line up until it cuts the curve.
3. From this point follow the horizontal line to read the CAS (103 kts) on the vertical axis

d) Airspeed Correction - Flaps FULL

Conditions : Instrument Error "0"

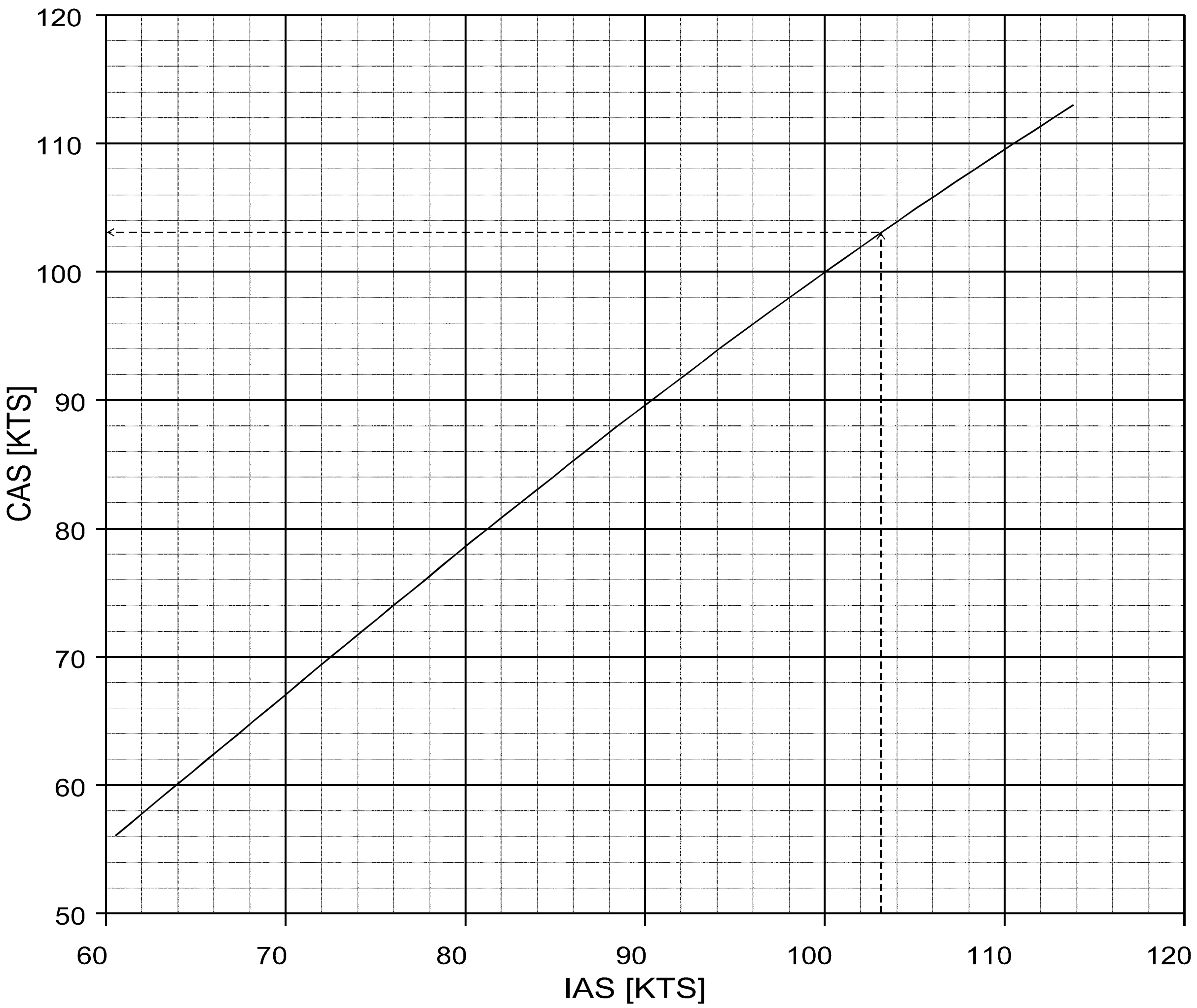


Example:

1. Find your indicated airspeed e.g. 75 kts on the horizontal axis.
2. Follow the vertical line up until it cuts the curve.
3. From this point follow the horizontal line to read the CAS (73 kts) on the vertical axis

e) Airspeed Correction - INVERTED FLIGHT

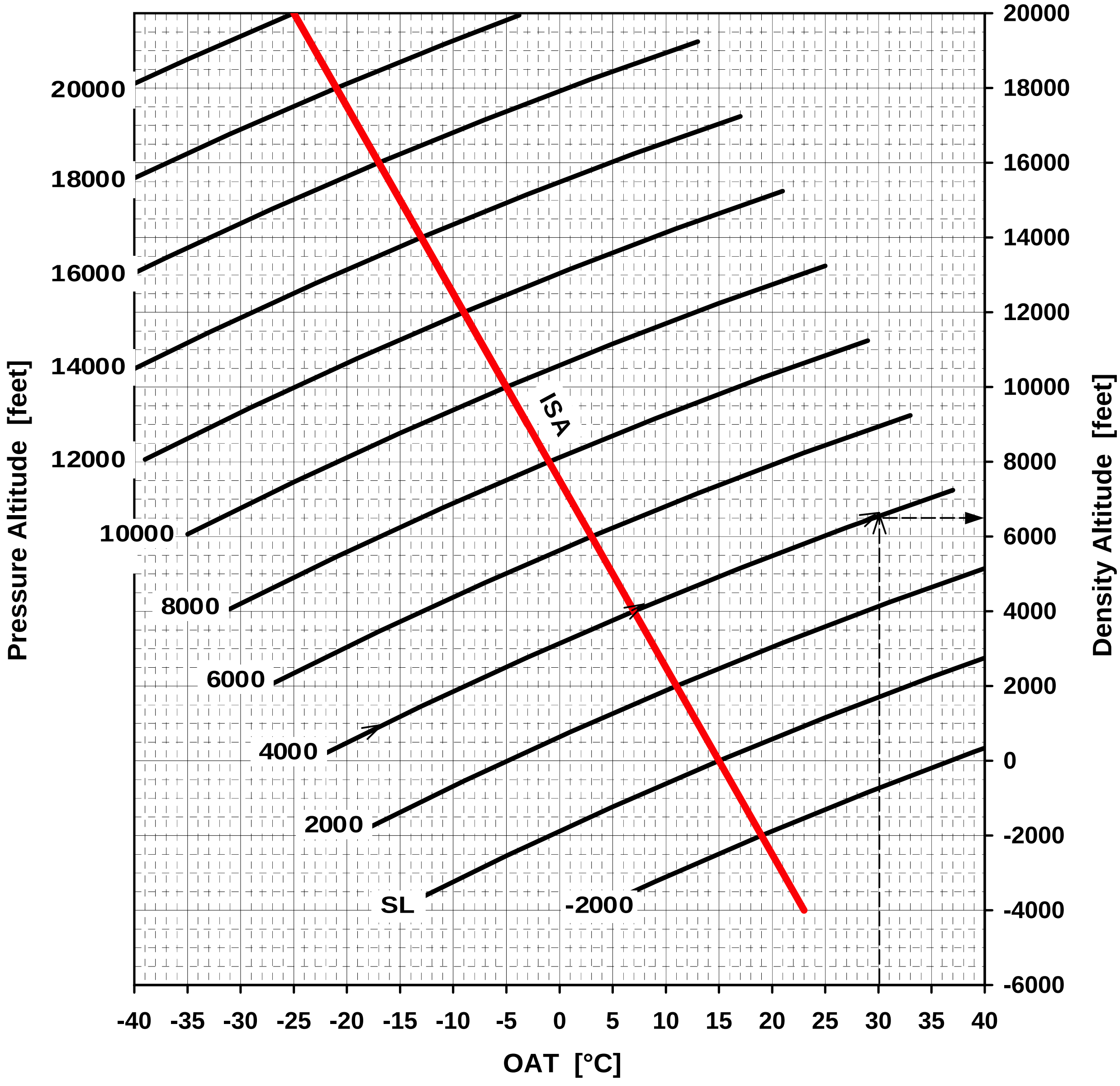
Conditions : Instrument Error "0"



Example:

1. Find your indicated airspeed e.g. 208 kts on the horizontal axis.
2. Follow the vertical line up until it cuts the curve.
3. From this point follow the horizontal line to read the CAS (197 kts) on the vertical axis

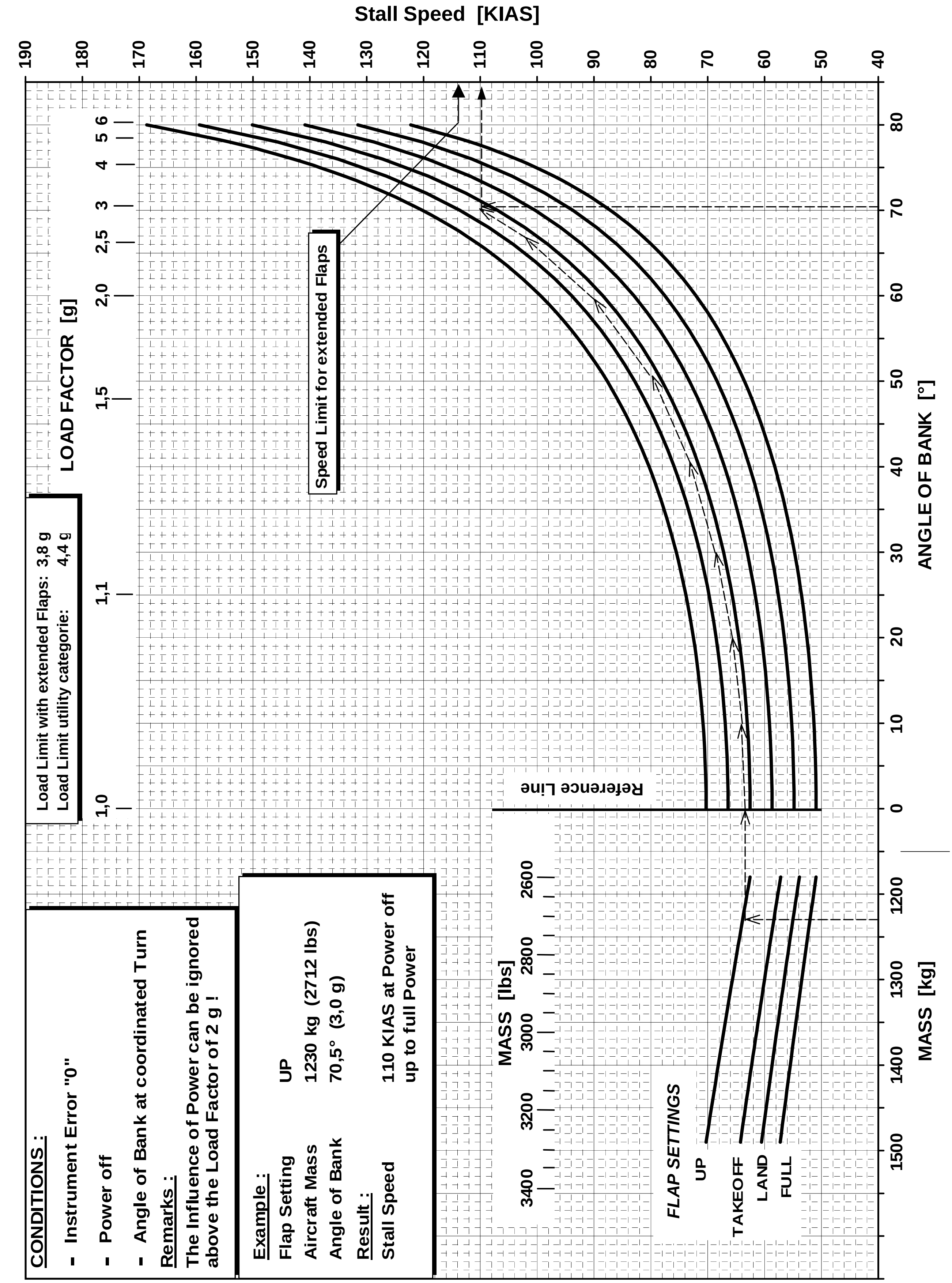
Fig. 5.2 PRESSURE AND DENSITY ALTITUDE



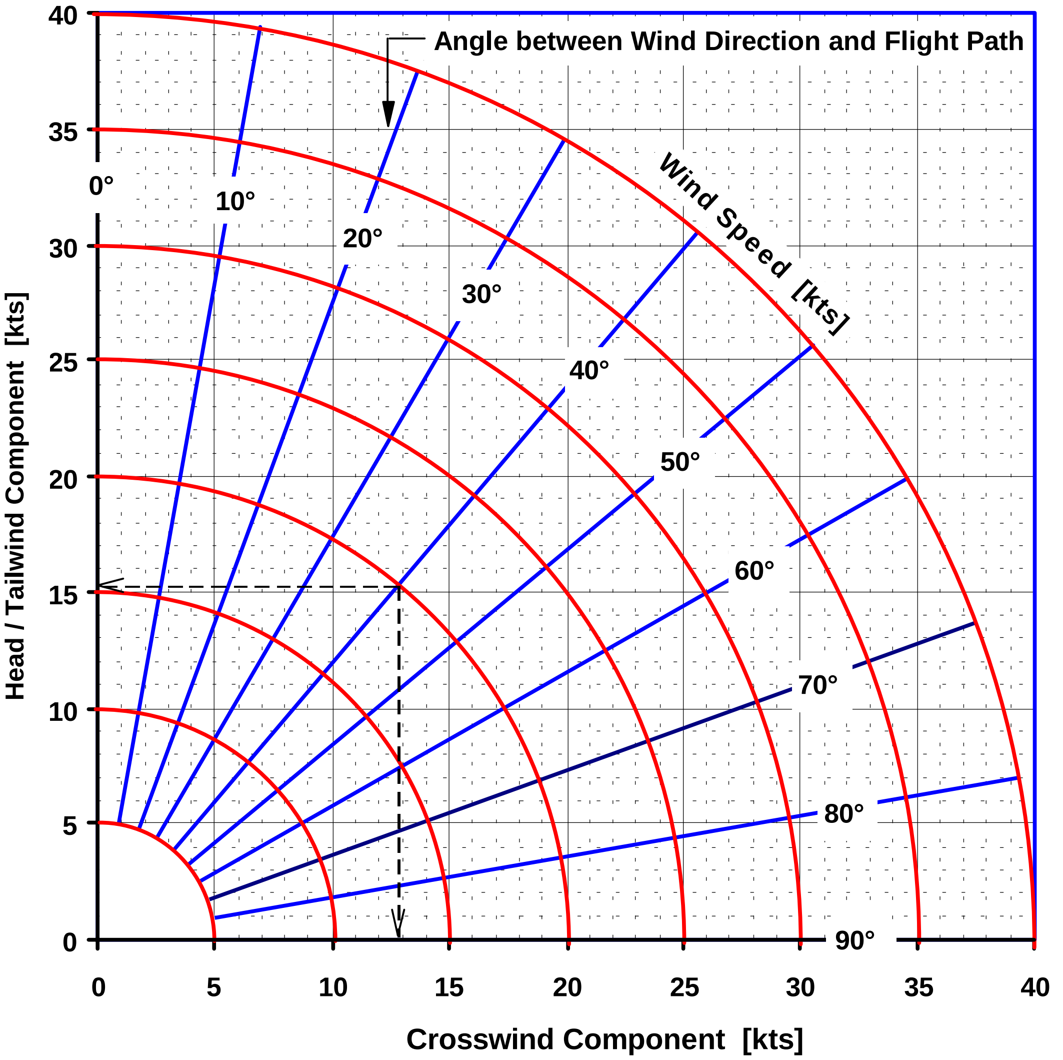
Example

1. Set 1013 hPa (29,92 inHG) on the Altimeter and read the Pressure Altitude (4000 feet)
2. Establish outside Air Temperature (30 °C)
3. Read off Density Altitude (6500 feet)

Fig. 5.3 STALL SPEED



5.4 WIND COMPONENTS



I. Demonstrated Crosswind Component : • for Takeoff and Landing : II. 2

Example	Wind Speed	20 kts
	Angle between Wind Direction and Flight Path	40°
Result	Head / Tailwind Component	15 kts
	Crosswind Component	13 kts

Fig. 5.5 TAKEOFF DISTANCE, FLAPS TAKEOFF [AIR COND ON]

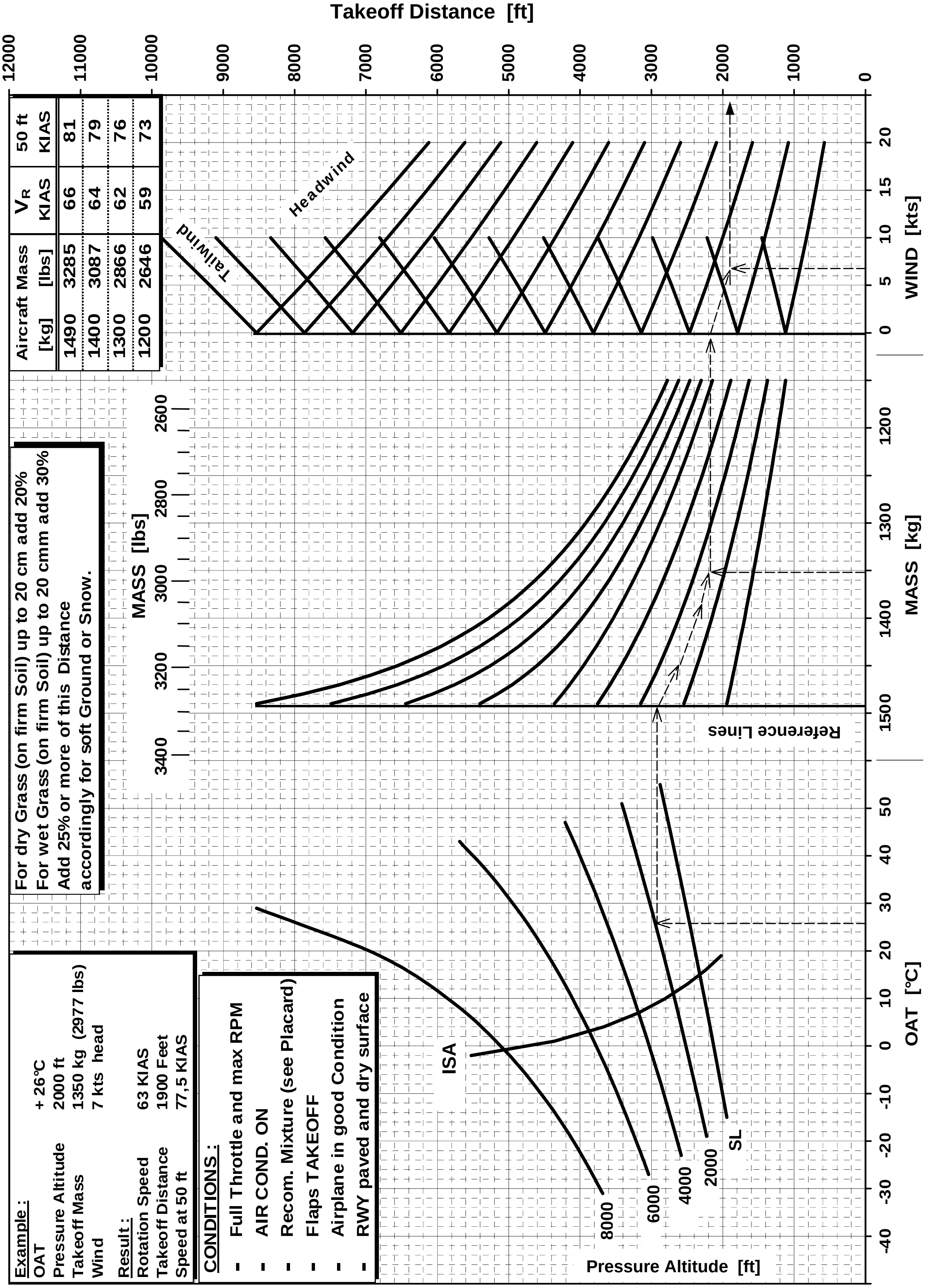


Fig. 5.5a TAKEOFF DISTANCE, FLAPS TAKEOFF [AIR COND OFF]

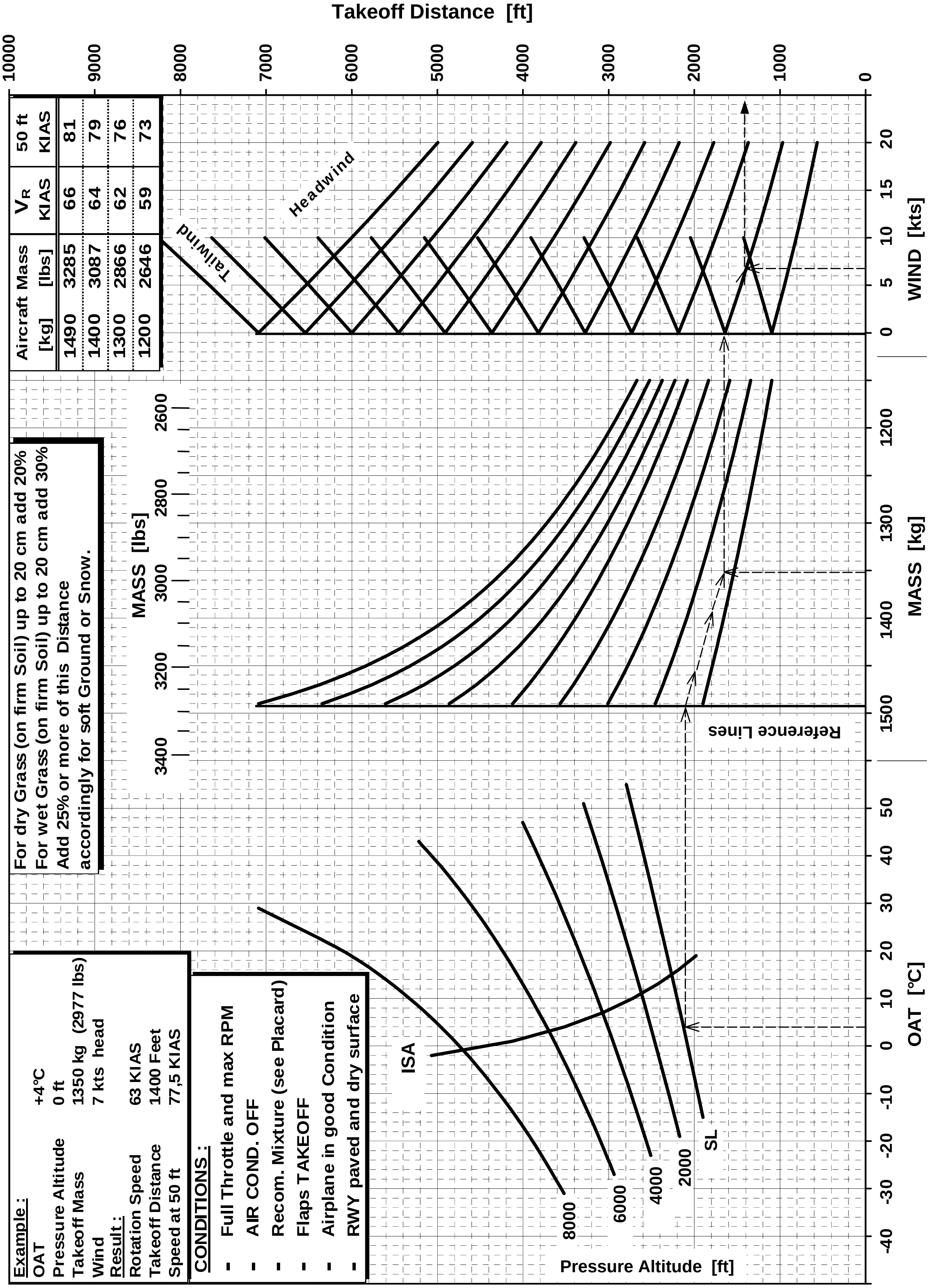
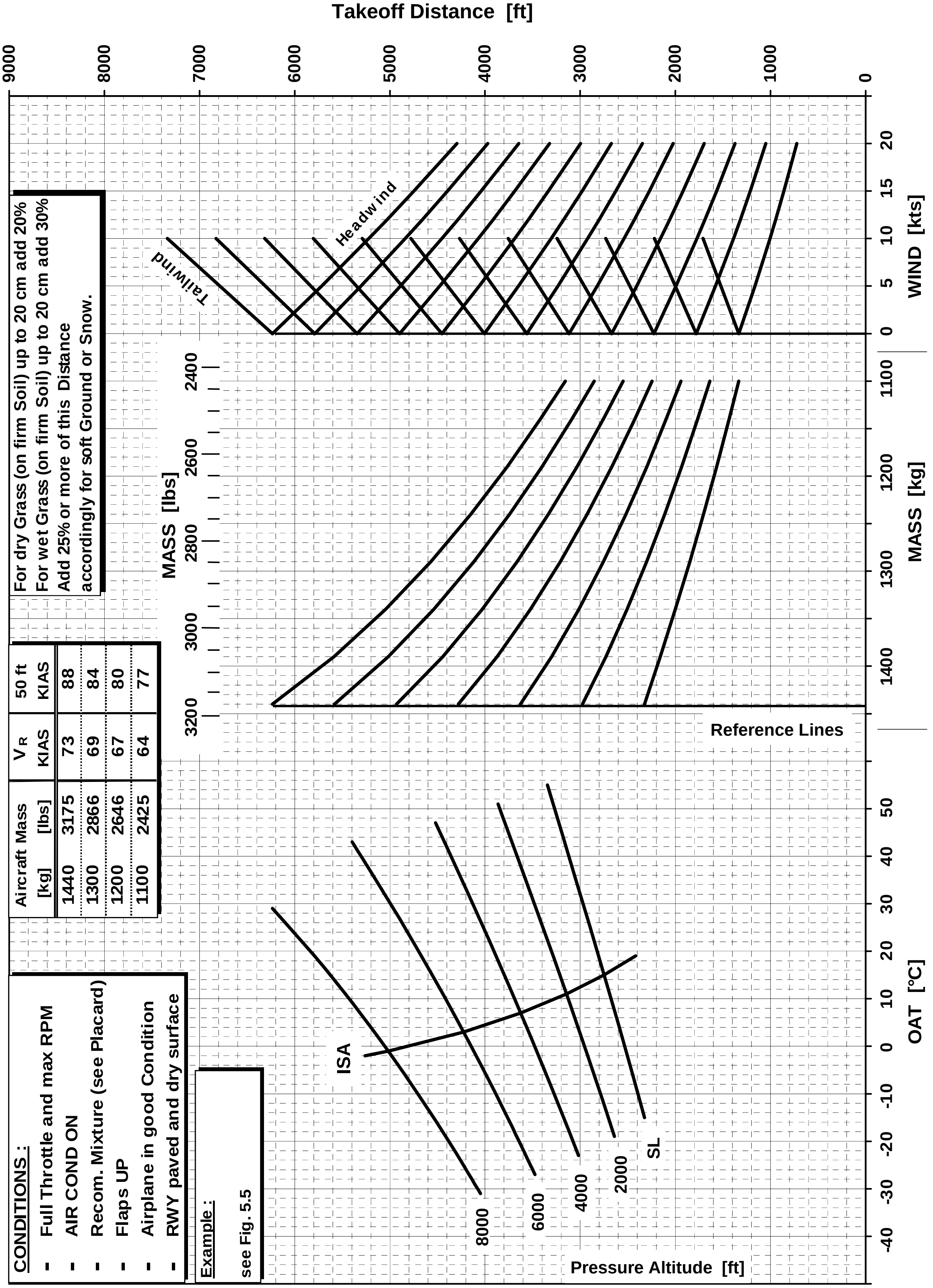
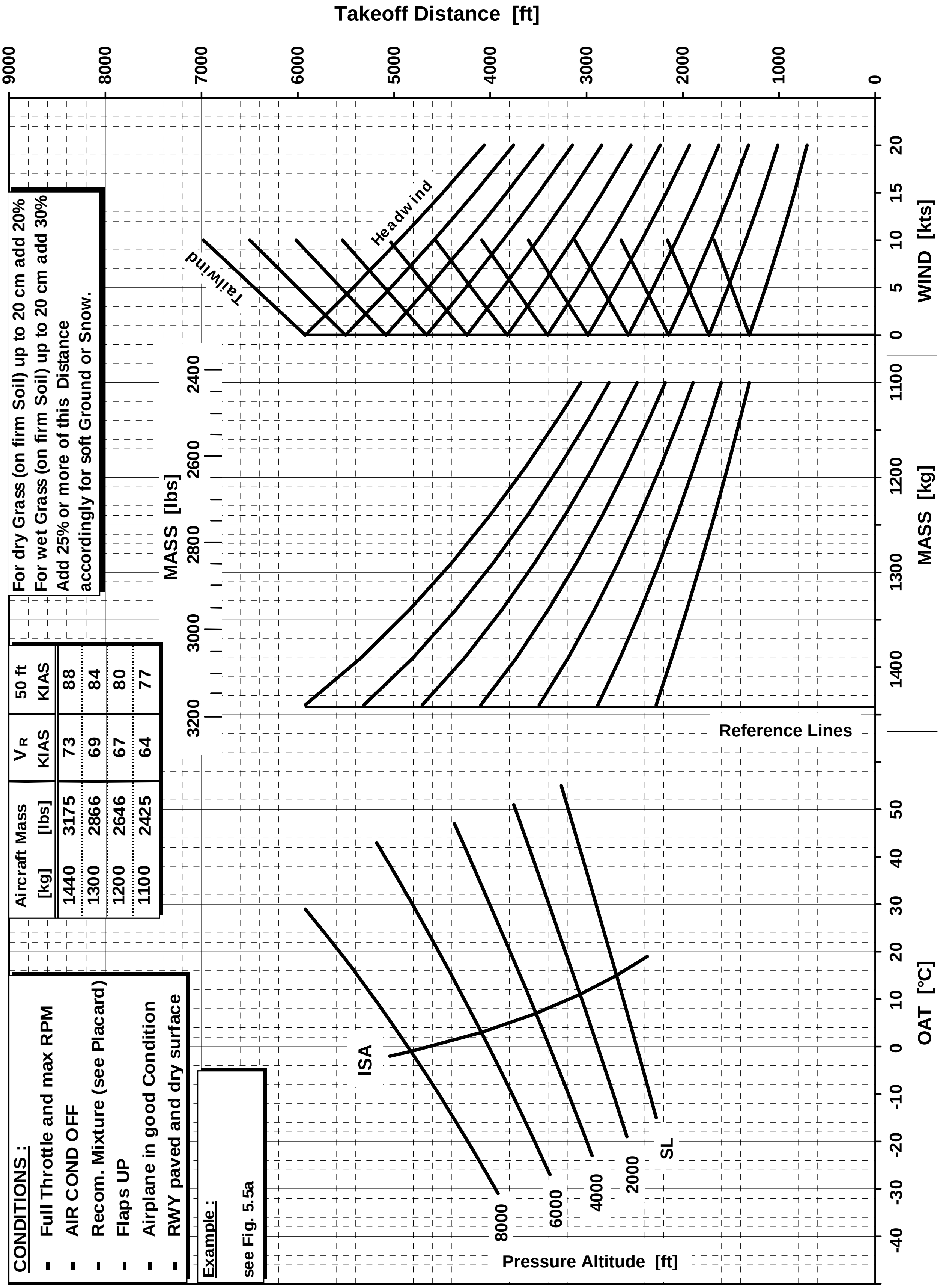


Fig. 5.5b TAKEOFF DISTANCE, FLAPS UP [AIR COND ON]



Aircraft Mass [kg]	Aircraft Mass [lbs]	V_R KIAS	50 ft KIAS
1440	3175	73	88
1300	2866	69	84
1200	2646	67	80
1100	2425	64	77

Fig. 5.5c TAKEOFF DISTANCE, FLAPS UP [AIR COND OFF]



Aircraft Mass [kg]	Aircraft Mass [lbs]	V_R KIAS	50 ft KIAS
1440	3175	73	88
1300	2866	69	84
1200	2646	67	80
1100	2425	64	77

Fig. 5.6 RATE OF CLIMB [AIR COND ON]

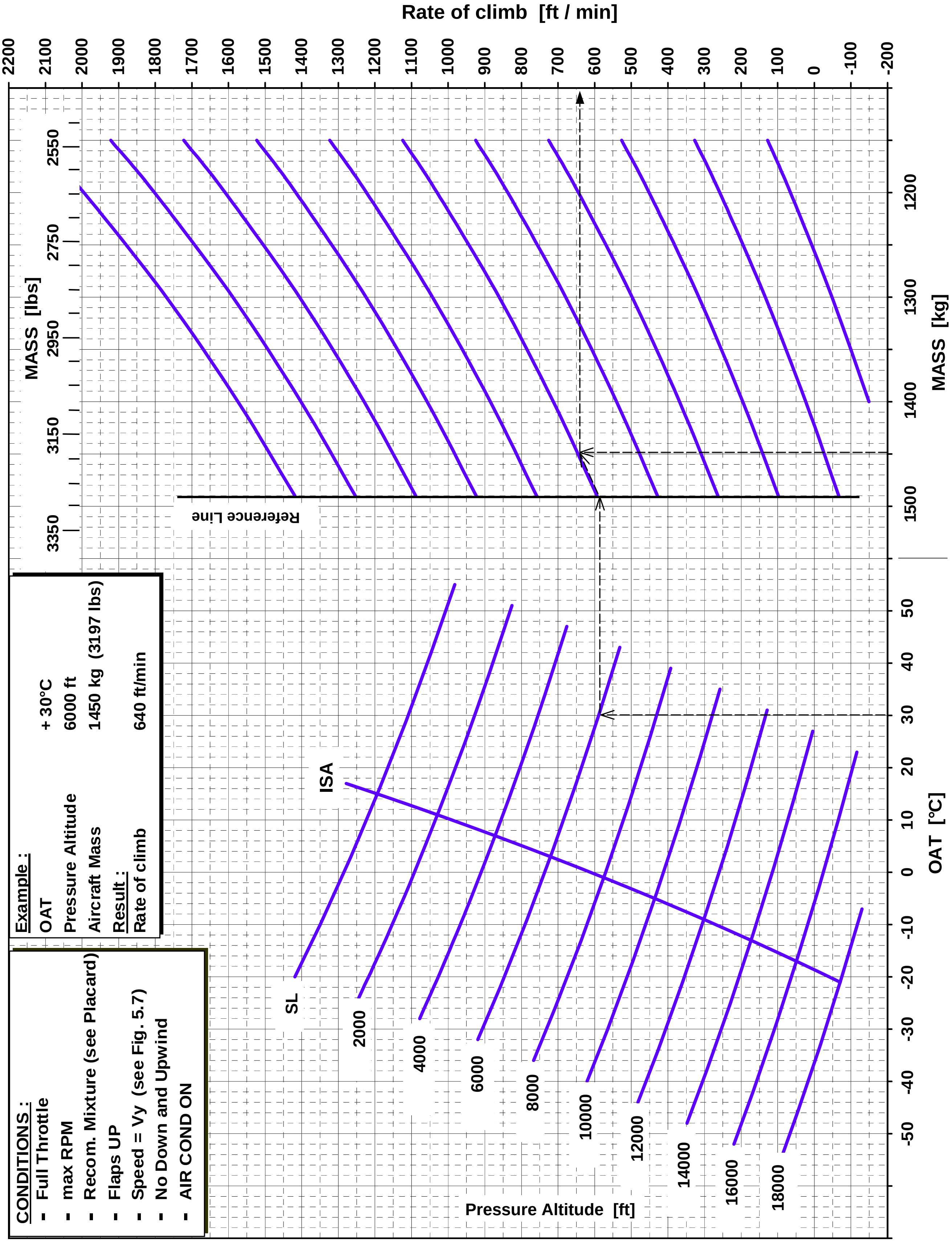


Fig. 5.6a RATE OF CLIMB [AIR COND OFF]

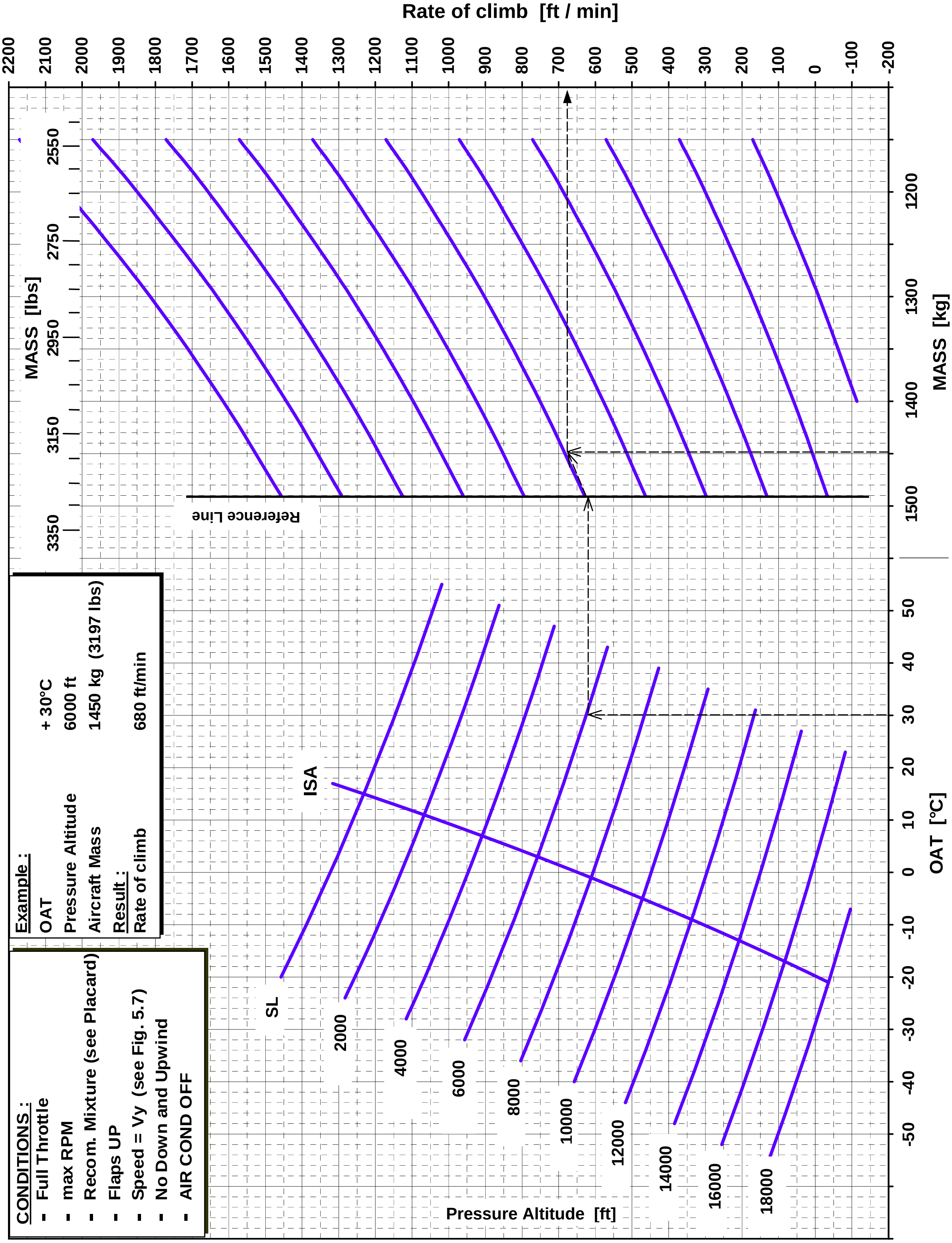


Fig. 5.7 BEST CLIMB SPEED Vy

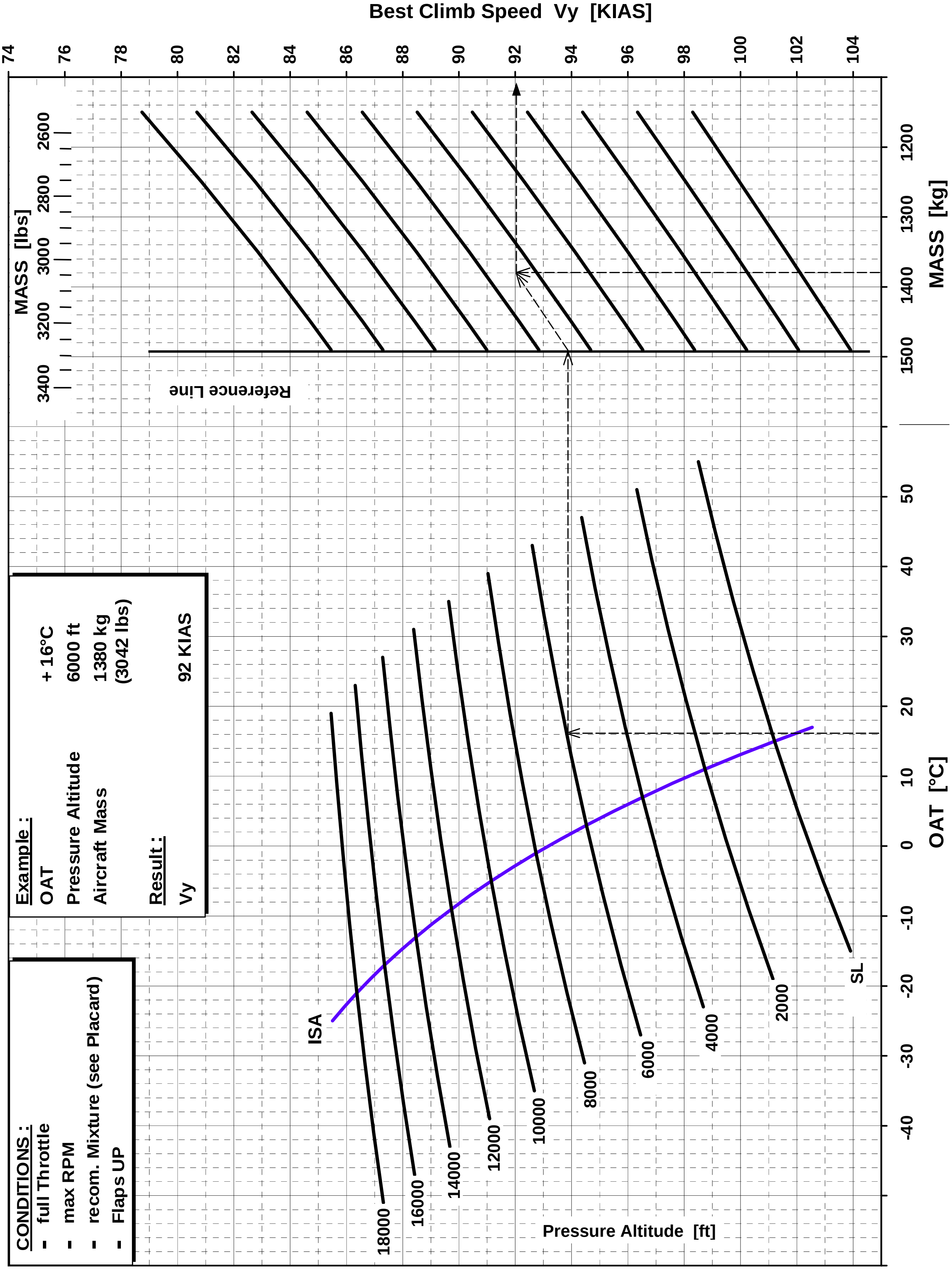


Fig. 5.8 FUEL, TIME, DISTANCE and Vy TO CLIMB [AIR COND ON]

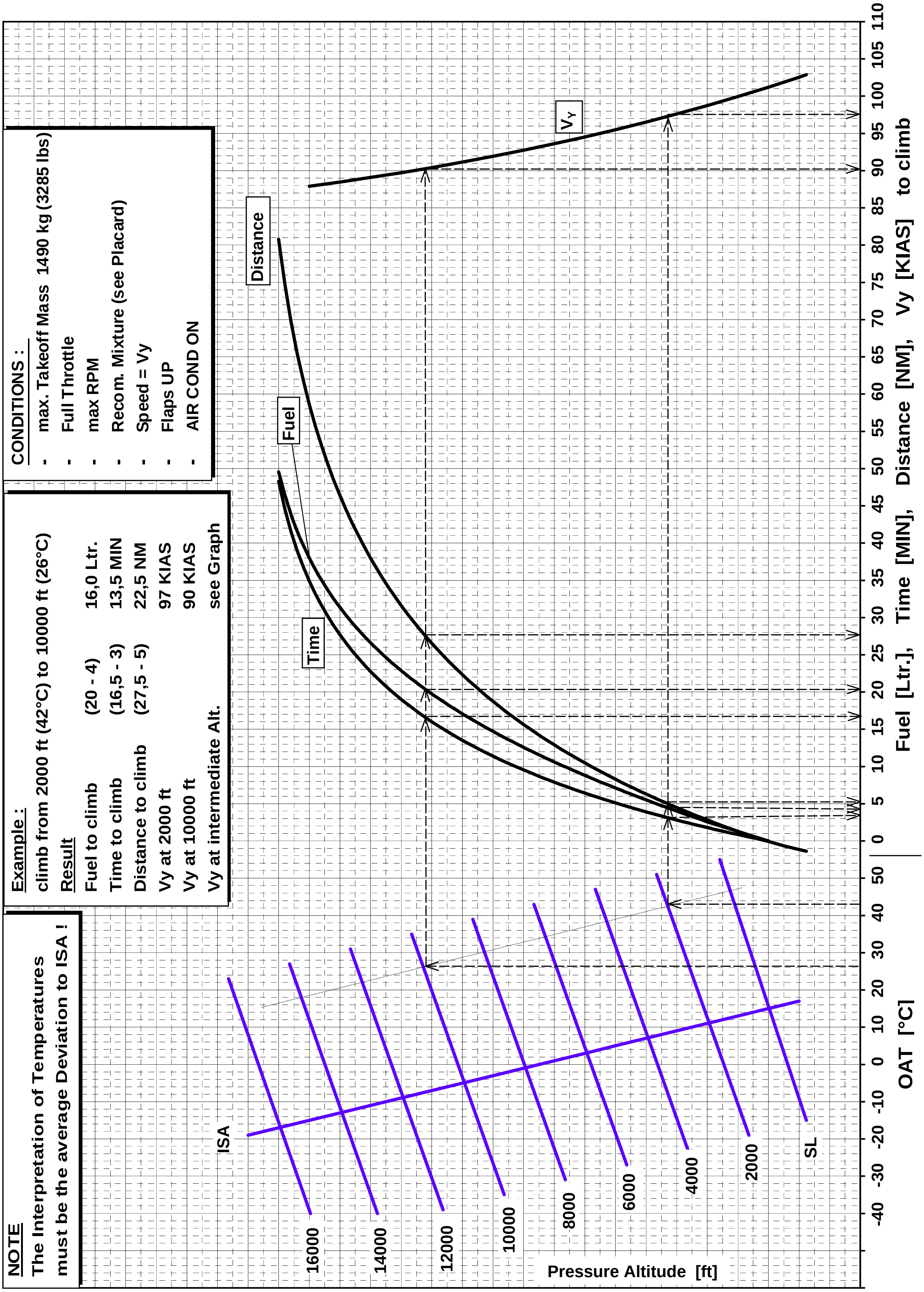


Fig. 5.8a FUEL, TIME, DISTANCE and Vy TO CLIMB [AIR COND OFF]

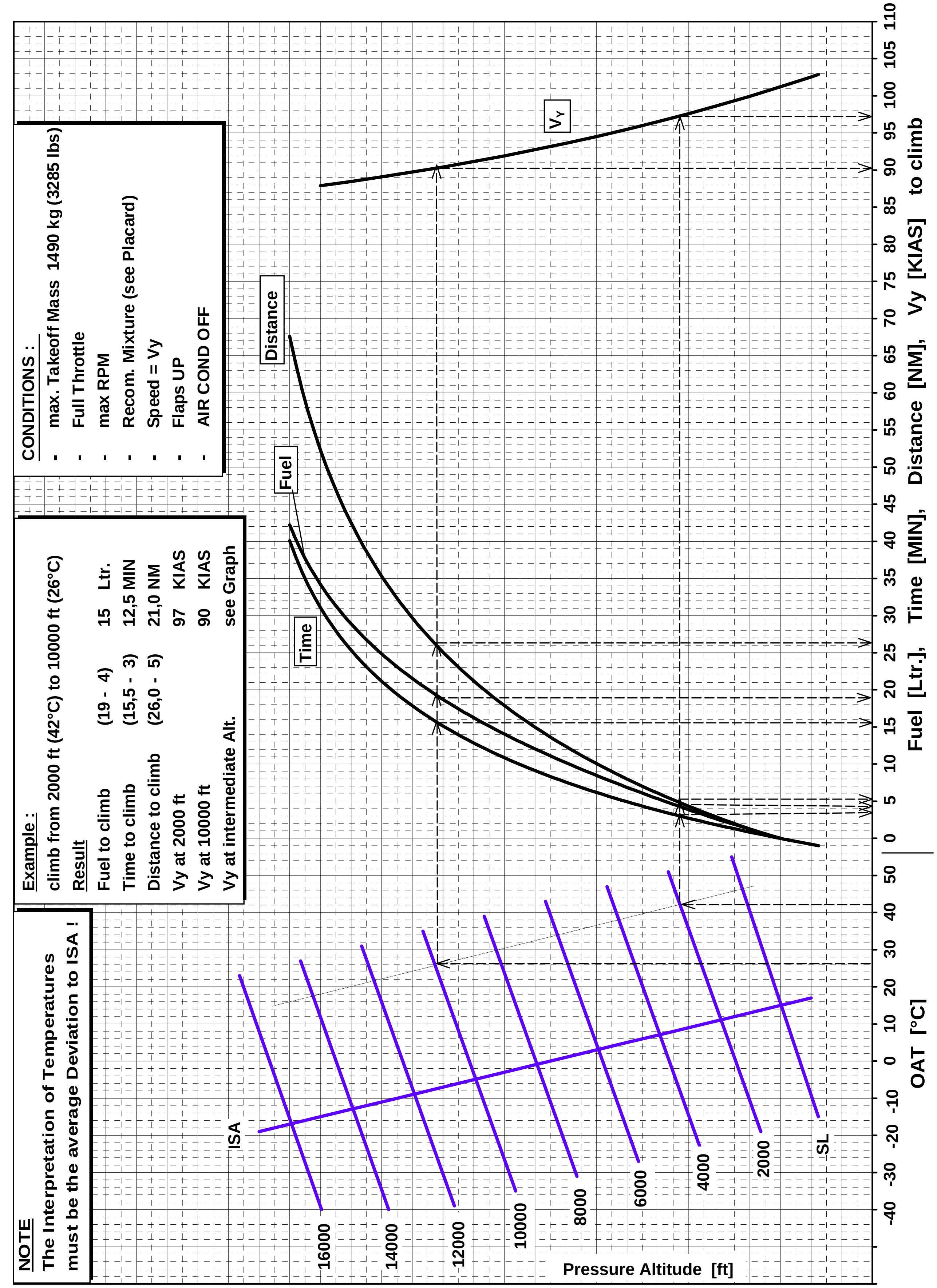


Fig. 5.8b FUEL, TIME, DISTANCE and Vy TO CLIMB [AIR COND ON]

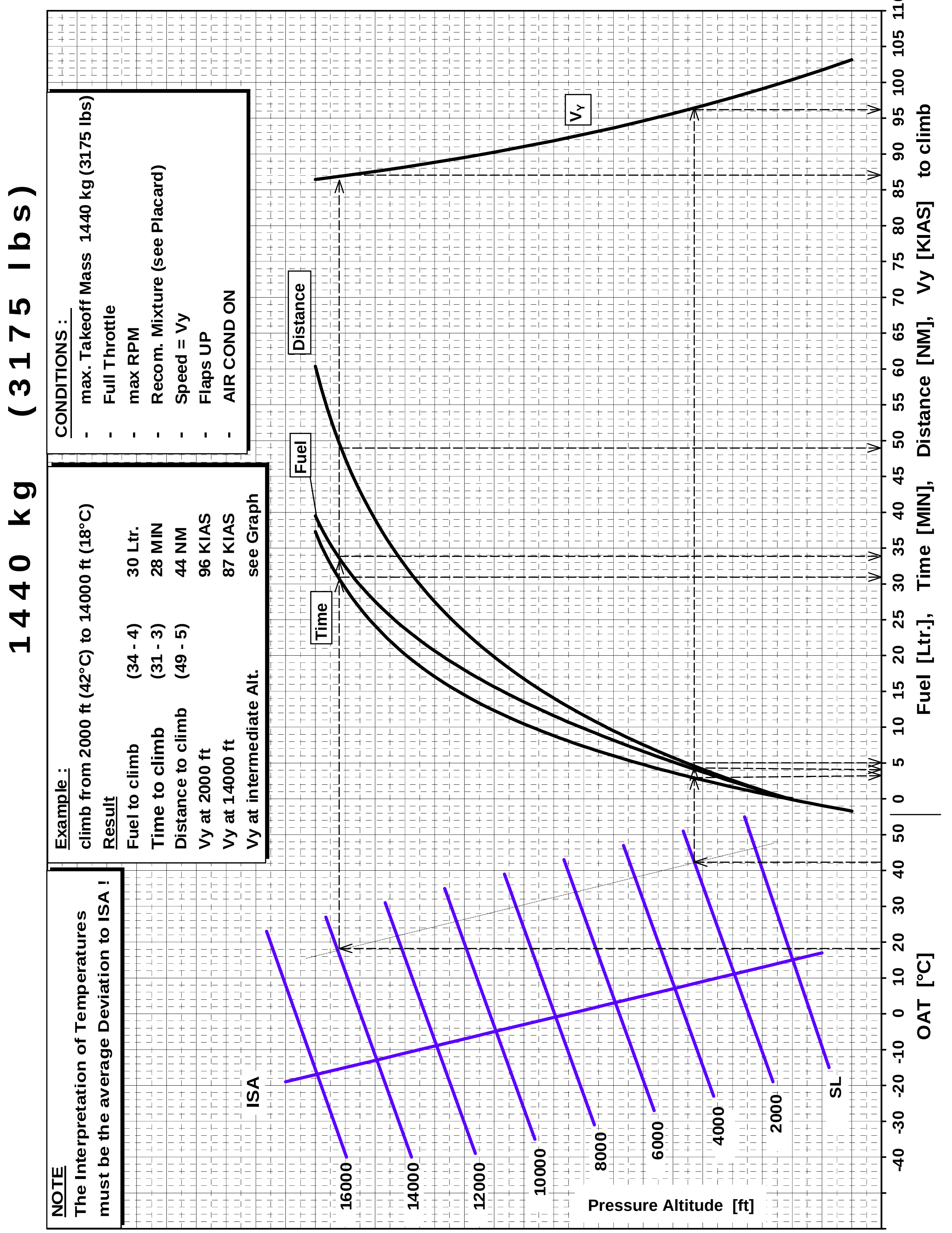


Fig. 5.8c FUEL, TIME, DISTANCE and Vy TO CLIMB [AIR COND OFF]

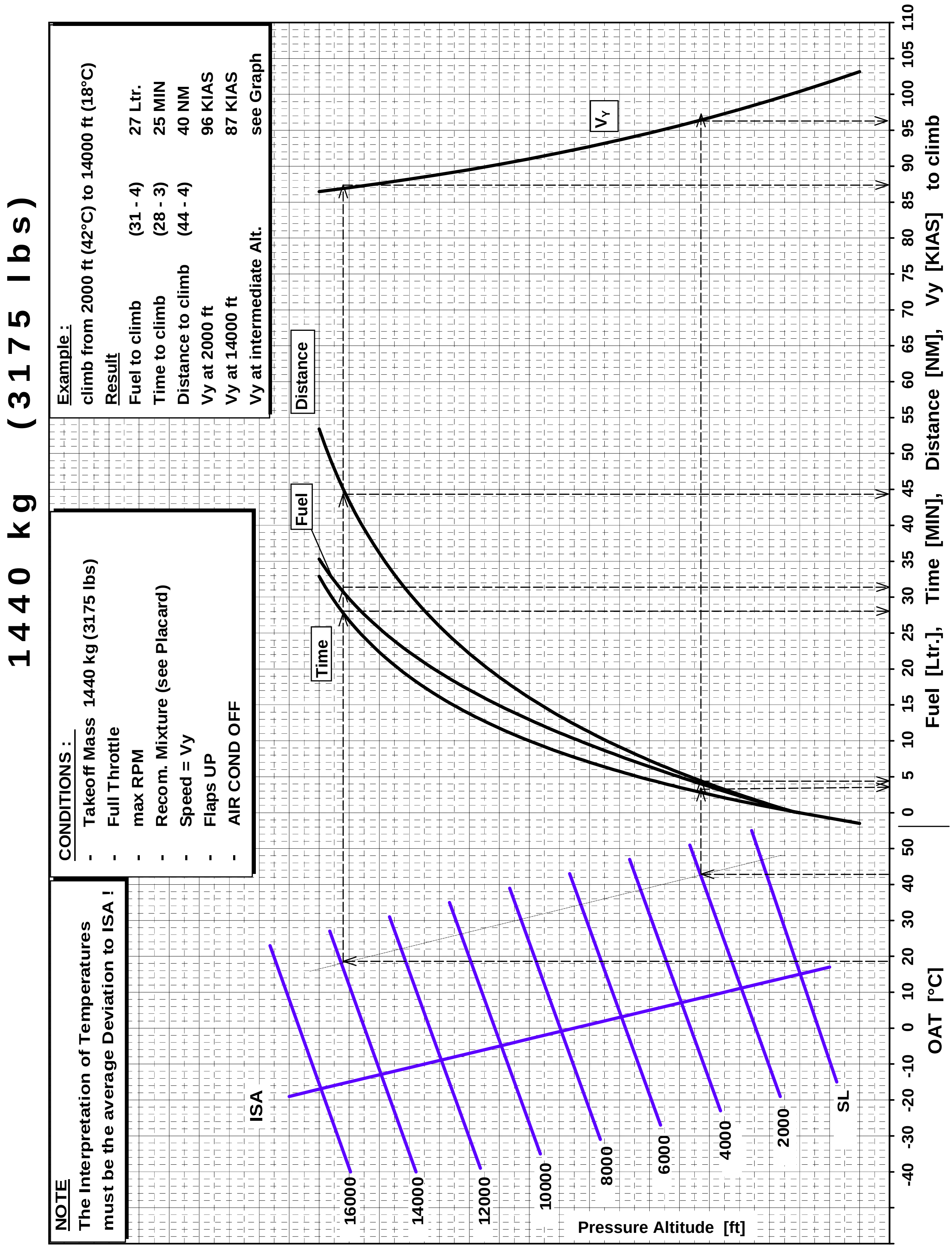


Fig. 5.9 CRUISE (true Airspeed) - BEST POWER MIXTURE

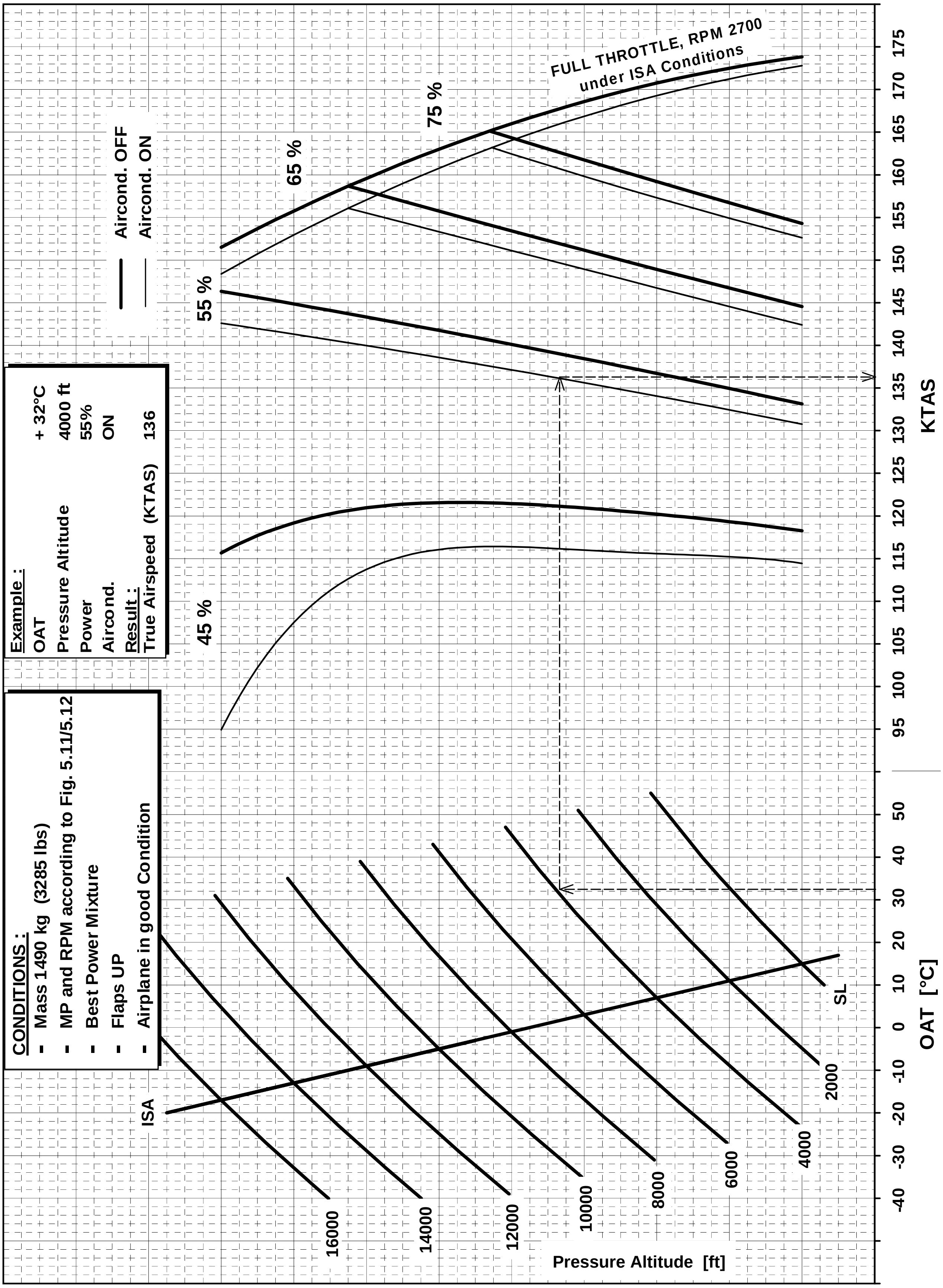


Fig. 5.10 CRUISE (true Airspeed) - ECONOMY MIXTURE

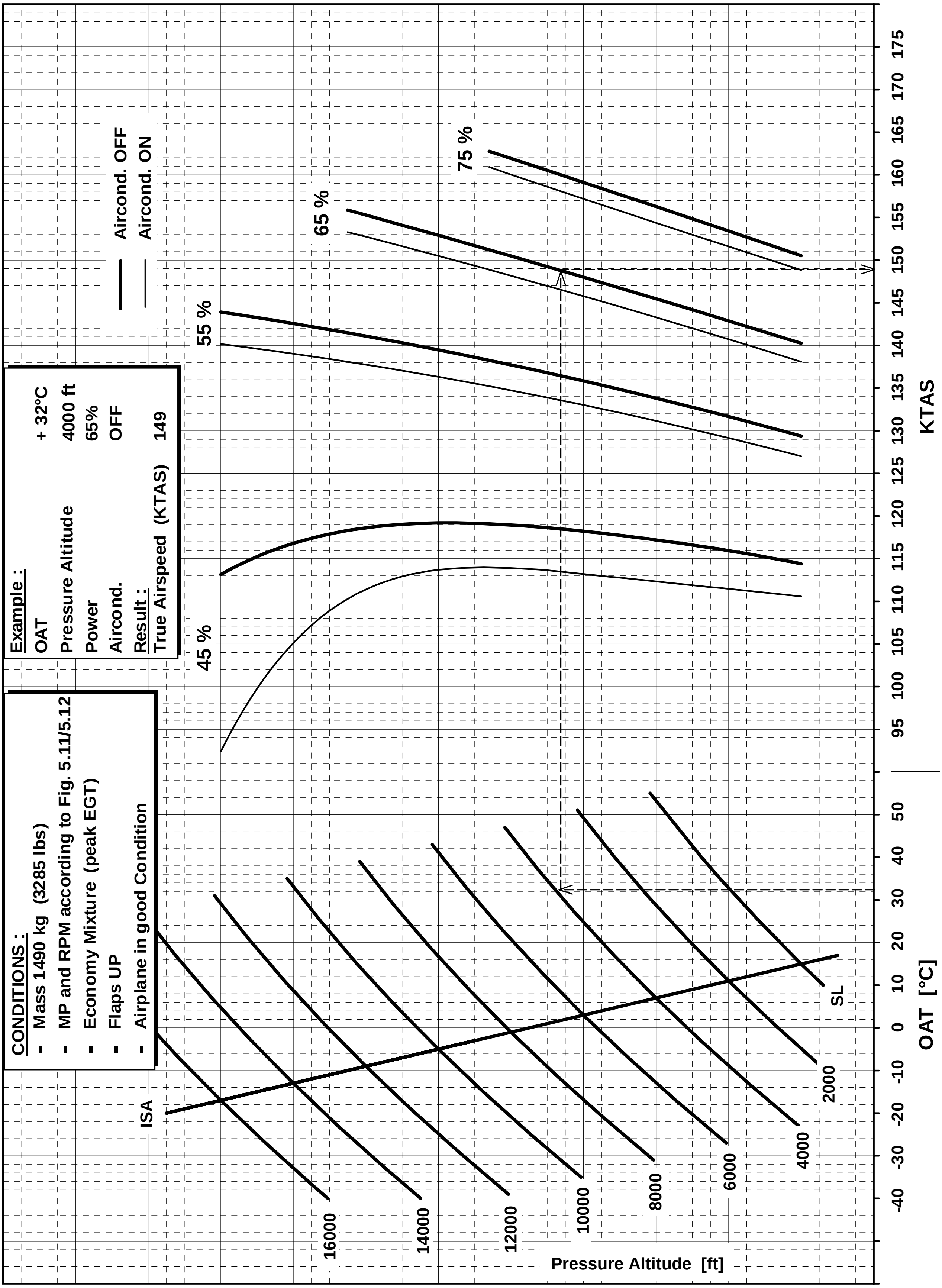
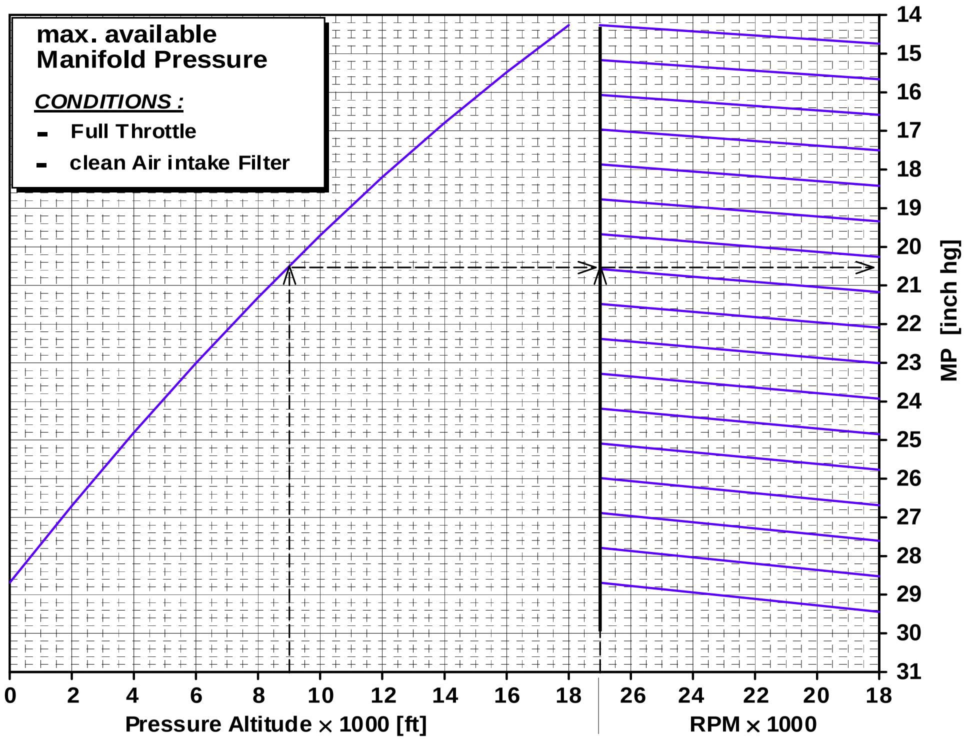


Fig. 5.11 POWER SETTING 75% and 65% BHP

Press. Alt. [feet]	OAT [°C]	RPM	MP [inch hg]	Fuel Flow [Ltr./h] best Power	Fuel Flow [Ltr./h] Economy (peak EGT)
75%					**ISA Conditions**
0	15	2200	27,0	60	51
1000	13	2200	26,7	60	51
2000	11	2300	25,4	61	52
3000	9	2300	25,2	61	52
4000	7	2400	24,0	62	53
5000	5	2500	23,0	63	54
6000	3	2600	22,0	64	55
7000	1	2600	21,8	64	55
8000	-1	2700	20,9	65	56
not available under ISA Cond. (Basic to calculate add. MP below ISA)					
9000	*-3*	*2700*	*20,8*	*65*	*56*
10000	*-5*	*2700*	*20,6*	*65*	*56*

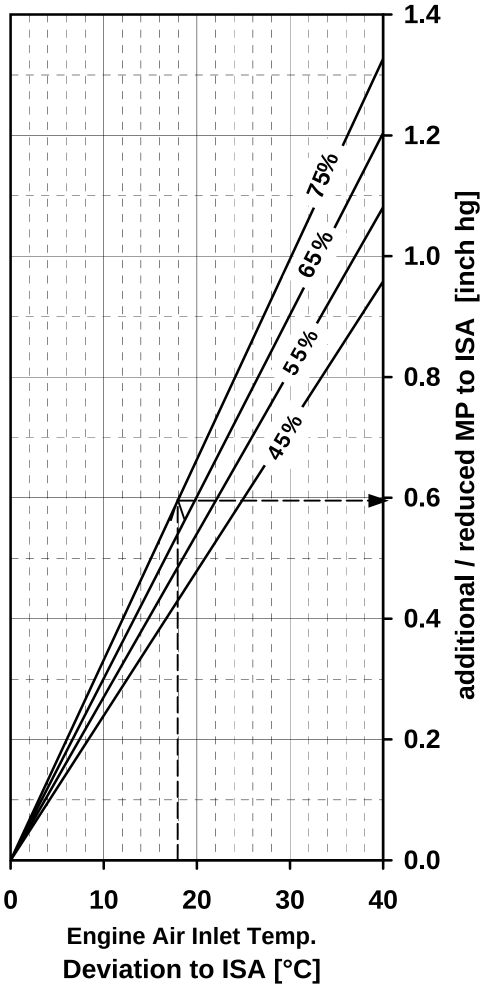
Press. Alt. [feet]	OAT [°C]	RPM	MP [inch hg]	Fuel Flow [Ltr./h] best Power	Fuel Flow [Ltr./h] Economy (peak EGT)
65%					**ISA Conditions**
0	15	2100	25,2	53	45
1000	13	2100	24,9	53	45
2000	11	2100	24,7	53	45
3000	9	2100	24,4	53	45
4000	7	2100	24,2	53	45
5000	5	2200	23,0	54	46
6000	3	2300	21,9	55	47
7000	1	2300	21,7	55	47
8000	-1	2400	20,8	56	48
9000	-3	2500	19,9	57	49
10000	-5	2600	19,0	58	50
11000	-7	2700	18,3	59	51
12000	-9	2700	18,1	59	51
not available under ISA Cond. (Basic to calculate add. MP below ISA)					
13000	*-11*	*2700*	*17,9*	*59*	*51*
14000	*-13*	*2700*	*17,7*	*59*	*51*
15000	*-15*	*2700*	*17,5*	*59*	*51*



Example :

OAT	**- 21°C**		
Pressure Altitude	**9000 ft**		
desired Power	**75%**		
Result :			
max avail. MP	**20,5 in.hg**		
Reference MP at ISA	**20,8 in.hg**		
OAT at ISA	**-3°C**		
OAT Deviation	**18°C**	below ISA	
reduced MP to ISA	**0,6 in. hg**	see Fig. 5.12	
Power setting	**MP**	**20,2**	
	RPM	**2700**	
	Fuel Flow [Ltr./h]	best Power	**65**
		Economy	**56**

Fig. 5.12 POWER SETTING 55% and 45%



Press. Alt. [feet]	OAT [°C]	RPM	MP [inch hg]	55% ISA Conditions — Fuel Flow [Ltr./h] best Power	Economy (peak EGT)
0	15	2000	23,3	46	39
1000	13	2000	23,0	46	39
2000	11	2000	22,8	46	39
3000	9	2000	22,5	46	39
4000	7	2000	22,3	46	39
5000	5	2000	22,0	46	39
6000	3	2000	21,8	46	40
7000	1	2000	21,6	46	39
8000	-1	2100	20,5	47	40
9000	-3	2200	19,5	48	41
10000	-5	2200	19,3	48	41
11000	-7	2300	18,4	49	42
12000	-9	2400	17,6	50	43
13000	-11	2500	16,8	51	44
14000	-13	2600	16,0	52	45
15000	-15	2600	15,9	52	45
16000	-17	2700	15,2	53	46
not available under ISA Cond. (Basic to calculate add. MP below ISA)					
17000	*-19*	*2700*	*15,0*	*53*	*46*
18000	*-21*	*2700*	*14,8*	*53*	*46*

Press. Alt. [feet]	OAT [°C]	RPM	MP [inch hg]	45% ISA Conditions — Fuel Flow [Ltr./h] best Power	Economy (peak EGT)
0	15	1800	22,1	38	33
1000	13	1800	21,8	38	33
2000	11	1800	21,6	38	33
3000	9	1800	21,4	38	33
4000	7	1800	21,1	38	33
5000	5	1800	20,9	38	33
6000	3	1800	20,6	38	33
7000	1	1800	20,4	38	33
8000	-1	1800	20,1	38	33
9000	-3	1800	19,9	38	33
10000	-5	1900	18,8	39	34
11000	-7	2000	17,8	40	35
12000	-9	2000	17,6	40	35
13000	-11	2100	16,7	41	36
14000	-13	2200	15,8	42	36
15000	-15	2200	15,6	42	36
16000	-17	2300	14,9	44	37
17000	-19	2400	14,1	45	38
18000	-21	2500	13,5	46	39

NOTE

- **at temperatures above ISA :**
  - increased MP required -
- **at temperatures below ISA :**
  - reduced MP required -

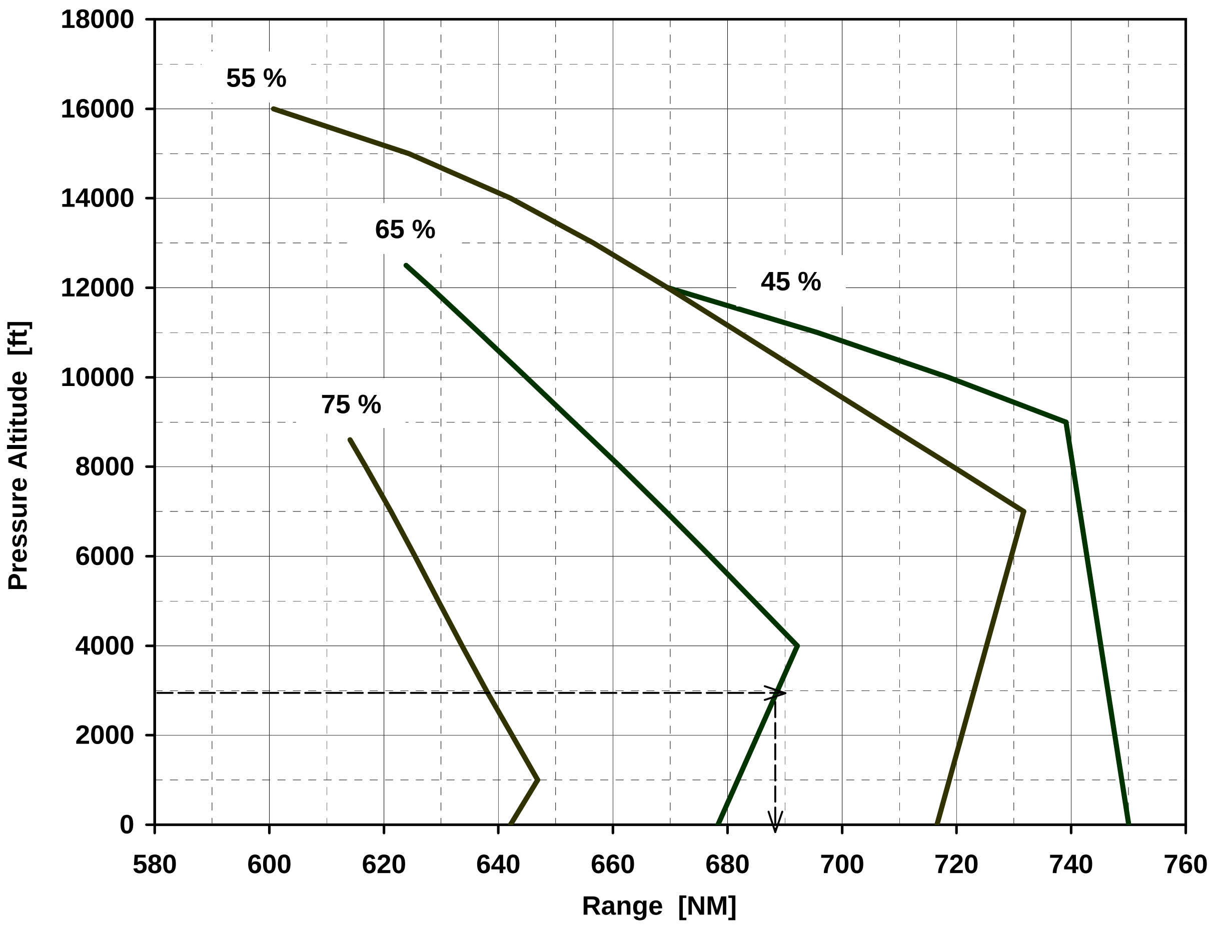
Example :

see Fig. 5.11

Fig. 5.13 RANGE ISA +/-0 [252 litres usable Fuel, AIR COND ON]

CONDITIONS

- No Wind and no Rain
- ISA Temperature
- Mass 1490 kg (3285 lbs)
- 252 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power
- AIR COND ON



Example

You plan to fly at 3000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

Result

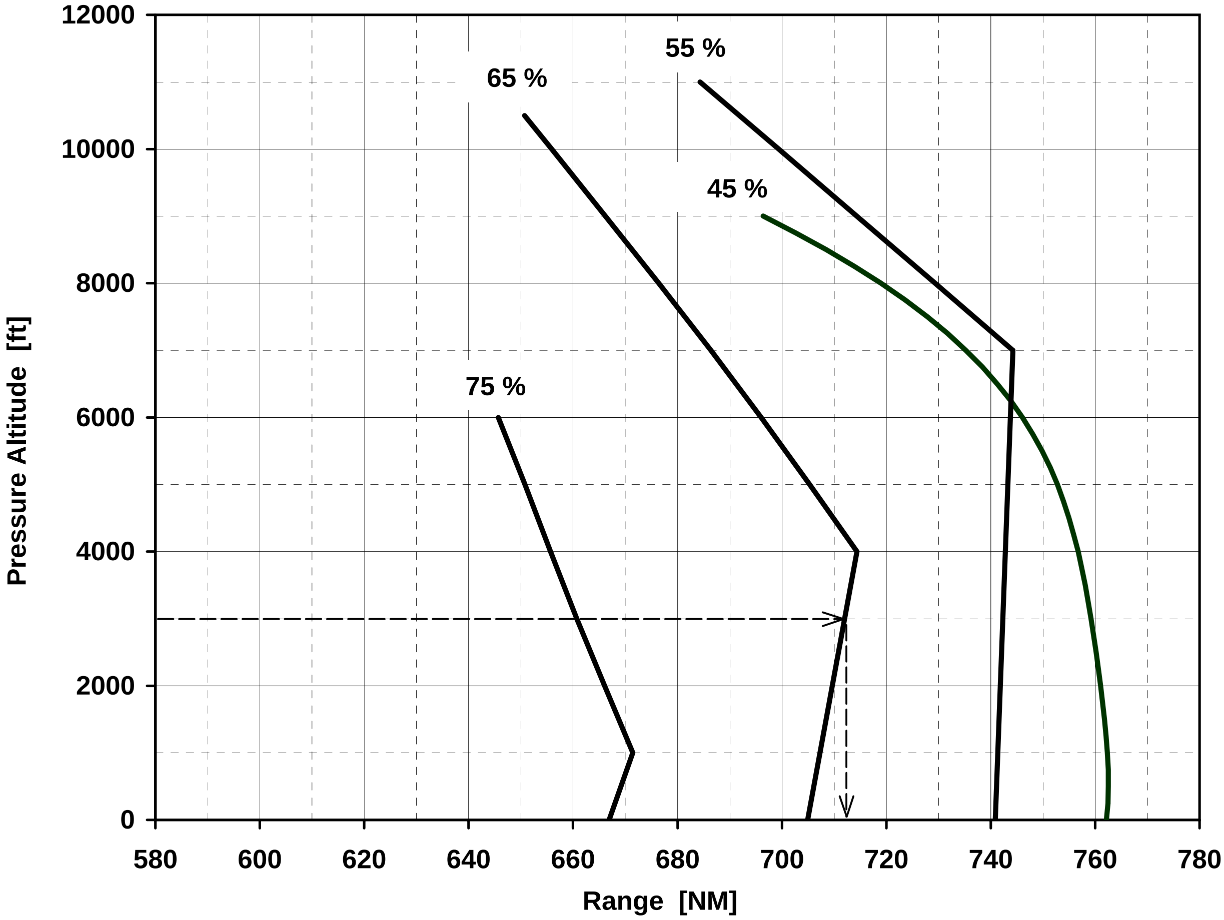
Range : 688 NM

Fig. 5.13a RANGE ISA +40°C [252 litres usable Fuel, AIR COND ON]

Note
interpolate linearly for intermediate temperatures between this figure and figure 5.13

CONDITIONS

- No Wind and no Rain
- ISA Temperature +40°C
- Mass 1490 kg (3285 lbs)
- 252 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power
- AIR COND ON



Example

You plan to fly at 3000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

Result

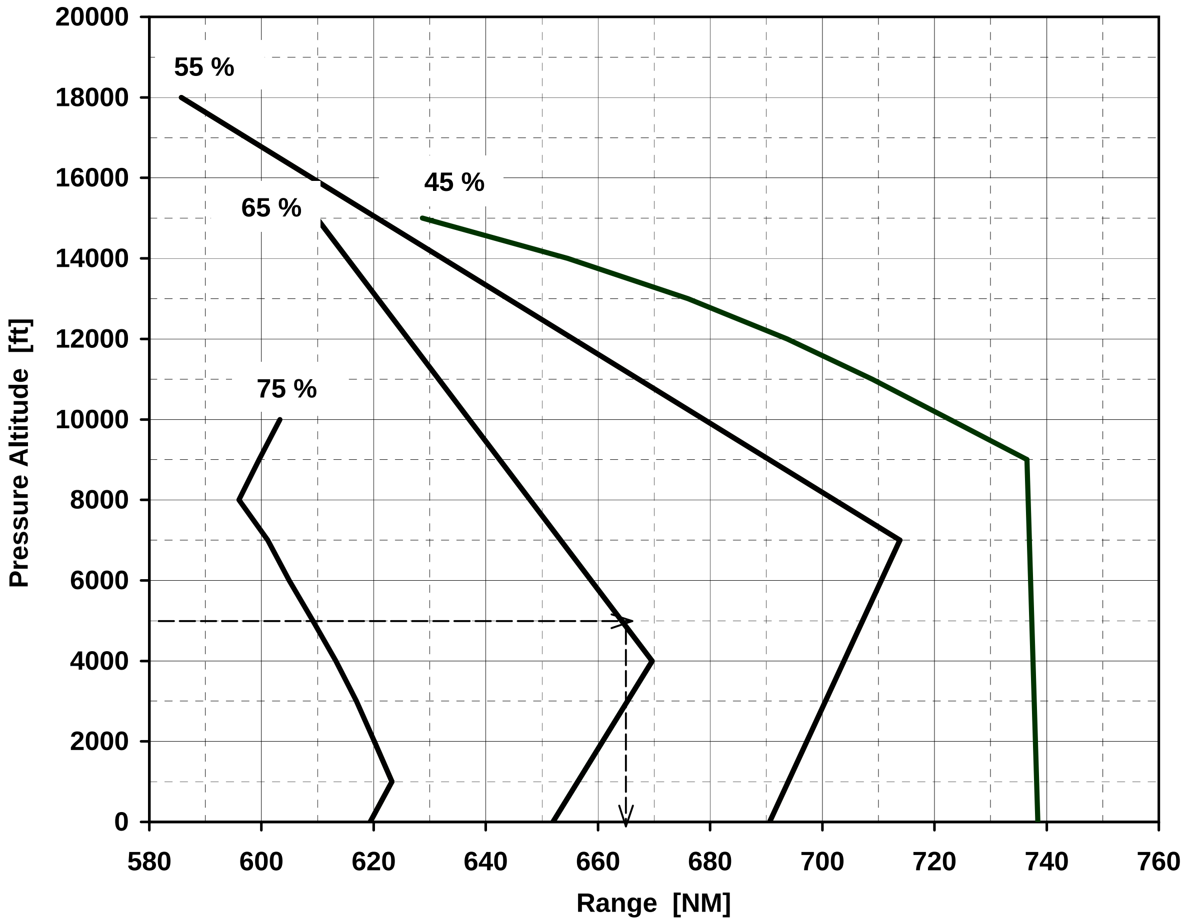
Range : 713 NM

Fig. 5.13b RANGE ISA -30°C [252 litres usable Fuel, AIR COND ON]

Note
interpolate linearly for intermediate temperatures between this figure and figure 5.13

CONDITIONS

- No Wind and no Rain
- ISA Temperature -30°C
- Mass 1490 kg (3285 lbs)
- 252 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sea level according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power
- AIR COND ON



Example
You plan to fly at 5000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

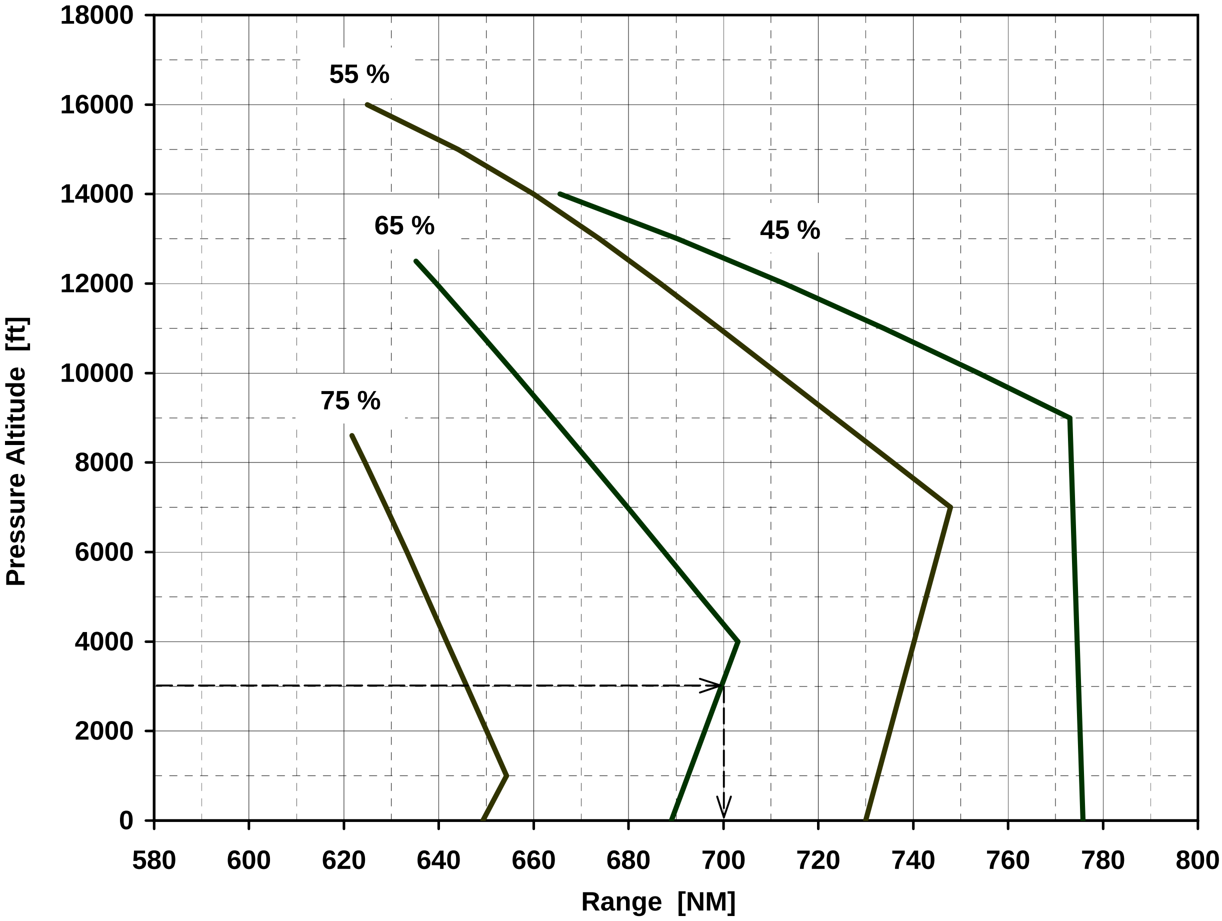
Result
Range : 664 NM

Fig. 5.13c RANGE ISA +/-0 [252 litres usable Fuel, AIR COND OFF]

Note
Use the percent deviations of the Figures "5.13a and b" to correct the ISA deviations.

CONDITIONS

- No Wind and no Rain
- ISA Temperature
- Mass 1490 kg (3285 lbs)
- 252 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy"
- including 45 minutes reserve fuel at 45% engine power
- AIR COND OFF



Example
You plan to fly at 3000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

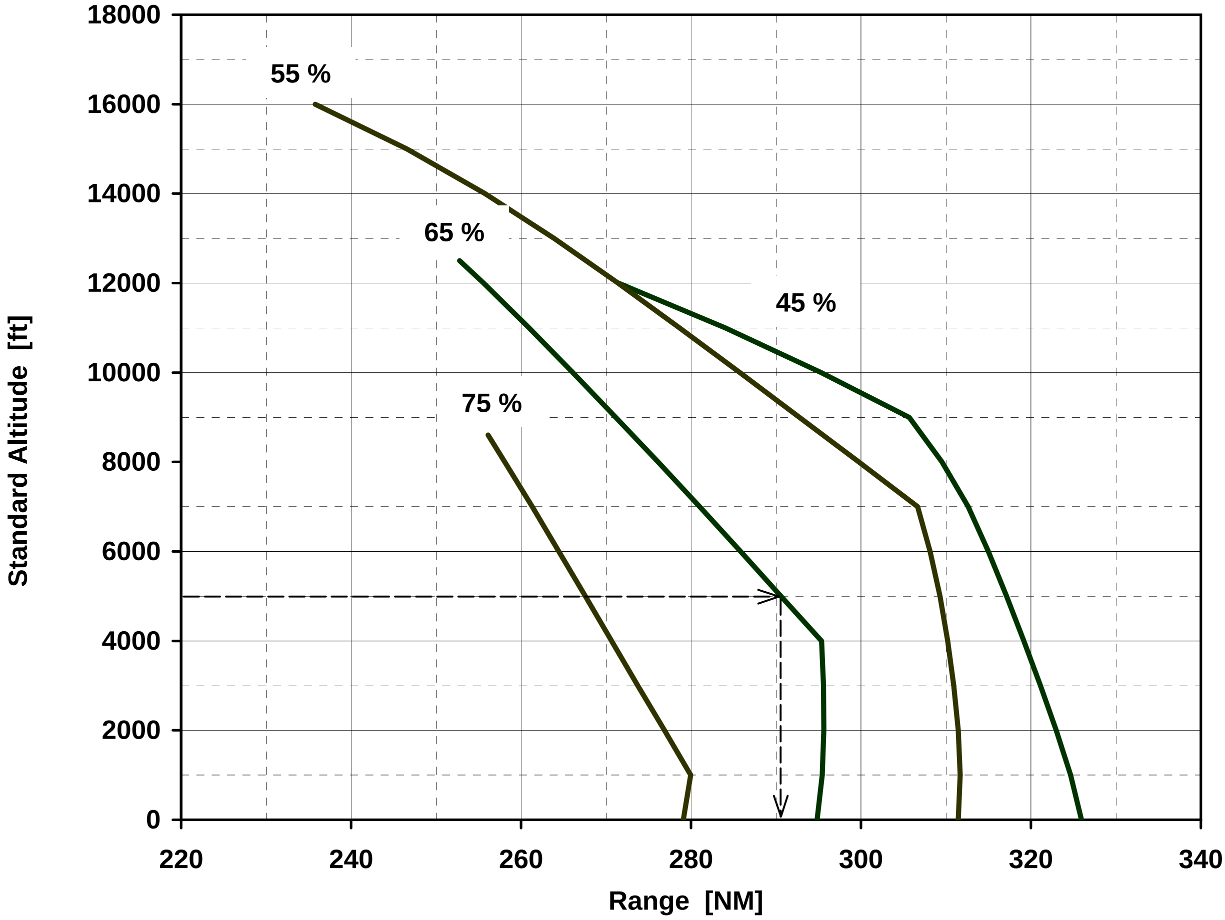
Result
Range : 700 NM

Fig. 5.13d RANGE [126 litres usable Fuel, AIR COND ON]

NOTE
Interpolate the range linearly between 252 and 126 litres fuel. (See Fig. 5.13 "Range 252 litres usable Fuel")

CONDITIONS

- No Wind and no Rain
- Standard Atmosphere
- Takeoff Mass 1440 kg (3175 lbs)
- 126 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sea level according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power
- AIR COND ON



Example
You plan to fly at 5000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

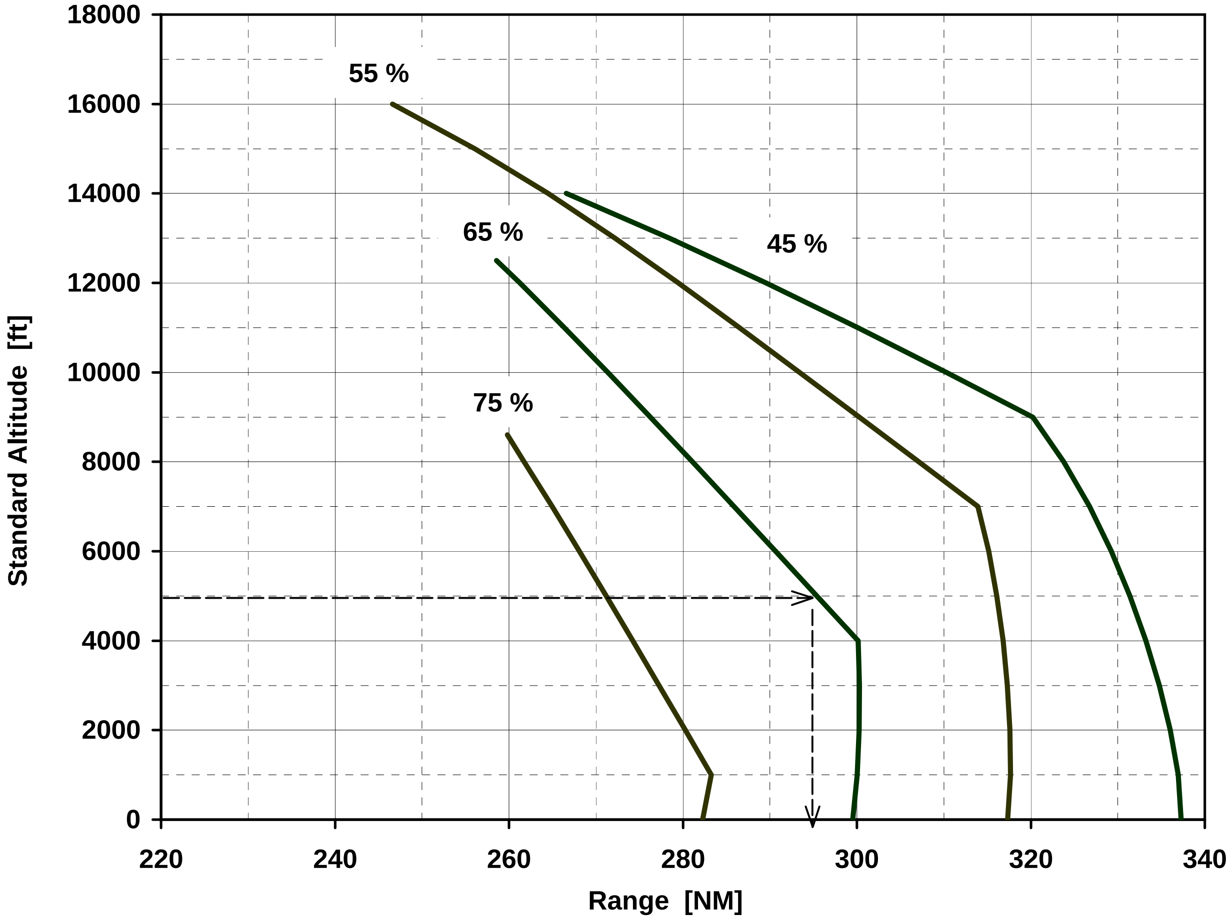
Result
Range : 290 NM

Fig. 5.13e RANGE [126 litres usable Fuel, AIR COND OFF]

NOTE
Interpolate the range linearly between 252 and 126 litres fuel. (See Fig. 5.13a "Range 252 litres usable Fuel")

CONDITIONS

- No Wind and no Rain
- Standard Atmosphere
- Takeoff Mass 1440 kg (3175 lbs)
- 126 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8a
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power
- AIR COND OFF



Example
You plan to fly at 5000 ft with a Power Setting of 65%.
What is the maximum Range according to the Conditions?

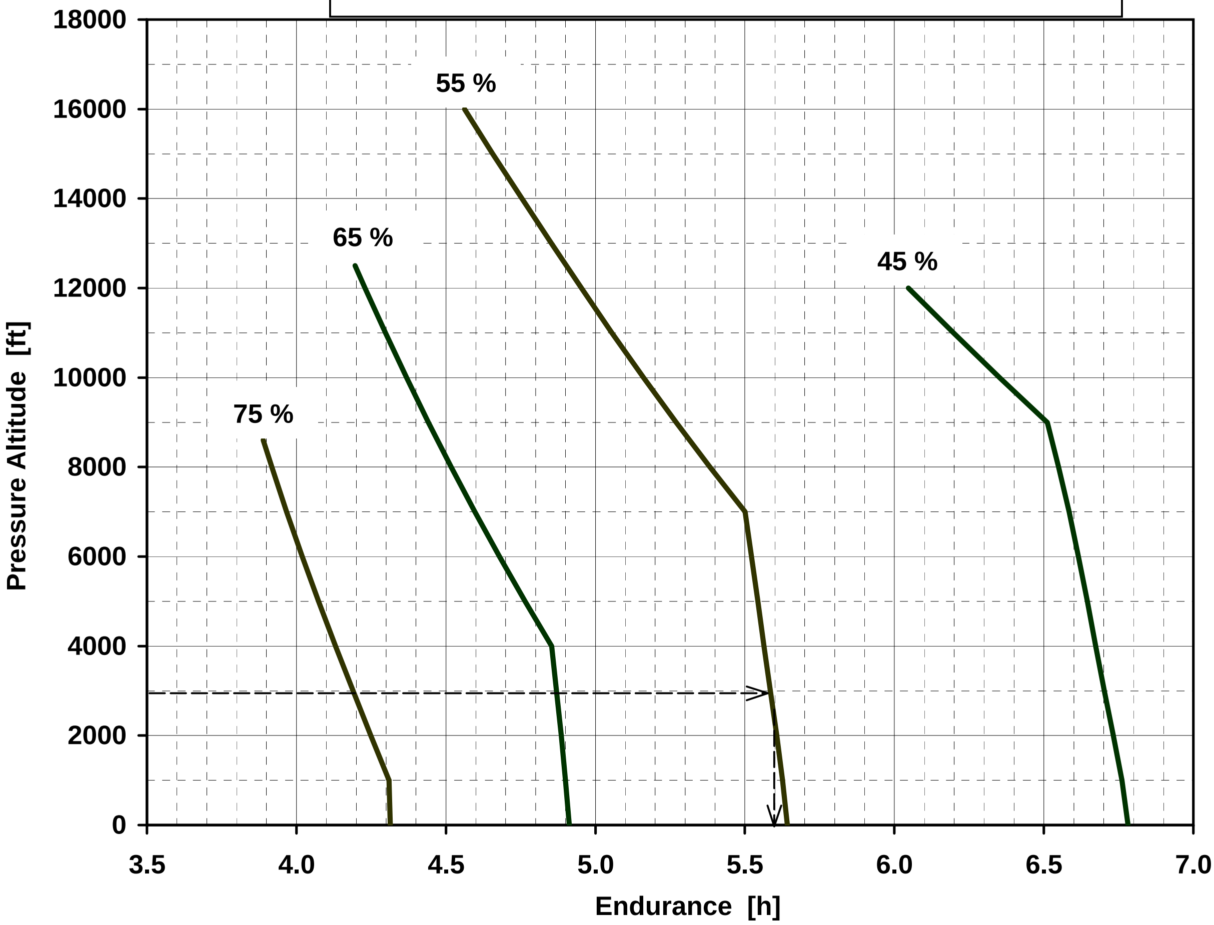
Result
Range : 295 NM

Fig. 5.14 ENDURANCE [252 litres usable Fuel]

CONDITIONS

- ISA Temperature
- Mass 1490 kg (3285 lbs)
- 252 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy“
- including 45 minutes reserve fuel at 45% engine power

Note
The deviation of data according to ISA variation (+40 up to -30°C) is in the worst case below 2%



Example
You plan to fly at 3000 ft with a Power Setting of 55%.
What is the maximum Endurance according to the Conditions?

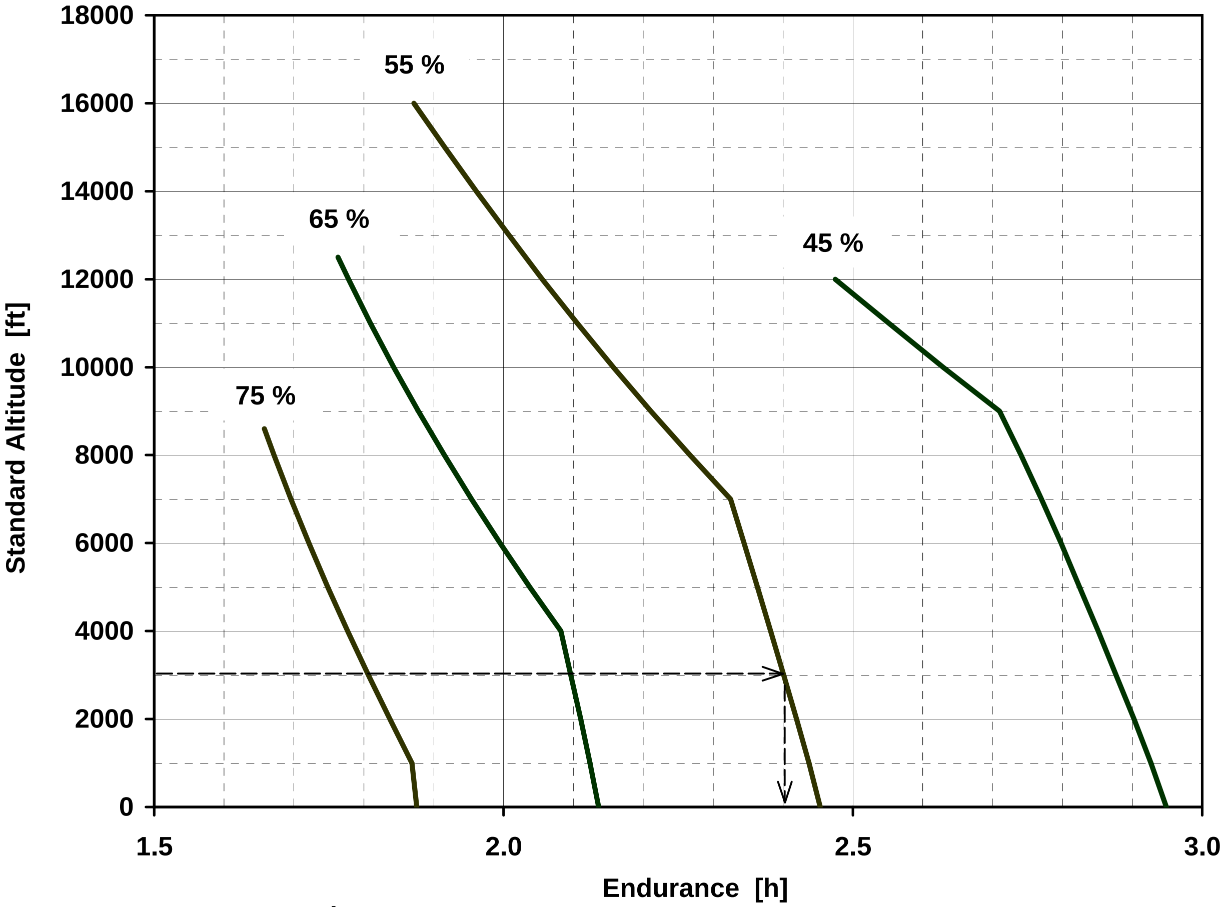
Result
Endurance : 5,6 hours (5h 36min)

Fig. 5.14a ENDURANCE [126 litres usable Fuel]

NOTE
Interpolate the endurance linearly between 252 and 126 litres fuel. (See Fig. 5.14 "endurance 252 litres usable Fuel")

CONDITIONS

- Standard Atmosphere
- Takeoff Mass 1440 kg (3175 lbs)
- 126 litres usable Fuel before Engine Start
- 3 litres used Fuel for Taxi, Engine warm up and Takeoff
- Climb from Sealevel according to Fig. 5.8
- Cruise according to Fig. 5.10
- MP and RPM according to Fig. 5.11/5.12 at „Economy"
- including 45 minutes reserve fuel at 45% engine power



Example
You plan to fly at 3000 ft with a Power Setting of 55%.
What is the maximum Endurance according to the Conditions?

Result
Endurance : 2,4 hours (2h 24min)

Fig. 5.15 LANDING DISTANCE [FLAPS LAND]

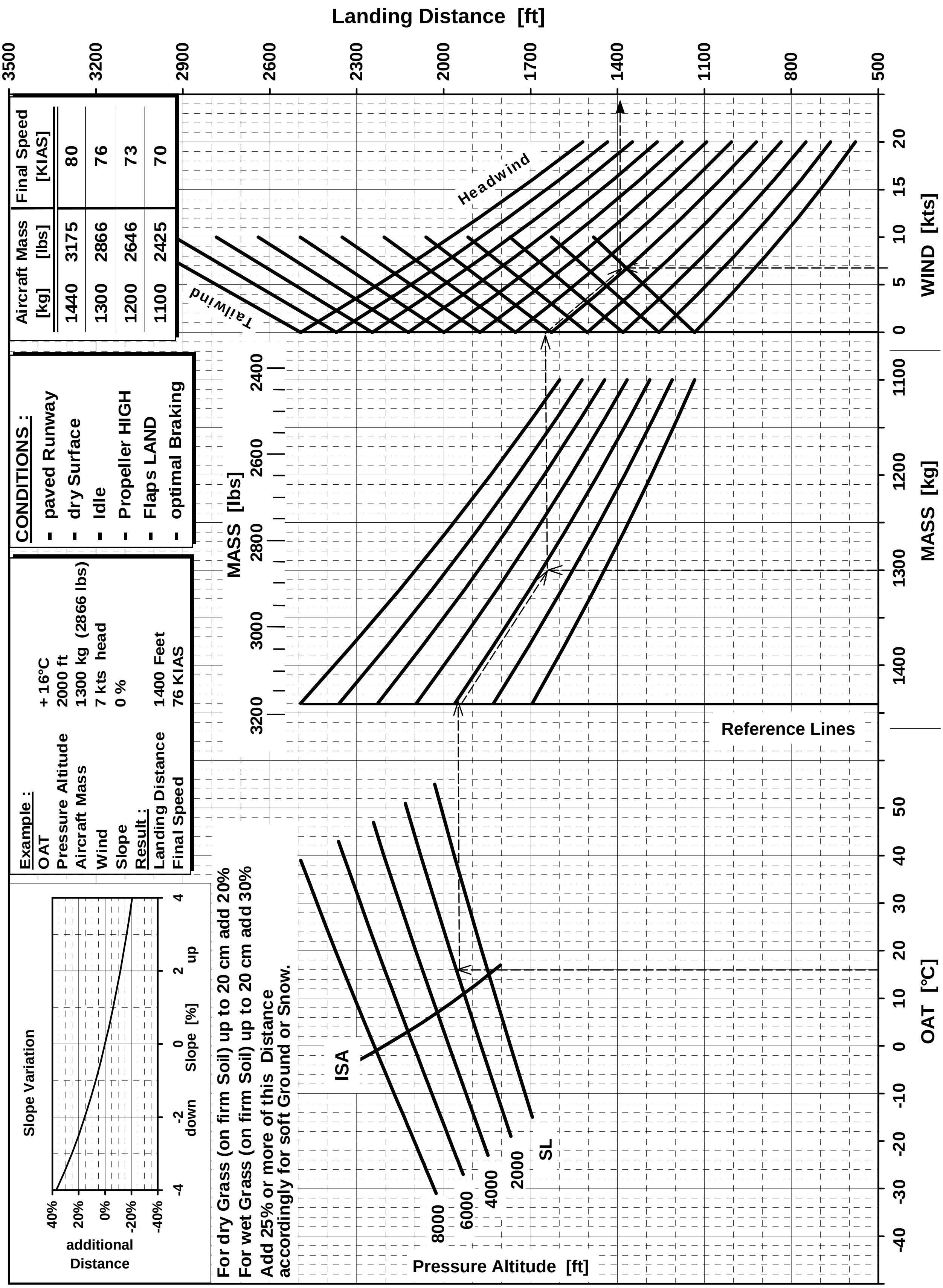


Fig. 5.15a LANDING DISTANCE [FLAPS UP]

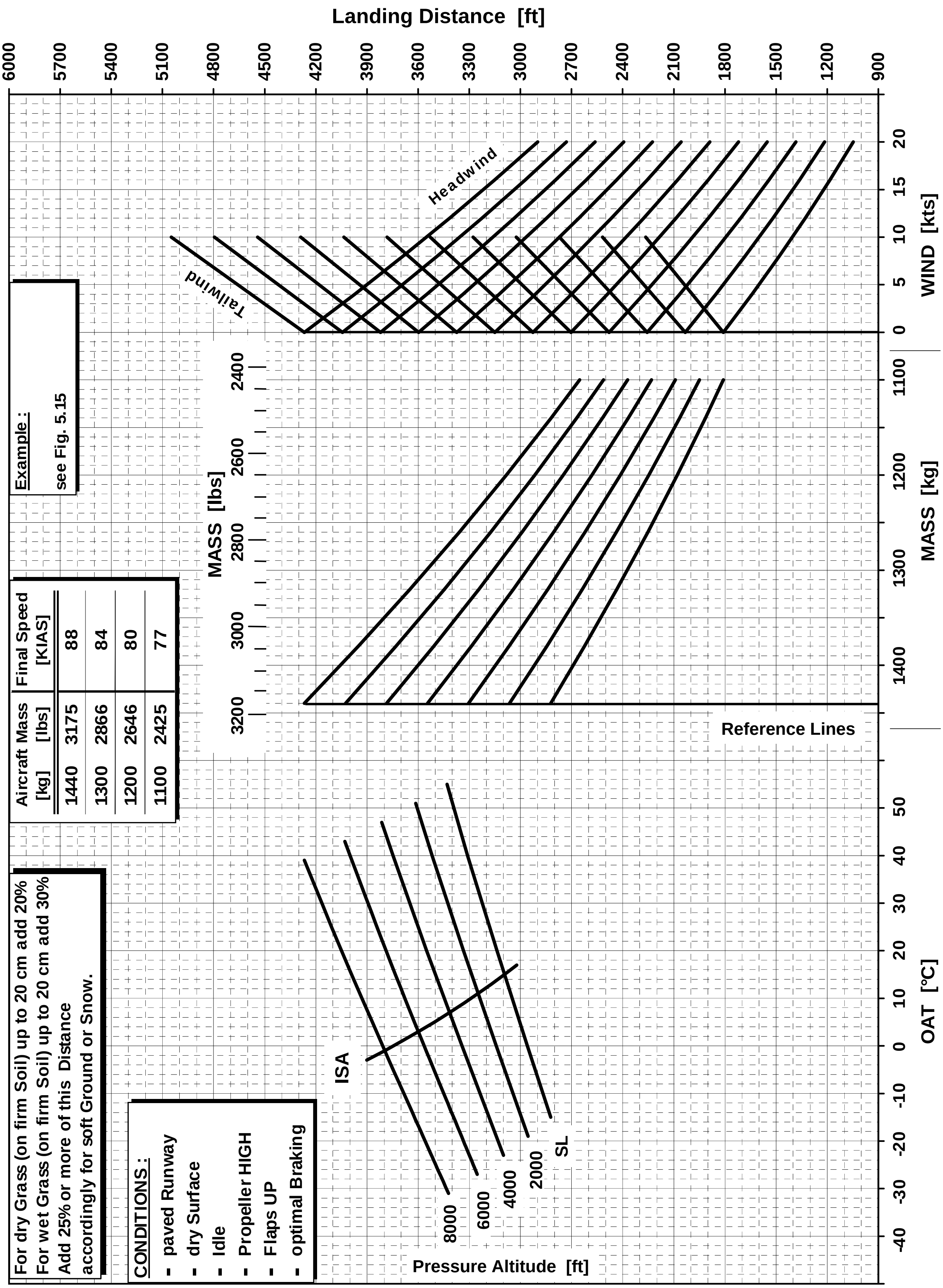


Fig. 5.15b LANDING DISTANCE [FLAPS TAKEOFF]

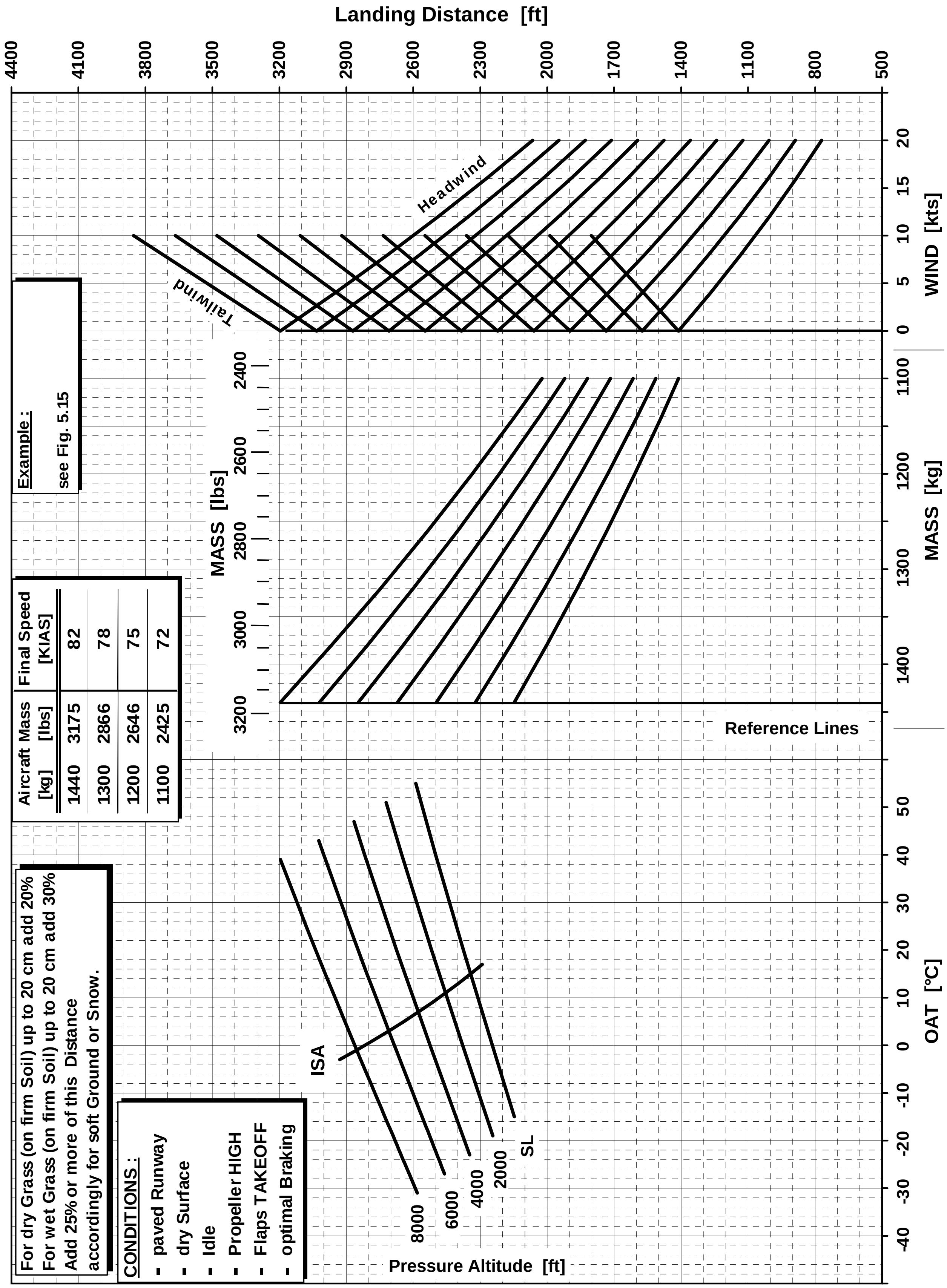
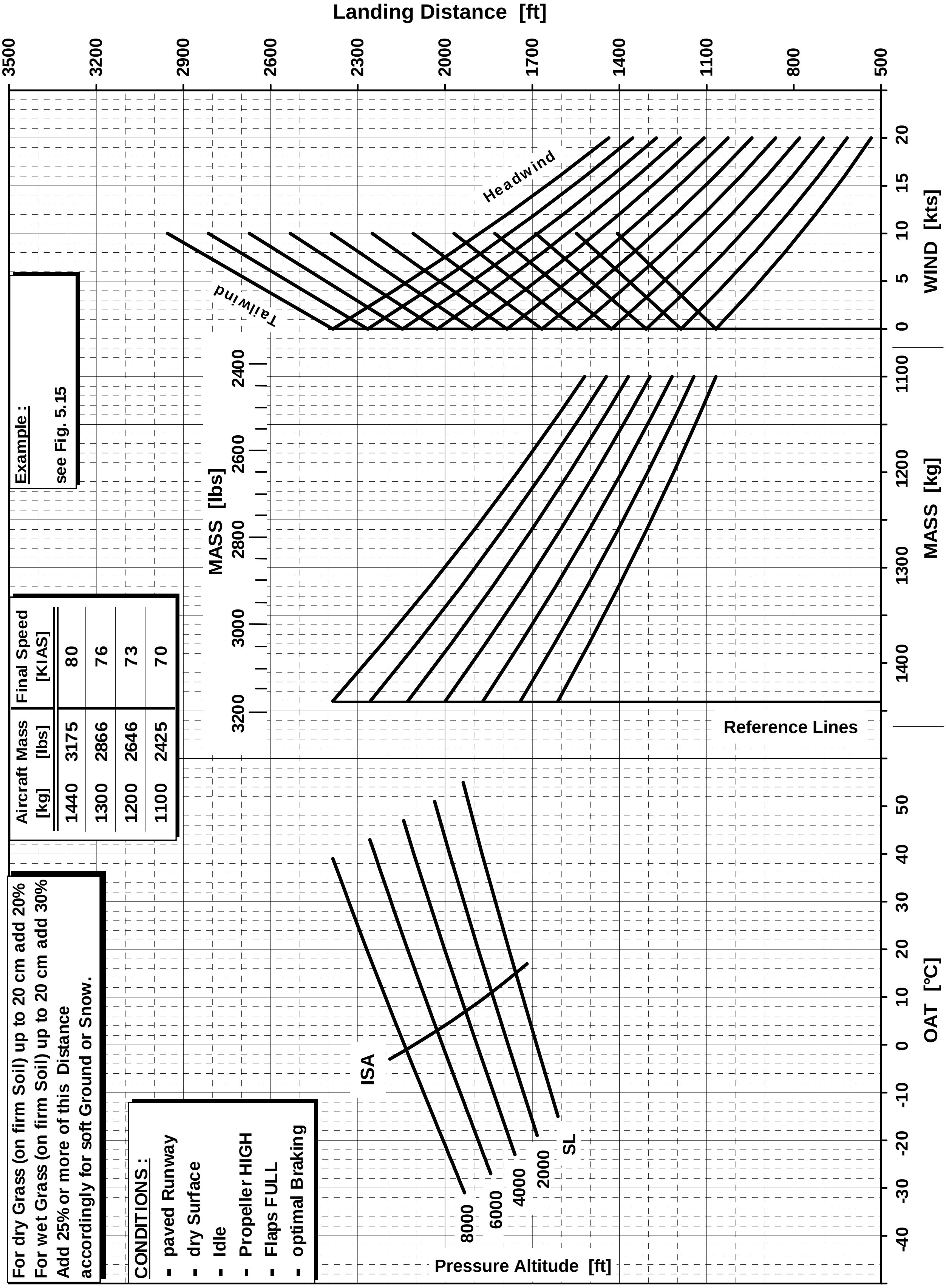


Fig. 5.15c LANDING DISTANCE [FLAPS FULL]



Aircraft Mass [kg]	Aircraft Mass [lbs]	Final Speed [KIAS]
1440	3175	80
1300	2866	76
1200	2646	73
1100	2425	70

SECTION 6
WEIGHT AND BALANCE

Table of Contents

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SECTION 6 WEIGHT AND BALANCE

6.1 General

In this Section, we use the terms Mass and Mass moment to comply with the Systeme Internationale (SI) system of units. The airplane is weighed to find its mass, measured in kilograms. The product of the mass and the lever arm about a reference point is called the mass moment.

In order to achieve the flight performance, safety and good flight characteristics which are designed into the airplane, it must be flown with the mass and center of gravity position within the approved operating range.

permissible weight and balance limits. The approved Center of Gravity limits in flight are given in Section 2.

Airplane attitude for weighing: bottom edge of canopy frame (fuselage) horizontal.

Center of Gravity is calculated. The empty mass contains the basic empty mass plus the optional equipment installed at delivery.

If the installation is changed, or any modifications to the airplane are undertaken, the mechanic or inspector who is responsible for the work is required to calculate the new basic empty mass and the center of gravity location through calculation and/or weighing and to enter the results in the Weight and Balance record.

The calculation of mass and mass moment is always necessary, to determine how much fuel can be loaded, to remain within the permissible boundaries. To prevent overloading, the mass of the crew and baggage should be calculated before the fuel.

The following pages show the prescribed forms for airplane weighing and the calculation of the basic empty mass, center of gravity and useful load. The useful load includes the usable fuel, crew, passenger and baggage.

6.2 Airplane Weighing Procedure

A requirement for the calculation of the Center of Gravity location is the location of the basic empty mass Center of Gravity (CG) through weighing. The airplane is put on 3 weighing units (one under each wheel), and leveled so that the bottom edge of the canopy frame is horizontal and the airplane is level laterally.

The empty mass is determined from the sum of the single masses G_N, G_{RH}, and G_{LH}.

Measured at the nose jack.. G_N =............kg (lbs.)

Measured at the right jack ....G_{RH} =............kg (lbs.)

Measured at the left jack.. G_{LH} =............kg (lbs.)

Empty Mass.. $G_E = G_N+G_{LH}+G_{RH}$ =............kg (lbs.)

In this flight manual, all mass moment arms refer to a datum plane at QE zero. The designated reference point (RP) for lever arms used in the weighing process is the wing leading edge at ME 1.150 m (45.3 in.), which represents QE 2.335 m (91.9 in.).

Lever arm nose jack to reference point.. a = ... m (in.)

Lever arm nose jack to datum plane..........x_N=2.335 m (91.1 in.) - a = ... m (in.)

Lever arm right jack to reference point....................................... b_{RH} = ... m (in.)

Lever arm right jack to datum plane......x_{RH}=2.335 m (91.1 in.) + b_{RH} = ... m (in.)

Lever arm left jack to reference point..b_{LH} = ... m (in.)

Lever arm left jack to datum plane.........x_{LH}=2.335 m (91.1 in.) + b_{LH} = ... m (in.)

Moment nose jack ....$M_N=G_N * x_N$ = ... kgm (lbs.in.)

Moment right side .... $M_{RH}=G_{RH} * x_{RH}$ = ... kgm (lbs.in.)

Moment left side .... $M_{LH}=G_{LH} * x_{LH}$ = ... kgm (lbs.in.)

The total empty mass moment is determined from the sum of the single moments: M_N, M_{RH} and M_{LH}.

Empty mass moment..$M_E=M_N+M_{LH}+M_{RH}$ = ... kgm (lbs.in.)

Empty mass Center of Gravity location...........................$x_E=M_E / G_E$ = ... m (in.)

behind the datum plane

Weighing the airplane and determining the empty mass and Center of Gravity is always done without luggage as follows:

- Engine oil contents full.
- Main fuel tanks drained to the unusable amount of fuel (drain main tank completely and add 5 liters (1.1 Imp. gal, 1.3 US. gal.) of fuel to each main tank).
- Hydraulic and brake fluid full.
- Refrigerant full.
- Seats in the third catch from front.
- Canopy locked.
- Equipment list updated.

Use the Weight and Balance form (Fig.6.1) when you weigh the airplane. Following the calculation of the empty mass and the Center of Gravity location, an inspector is to enter the values in the Weight and Balance record.

After repairs, repainting, installing additional equipment or at regular intervalls, the empty mass and Center of Gravity location must be determined.

It may be desirable in the case of nose heavy airplanes, to install fixed ballast at the provided locations at the vertical stabilizer spar, to enable all pilots to fly the airplane in the certified Center of Gravity range. The Weight and Balance form provides space to enter mass and lever arm of such ballast and the resulting basic empty mass and Center of Gravity location.

Fig. 6.1 Weighing Form

Registration: ____________ S/N: ________ Date: ________

Datum plane: QE zero

Reference Point: Wing leading edge at ME 1150 mm (45.3 in.) = QE 2.335 m (91.9 in.)

Level plane: ....Bottom edges of canopy frame longitudinally and laterally level

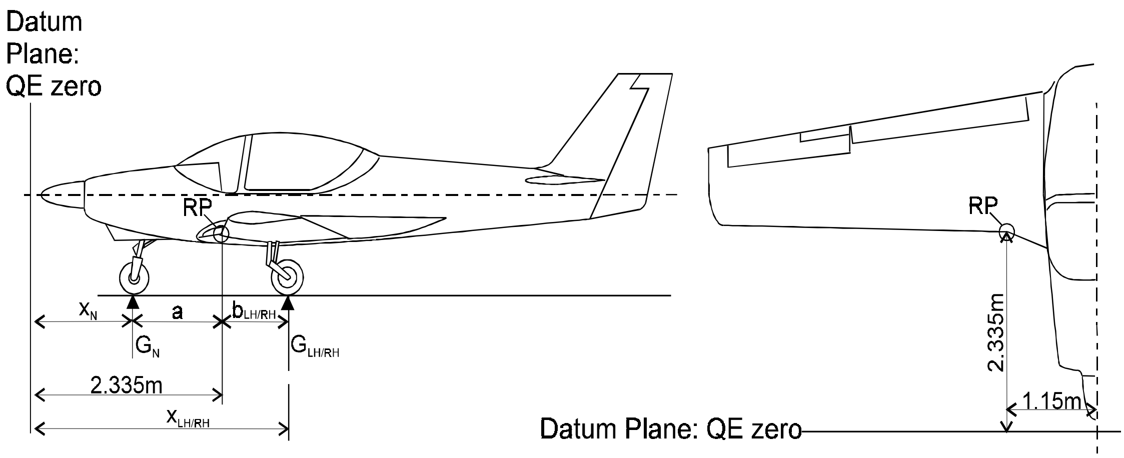
Weighing conditions:

Engine oil, brake fluid, hydraulic fluid, air conditioning refrigerant filled to maximum

Usable fuel drained = drained main tank completely and 8 lbs unusable fuel per main tank added

Seats adjusted in third catch from front. Canopy locked

For equipment installed during weighing see equipment List dated: ____________



	Arm from Ref. Point [m] / [in.]	Scale Reading kg] / [lbs.]	Scale Error kg] / [lbs.]	Net mass kg] / [lbs.]	Arm from Datum Plane [m QE] / [in. QE]	Moment [kgm] / [lbs.in.]
Left Side	b_{LH} =			G_{LH} =	x_{LH} =b_{LH}+2.335 m (91.1 in.)	M_{LH} =G_{LH}*x_{LH}
Right Side	b_{RH} =			G_{RH} =	x_{RH} =b_{RH}+2.335 m (91.1 in.)	M_{RH} =G_{RH}*x_{RH}
Nose	a =			G_N =	x_N =2.335 m -a	M_N =G_N*x_N
Airplane empty mass and CG				G_E =G_{LH}+G_{RH}+G_N	X_E =M_E/G_E	M_E =M_{LH}+M_{RH}+M_N
Fixed ballast installed after weighing:				G_B =	x_B =	M_B =G_B*x_B
Airplane basic empty mass and CG				G =G_E+G_B	X_{CG} =M/G	M =M_E+M_B

6.3 Weight and Balance Record

Fig 6.2 shows the weight and balance record form. The basic empty mass and the corresponding CG location are the first entries made in the Weight and Balance record. This form is provided to present the current status of the airplane basic empty mass, empty mass CG location, empty mass moment and a complete history of previous structural or equipment modifications.

Any change to the permanently installed equipment or modification or airplane repair which affects empty mass, empty mass CG or empty mass moment must be entered in the Weight and Balance record.

For the calculation of the gross mass and corresponding CG location, or the mass moment respectively, always use the basic empty mass, current empty mass CG location and the corresponding empty mass moment.

Fig. 6.2 Weight and Balance Record

Grob G 120A			**Serial Number:**				**Registration:**					**Page No.**	
Date	Item No.		Description of article or modification	Mass Change						Running basic empty Mass		Inspector/ Date and Stamp	
	IN	OUT		Added (+)			Removed (-)						
				Mass kg (lbs.)	Arm m (in)	Moment kgm (lbs.in.)	Mass kg (lbs.)	Arm m (in)	Moment kgm (lbs.in.)	Mass kg (lbs.)	Moment kgm (lbs.in.)	Inspection Date	Stamp

6.4 Mass and Mass Moment Calculations for Flight

The following information is intended to assist you in operating the G 120A within the prescribed mass and center of gravity envelope. To determine the mass and center of gravity for the flight, use the graphs Fig 6.3 'Permissible Center of Gravity Limits', Fig 6.4 'Permissible Mass Moment Limits', Fig 6.5 'Pilot and Co-pilot Loading Table', Fig 6.6 'Baggage Loading Table', Fig 6.7 'Fuel Loading Table' and Fig 6.8/9, 'Calculation of the Loading Condition' as follows.

First obtain the basic mass and corresponding CG location of the airplane from the Weighing Form or the Weight and Balance Record and enter them in the corresponding columns headed 'Your Airplane' of Fig 6.9 'Calculation of the Loading Condition'.

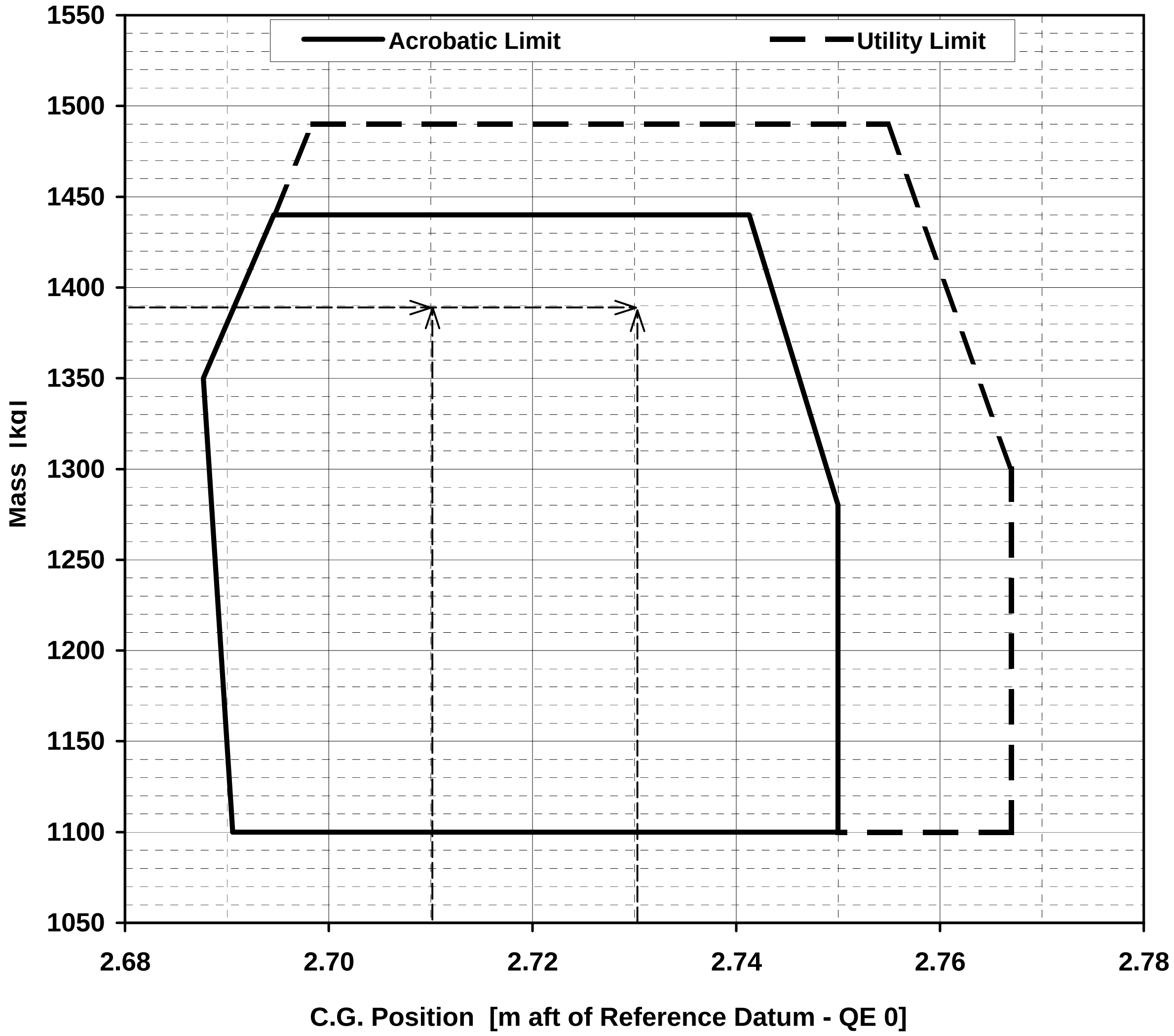
Then using the 'Loading Tables' (Fig 6.5-6.7), determine the mass moment of all payload items and enter these masses and mass moments into the corresponding column of Fig 6.9.

NOTE

The baggage table applies to baggage stowed in the center of the baggage compartment. Loading conditions must be taken into account accordingly by changing the arm entries. The arm for baggage located in the center of the baggage area is 3.82 m (150.4 in.). The arm for The mass moments of loads which may deviate from their indicated location in the airplane according to the loading diagram, must be additionally computed on the basis of their actual mass and arm.

Add the masses and mass moments of each column (item 4 and item 5 in Fig 6.8/9) and enter the resulting sums in Fig 6.4 'Permissible Mass Moment Limits' to check whether they are within the envelope so that the loading condition is permissible.

Fig. 6.3 Permissible Center of Gravity Limits (kg, m)



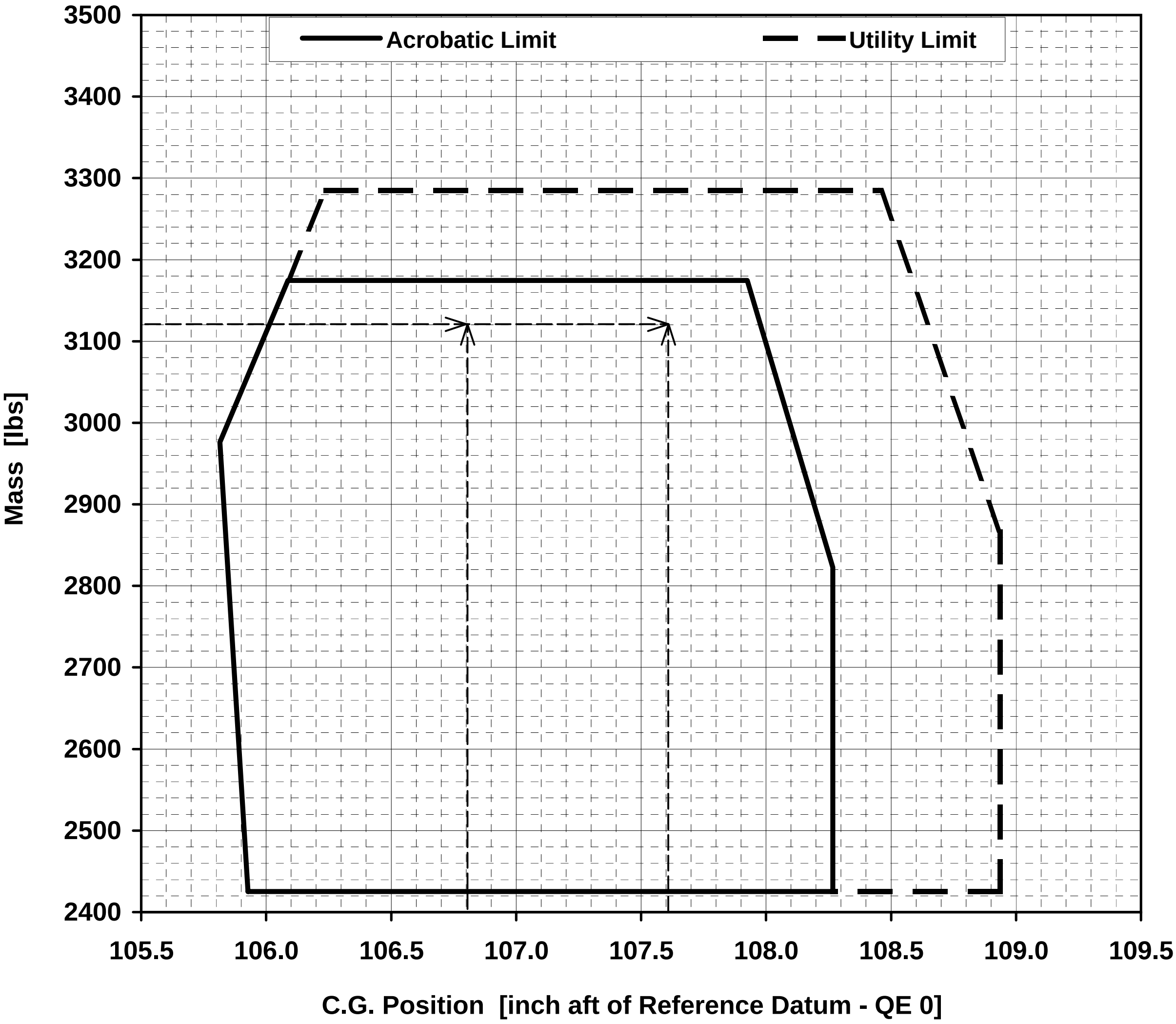
The airplane has a total mass of 1390 kg and
a C.G. position between 2,71 and 2,73 m.
Is the loading condition permissible?

Find the value 1390 on the vertical axis 'Mass [kg].
Draw a horizontal line to cross the envelope.

Find the value 2,71 and 2,73 on the horizonal axis 'C.G. Position [m].
Draw a vertical line to cross the envelope.

The point where the 2 lines intersect is the loading condition.
The loading condition lies inside the envelpoe and so is permissible.

Fig. 6.3a Permissible Center of Gravity Limits (lbs, in)



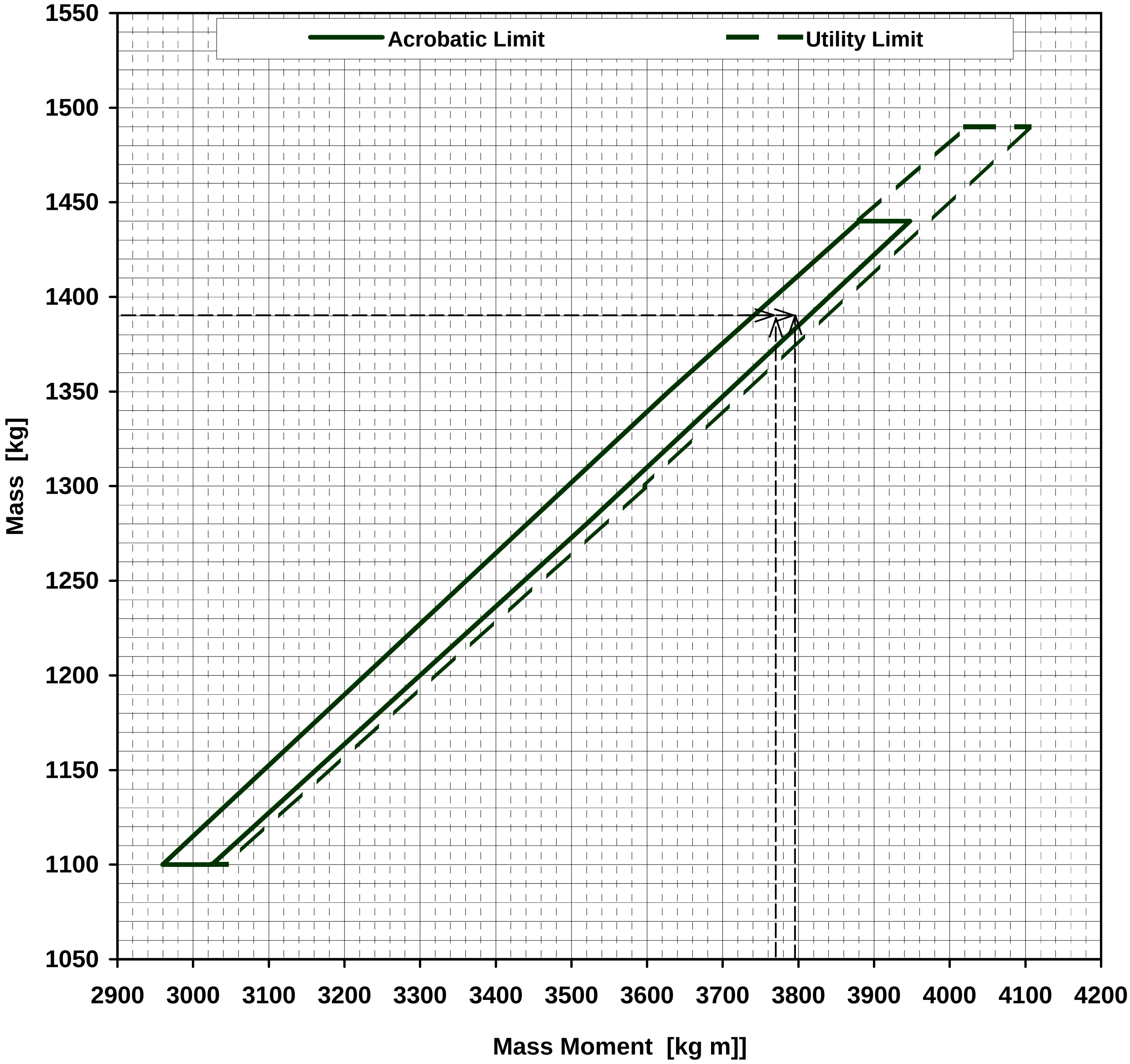
The airplane has a total mass of 3120 lbs and a C.G. position between 106,8 and 107,6 inch.
Is the loading condition permissible?

Find the value 3120 on the vertical axis 'Mass [lbs].
Draw a horizontal line to cross the envelope.

Find the value 106,8 and 107,6 on the horizonal axis 'C.G. Position [inch].
Draw a vertical line to cross the envelope.

The point where the 2 lines intersect is the loading condition.
The loading condition lies inside the envelpoe and so is permissible.

Fig. 6.4 Permissible Mass Moment Limits (kg, m)



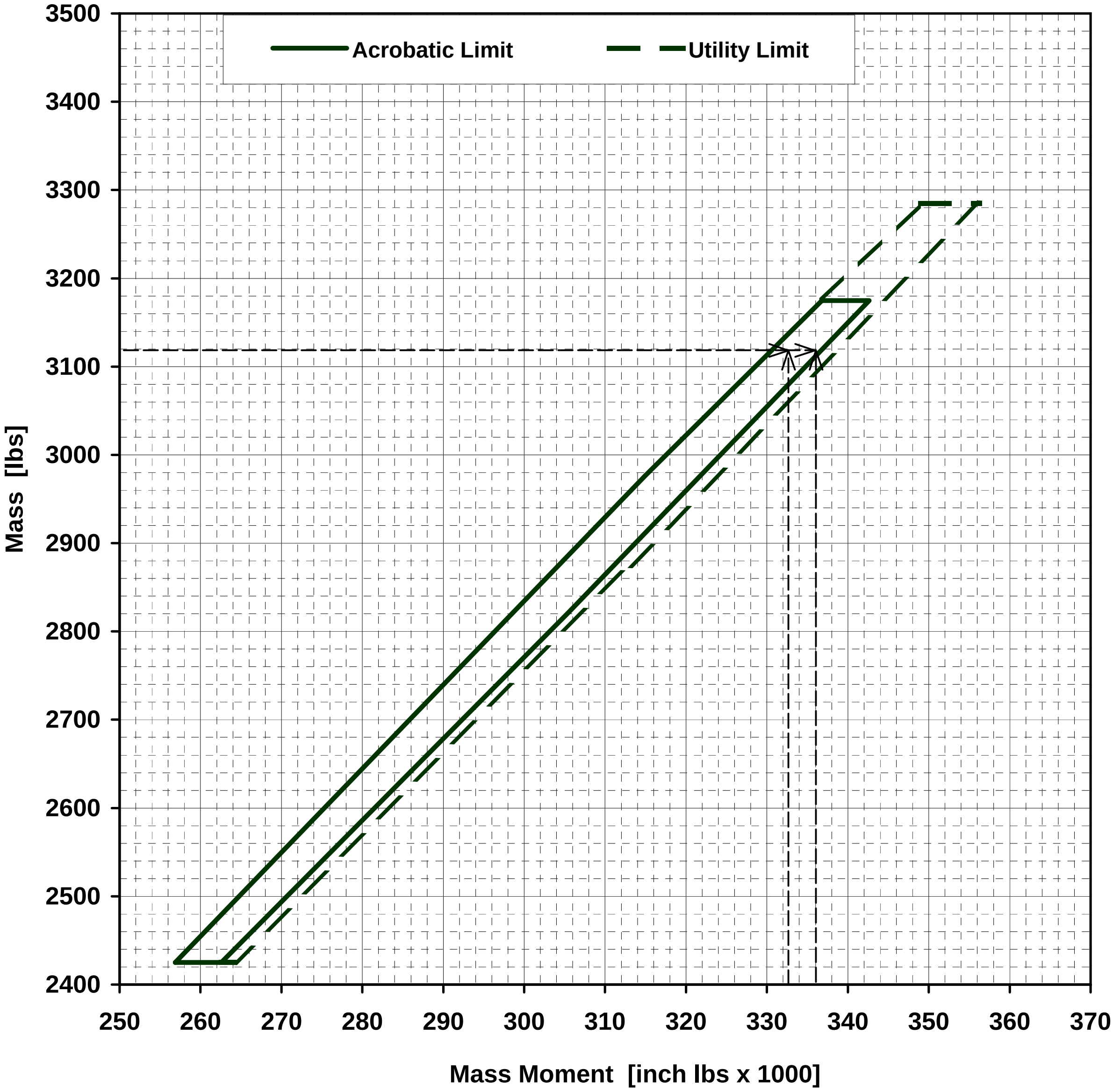
The airplane has a total mass of 1390 kg and a mass moment between 3767 and 3795 kg m.
Is the loading condition permissible?

Find the value 1390 on the vertical axis 'Mass [kg].
Draw a horizontal line to cross the envelope.

Find the value 3767 and 3795 on the horizonal axis 'Mass Moment [kg m].
Draw a vertical line to cross the envelope.

The point where the 2 lines intersect is the loading condition. The loading condition lies inside the envelope and so is permissible.

Fig. 6.4a Permissible Mass Moment Limits (lbs, in)



The airplane has a total mass of 3120 lbs and a mass moment between 333 and 336 inch lbs × 1000.
Is the loading condition permissible?

Find the value 3120 on the vertical axis 'Mass [lbs].
Draw a horizontal line to cross the envelope.

Find the value 333 and 336 on the horizonal axis 'Mass Moment [inch lbs × 1000].
Draw a vertical line to cross the envelope.

The point where the 2 lines intersect is the loading condition.
The loading condition lies inside the envelope and so is permissible.

Fig. 6.5 Pilot and Co-Pilot Loading Table

Mass	Pilot or Copilot's Seat Position		Mass	Pilot or Copilot's Seat Position	
	forward	aft		forward	aft
[kg]	**Mass Moment [kg m]**		**[lb]**	**Mass Moment [lbs.in.]**	
50	138.35	149.02	110	12001	12859
55	152.24	163.80	121	13201	14145
60	166.13	178.57	132	14401	15431
65	180.01	193.35	142	15601	16717
70	193.90	208.12	154	16801	18003
75	207.78	222.90	165	18001	19289
80	221.67	237.67	176	19201	20574
85	235.56	252.45	187	20402	21860
90	249.44	267.22	198	21602	23146
95	263.33	282.00	209	22802	24432
100	277.21	296.77	220	24002	25718
105	291.10	311.55	231	25202	27004
110	304.99	326.32	243	26511	28407
115	318.87	341.10	254	27711	29693
120	332.76	355.87	265	28911	30979
125	346.64	370.65	276	30111	32265
130	360.53	385.42	287	31312	33551

In this table, the most forward and most aft seat positions are listed. Interpolation for intermediate positions can be made linearly as necessary.

Fig. 6.6 Baggage Loading Table

Mass **[kg]**	Baggage Compartment *Center Position* **Mass Moment [kg m]**	Mass **[lbs]**	Baggage Compartment *Center Position* **Mass Moment [lbs.in]**
5	19	11	1654
10	38	22	3309
15	57	33	4963
20	76	44	6618
25	96	55	8272
30	115	66	9926
35	134	77	11581
40	153	88	13235
45	172	99	14890
50	191	110	16544

Fig. 6.7 Fuel Loading Table

Mass		Wing Tanks	Wing Tanks
[kg]	[lbs]	Mass Moment [kg m]	Mass Moment [lbs.in.]
10	22.05	26.75	2322
20	44.09	53.50	4643
30	66.14	80.25	6965
40	88.18	107.00	9287
50	110.23	133.75	11608
60	132.28	160.50	13930
70	154.32	187.25	16252
80	176.37	214.00	18573
90	198.41	240.75	20895
100	220.46	267.50	23217
110	242.51	294.25	25538
120	264.55	321.00	27860
130	286.60	347.75	30182
140	308.64	374.50	32503
150	330.69	401.25	34825
160	352.74	428.00	37147
170	374.78	454.75	39468
180	396.83	481.50	41790

The lever arm for the fuel is 2.675 m QE (105.31 in.).

The values of mass in this table refer to a specific gravity for AVGAS 100/100LL of 0.72 kg/ Liter (7.6 lbs/Imp.gal, 6 lbs./USgal). If the specific gravity of your fuel is significantly different, use your value to calculate the mass and mass moment.

Fig. 6.8 Calculation of the Loading Condition – Example (kg, m)

G 120A – Example (in kg and m)			Seat position				
			forward		rearward		
		Mass [kg]	Mass Moment [kg m]	C.G. Position [m]	Mass Moment [kg m]	C.G. Position [m]
1	Basic mass and mass moment	1080.3	2927.3		2927.3	
2	Pilot and Co-Pilot (2 x 70 kg, see Fig 6.5)	140.0	387.8		416.2	
3	Baggage (See Fig 6.6)	0.0	0.0		0.0	
4	Mass and mass moment with unusable fuel (sum of 1, 2 and 3)	1220.3	3315.1	2.72	3343.5	2.74
5	176 litres usable fuel (See Fig 6.7) (at 0.72 kg / litre, Lever arm: 2.675 m QE)	127.0	339.7		339.7	
6	Total mass and mass moment with fuel (sum of 4 and 5)	1347.3	3654.8	2.71	3683.2	2.73
7	Check the calculated values from row 4 and 6 in the graph "Permissible Center of Gravity and/or Moment Limits" Fig 6.3 / 6.4 If the point where the mass and mass moment or center of gravity values intersect lies within the permissible envelope, the loading condition is permissible.					

Fig. 6.9 Calculation of the Loading Condition – Your Airplane (kg, m)

G 120A Registration: _______________			Seat position			
			forward		rearward	
		Mass [kg]	Mass Moment [kg m]	C.G. Position [m]	Mass Moment [kg m]	C.G. Position [m]
1	Basic mass and mass moment					
2	Pilot and Co-Pilot (see Fig 6.5)					
3	Baggage (See Fig 6.6)					
4	Mass and mass moment with unusable fuel (sum of 1, 2 and 3)					
5	_____ litres usable fuel (See Fig 6.7) (at 0.72 kg / litre, Lever arm: 2.675 m QE)					
6	Total mass and mass moment with fuel (sum of 4 and 5)					
7	Check the calculated values from row 4 and 6 in the graph "Permissible Center of Gravity and/or Moment Limits" Fig 6.3 / 6.4 If the point where the mass and mass moment or center of gravity values intersect lies within the permissible envelope, the loading condition is permissible.					

Fig. 6.10 Calculation of the Loading Condition – Example (lbs, in)

G 120A – Example (in kg and m)		Mass lbs]	Seat position forward: Mass Moment [in.lbs x 1000]	Seat position forward: C.G. Position [in]	Seat position rearward: Mass Moment [in.lbs x 1000]	Seat position rearward: C.G. Position [in]
1	Basic mass and mass moment	2382	254		254	
2	Pilot and Co-Pilot (2 x 70 kg, see Fig 6.5)	308	33.66		36.12	
3	Baggage (See Fig 6.6)	0	0		0	
4	Mass and mass moment with unusable fuel (sum of 1, 2 and 3)	2690	287.66	106.94	290.12	107.85
5	280 Pounds usable fuel (See Fig 6.7) (Lever arm: 105.31 in. QE)	280	29.49		29.49	
6	Total mass and mass moment with fuel (sum of 4 and 5)	2970	317.15	106.78	319.61	107.61
7	Check the calculated values from row 4 and 6 in the graph "Permissible Center of Gravity and/or Moment Limits" Fig 6.3a / 6.4a If the point where the mass and mass moment or center of gravity values intersect lies within the permissible envelope, the loading condition is permissible.					

Fig. 6.11 Calculation of the Loading Condition – Your Airplane (lbs, in)

G 120A Registration: _______________		Mass lbs]	Seat position forward: Mass Moment [in.lbs x 1000]	Seat position forward: C.G. Position [in]	Seat position rearward: Mass Moment [in.lbs x 1000]	Seat position rearward: C.G. Position [in]
1	Basic mass and mass moment					
2	Pilot and Co-Pilot (see Fig 6.5)					
3	Baggage (See Fig 6.6)					
4	Mass and mass moment with unusable fuel (sum of 1, 2 and 3)					
5	_____ Pounds usable fuel (See Fig 6.7) (Lever arm: 105.31 in. QE)					
6	Total mass and mass moment with fuel (sum of 4 and 5)					
7	Check the calculated values from row 4 and 6 in the graph "Permissible Center of Gravity and/or Moment Limits" Fig 6.3a / 6.4a If the point where the mass and mass moment or center of gravity values intersect lies within the permissible envelope, the loading condition is permissible.					

6.5 Equipment List

The following is a list of equipment available at this time. All of the items installed in your airplane are identified in the corresponding column.

The present equipment list contains the following details:

- The item number consists of a letter identification for the associated group and a sequence number.

Letter identification is as follows:

A	Avionics
E	Electrical
I	Instrumentation
S	Systems
T	Engine
Z	Airframe

- The column "Code" identifies whether the equipment item is a mandatory, standard or optional equipment item according to the following abbreviations:

A	Mandatory equipment item
B	Standard equipment item
C	Optional equipment item
D	Additional optional equipment item
E	Loose item of equipment, not included in the airplane empty weight

NOTE

When an optional equipment item is installed, this must be in agreement with the corresponding installation drawing, equipment instructions or in compliance with special approval of the Civil Aviation Authorities.

The columns "Mass" and "Arm" list the weight and and C.G. location relative to the datum of the equipment item, positive relating to distances aft of the datum, and vice versa.

Equipment List

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
A 1		Audio Panel Garmin GMA 340H	0.55	1.21	2.300	90.55	1.265 109.80
A 2		Marker Antenna COMANT IND. CI 102	0.22	0.49	3.832	150.87	0.843 73.17
A 3		COM 1 Antenna COMANT IND. CI 211-16	0.60	1.32	4.150	163.39	2.490 216.12
A 4		COM/NAV/GPS 1 Garmin GNS 430	2.32	5.11	2.300	90.55	5.336 463.14
A 5		COM 2/ GPS 2 Antenna COMANT IND. CI 2480-201	0.27	0.60	5.540	218.11	1.496 129.83
A 6		COM/NAV/GPS 2 GARMIN GNS 430	2.32	5.11	2.300	90.55	5.336 463.14
A 7							
A 8							
A 9		EHSI 1 SANDEL SN3500	1.37	3.02	2.300	90.55	3.151 273.49
A 10		EHSI 2 SANDEL SN3500	1.37	3.02	2.300	90.55	3.151 273.49
A 11		COM 3 UHF HONEYWELL KTR 909B	2.29	5.05	4.500	177.17	10.305 894.42
A 12		COM 3 Control Head HONEYWELL KFS 599B	0.40	0.88	2.300	90.55	0.920 79.85
A 13		COM 3 Antenna SENSOR SYSTEMS S65-1227	0.60	1.31	3.540	139.37	2.106 182.82
A 14		DME HONEYWELL KN 63	1.11	2.45	4.500	177.17	4.995 433.54
A 15		DME Indicator HONEYWELL KDI 572	0.34	0.75	2.300	90.55	0.782 67.87

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
A 16		DME Antenna COMANT IND. CI 100-2	0.12	0.26	2.260	88.98	0.271 23.54
A 17		ELT KANNAD 406AF	1.18	2.60	4.500	177.17	5.310 460.88
A 18		ELT Antenna DG 720063	0.15	0.33	6.290	247.64	0.944 81.89
A 19		ELT Remote Switch KANNAD RCP 200	0.04	0.09	2.300	90.55	0.092 7.99
A 20		GPS 1 Antenna COMANT IND. CI 420-221	0.08	0.18	7.580	298.42	0.606 52.63
A 21							
A 22							
A 23							
A 24		KCS 55 A Slaved Compass System HONEYWELL KMT 112 (Flux Valve)	0.13	0.29	2.930	115.35	0.381 33.06
A 25		KCS 55 A Slaved Compass System HONEYWELL Direct. Gyro KG 102 A	1.96	4.32	4.500	177.17	8.820 765.53
A 26		ADF Antenna HONEYWELL KA 44B	1.76	3.88	3.540	139.37	6.230 540.77
A 27		ADF Receiver HONEYWELL KR 87	1.32	2.91	2.300	90.55	3.036 263.51
A 28							
A 29							
A 30		VOR / LOC / GS 1/2 Antenna COMANT IND. CI 120-1	0.96	2.12	7.150	281.50	6.864 595.76

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
A 31		VOR/LOC/GS 1/2 Power Combiner COMANT IND. CI 120-4	0.08	0.18	7.030	276.77	0.562 48.81
A 32		Transponder GARMIN GTX 330	1.50	3.31	2.300	90.55	3.450 299.44
A 33		Transponder Antenna COMANT IND. CI 100-2	0.12	0.26	2.260	88.98	0.271 23.54
A 34		Audio Board AEE AP 4115 120A-C 913150	0.60	1.32	2.300	90.55	1.380 119.78
A 35		Annunciator Panel COMTRONIC 22-2756 027	0.36	0.79	2.300	90.55	0.828 71.87
A 36		Altitude Encoder ACK A-30 MOD.8	0.15	0.33	2.040	80.31	0.306 26.56
A 37							
A 38							
A 39							
A 40							
A 41							
A 42							
A 43							
A 44							
A 45							

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
E 1		ACL LH (red/white) WHELEN A600-PR-28V	0.24	0.53	2.760	108.66	0.662 57.49
E 2		ACL RH (green/white) WHELEN A600-PG-28V	0.24	0.53	2.760	108.66	0.662 57.49
E 3		ACL Power Wing LH WHELEN A490ATSCF	0.70	1.54	2.660	104.72	1.862 161.61
E 4		ACL Power Wing RH WHELEN A490ATSCF	0.70	1.54	2.660	104.72	1.862 161.61
E 5		Battery CONCORDE RG-24-20	19.10	42.11	5.690	224.02	108.679 9432.80
E 6		Ignition Switch TCM 10-357210-1	0.16	0.353	2.300	90.55	0.368 31.94
E 7		Lift Detector GROB 120A-7090	0.05	0.11	2.350	92.52	0.118 10.20
E 8		Pitot Tube GROB 115TA-7805	1.01	2.23	2.580	101.57	2.606 226.17
E 9		Alternator Control Unit ZEFTRONICS R25V0N	0.11	0.24	1.710	67.32	0.188 16.33
E 10							
E 11							
E 12							
E 13							
E 14		Elevator-Trim Servo with Mount BENDIX-KING KS 272A / KM 0275	1.10	2.43	4.895	192.72	5.385 467.35
E 15							

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
I 1		Accelerometer QED IND. 2117-800 or 2117-832	0.35	0.77	2.300	90.55	0.805 69.87
I 2		Airspeed Indicator LH SIGMA TEK EA 5173-101L	0.34	0.75	2.300	90.55	0.782 67.87
I 3		Airspeed Indicator RH SIGMA TEK EA 5173-101L	0.34	0.75	2.300	90.55	0.782 67.87
I 4		Altimeter LH Revue Thommen 3A63.22.20F.28.1.PR	0.73	1.61	2.300	90.55	1.679 145.73
I 5		Altimeter RH Revue Thommen 3A63.22.20F.28.1.PR	0.73	1.61	2.300	90.55	1.679 145.73
I 6		Attitude Gyro LH MikroTechna LUN 1241.E8G8R	1.40	3.09	2.300	90.55	3.220 279.48
I 7		Attitude Gyro RH SIGMATEC 1U149-021-9	1.01	2.23	2.300	90.55	2.323 201.63
I 8		Vertical Speed Indicator UNITED INSTR. 7000	0.37	0.82	2.300	90.55	0.851 73.86
I 9		Clock GROB-BENZ 115EG-7780	0.13	0.29	2.300	90.55	0.299 25.95
I 10		Compass AIRPATH C 2300 L4-24	0.26	0.57	2.300	90.55	0.598 51.90
I 11		Flight Hours Meter KÜBLER Typ HK 17.251.39.56	0.04	0.09	2.300	90.55	0.092 7.99
I 12		Combined Indicator, analog / Digital (MAP, RPM, EGT, CHT, Oil Press, Oil Temp, Fuel Flow, Fuel QTY LH/RH, Fuel Press, OAT, VDC-Amp). JPI EDM-930	1.33	2.93	2.300	90.55	3.059 265.51
I 13							

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
I 14		Vacuum Indicator UMA 3-200-12	0.04	0.09	2.300	90.55	0.092 7.99
I 15		Turn and Slip Indicator RH EGC 1234T100-(3TZ)	0.56	1.23	2.300	90.55	1.288 111.79
I 16		Turn and Slip Indicator LH United Instruments 9551BN541	0.54	1.19	2.300	90.55	1.242 107.80
S 1		Landing Gear Hydraulic System GROB 120A-C-5700	-	-	-	-	-
S 2		Air conditioning System GROB ECS 120A-7400	-	-	-	-	-

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
T 1		Engine LYCOMING AEIO-540-D4D5	182.30	402.00	1.090	42.91	198.757 17251.15
T 2		Magneto LH SLICK 6393					Part of engine
T 3		Magneto RH SLICK 6350					Part of engine
T 4		Magneto start booster SLICK SS1001	0.27	0.60	1.710	67.32	0.462 40.07
T 5		Fuel Pump LEAR ROMEC RG 9570K1/M					Part of engine
T 6		Electr. Fuel Pump PARKER 1 B 5-14	1.34	2.95	1.870	73.62	2.506 217.49
T 7		Propeller Hartzell, HC-C3YR-1RF/FC7663R	36.00	79.37	0.590	23.23	21.240 1843.53
T-8		Propeller Governor WOODWARD P210761					Part of engine
T 9		Starter Grob G120A-6001					Part of engine
T 10		Generator GROB 120A-6002					Part of engine
T 11		Injector PAM 2576608-1					Part of engine
T 12		Vacuum pump SIGMA TEK 1U478-003					Part of engine
T 13		ECS-Compressor SANDEN Mode Number 7170					Part of engine
T 14		Vacuum Regulator Valve RAPCO RA2H3-12	0.15	0.32	1.850	72.83	0.268 23.28
T 15							

Item No.	Code	Item, Manufacturer, Type	Mass [kg]	Mass [lbs]	Arm [m]	Arm [in]	Moment [kg.m] / [lbs.in]
Z 1		Pilot Seat GROB 120AI-7201	14.00	30.86	2.930	115.35	41.020 3560.34
Z 2		Co-pilot Seat GROB 120AI-7201	14.00	30.86	2.930	115.35	41.020 3560.34
Z 3		Seat belts(For items Z 1, Z 2) SCHROTH 1-09-483D01	-	-	-	-	Part of crew seat
Z 4		Fire Extinguisher (Cockpit) TOTAL HAL 1 0074-00	2.00	4.41	3.260	128.35	6.520 565.90
Z 5		First aid kit ADAMS AVIATION ADAK1	0.70	1.54	3.410	134.25	2.387 207.18
Z 6		Engine fire extinguisher bottle PACIFIC SCIENTIFIC 30300025					
Z 7		Pneumatic fire detector MEGGIT 3001-271-500/245C-4m					
Z-8							
Z 9		Hand Held Light	Not part of the empty mass				
Z 10							
Z 11							
Z 12							
Z 13							
Z 14							
Z 15							

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SECTION 7
AIRPLANE AND SYSTEM DESCRIPTION

Table of Contents

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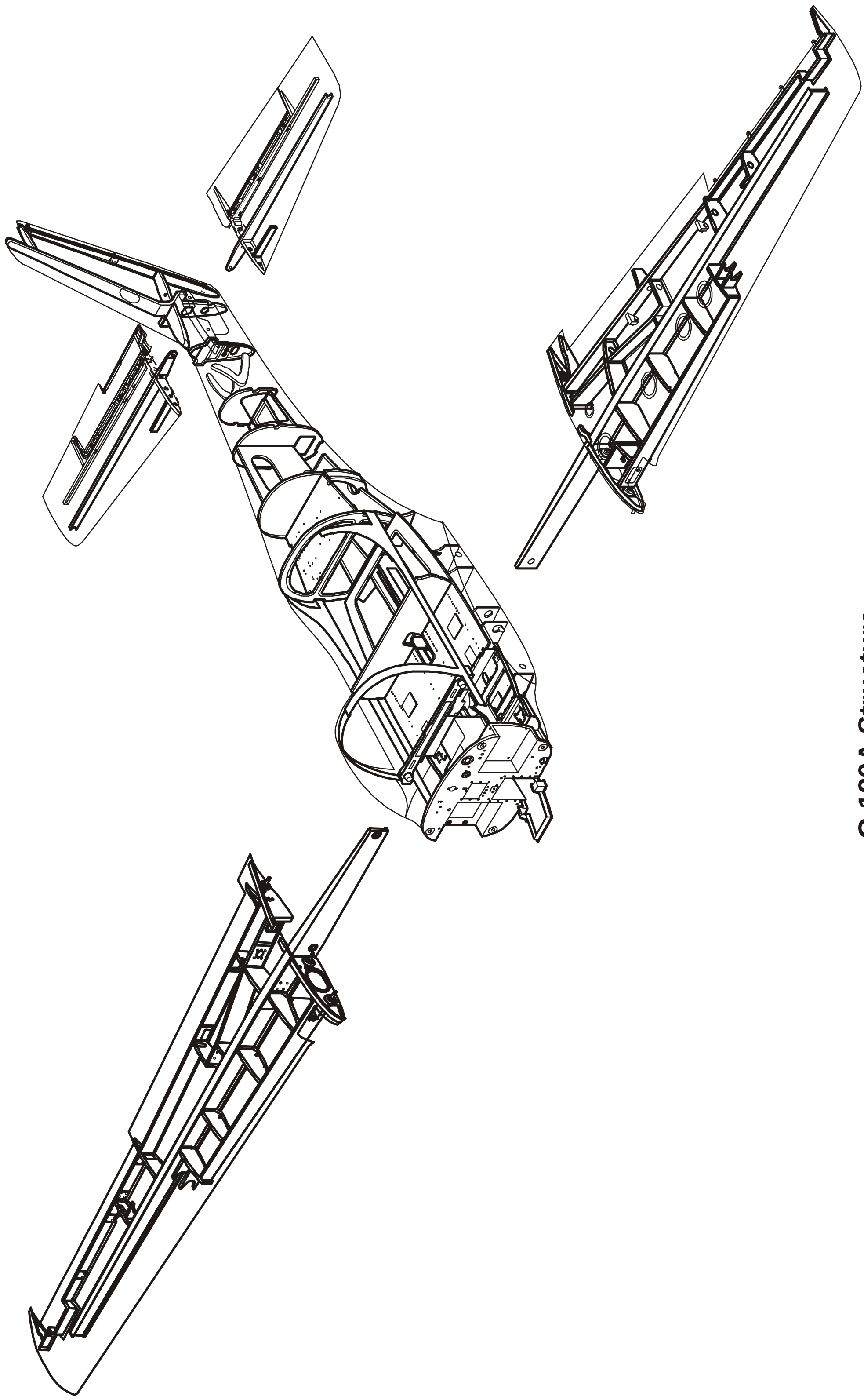
SECTION 7 AIRPLANE AND SYSTEM DESCRIPTION

7.1 General

This chapter contains the description of the airplane and its systems and some operating instructions. Some systems are optional and described in more detail in section 9 of this manual.



G 120A Structure
Figure 7.1

7.2 Airframe

The aircraft is an acrobatic category airplane designed as a single-engine, two-seater low-wing aircraft with cantilever wings and a conventional empennage. The tricycle gear of the aircraft is retractable. The aircraft is designed and manufactured considering latest knowledge and requirements of industrial fiber reinforced plastic materials (GFRP / CFRP).

The semi-monocoque fuselage comprises a self-supporting carbon-fiber reinforced plastic shell with frame and web members. The one-part canopy has a two-part generous wrap-around glazing.

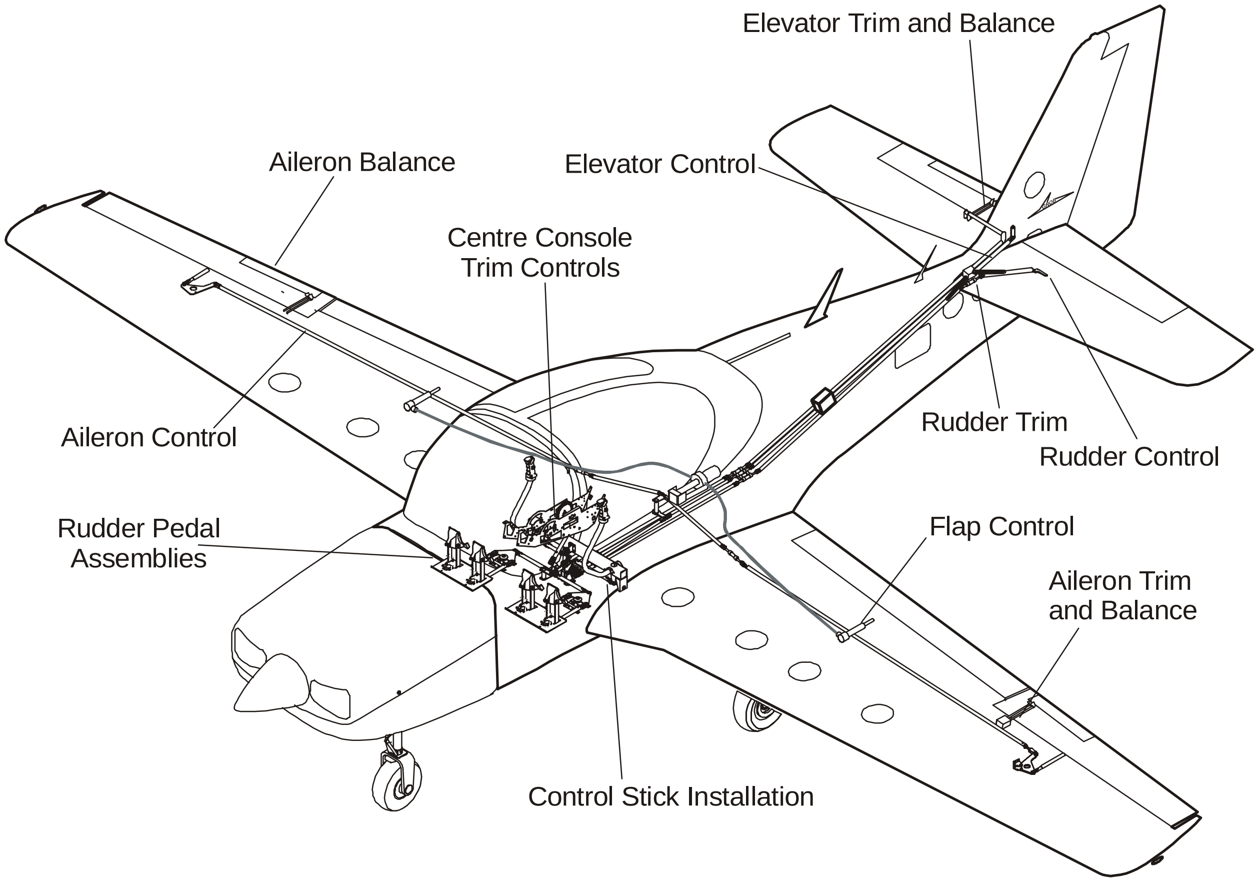
The cantilever wing of single-trapezoidal cross section has an I-beam main spar with spar caps of carbon fiber rovings. The wing shell is of honeycomb sandwich design, except the tank section, which consists of a PVC foam sandwich. Interconnection of the wings is made via the spar stubs, bolted together with 2 large bolts which connect the stub spars to each other. Each wing is attached to the fuselage by three bolts. The wing has a cut-out in the bottom shell for the main landing gear. The main spar and strong webs hold the mountings for the main gear leg. An auxiliary spar closes the trailing edge of the wing and carries the flaps and conventional ailerons.

The aircraft has slotted flaps with upper and lower CRP skins in rigid PVC foam core. The hinge line is approximately 130mm below the wing bottom surface. The ailerons have GFRP sandwich skins with PVC cores. Each aileron has a servo tab and a mass balance.

The conventional empennage comprises fin, rudder, tailplane, elevator and elevator trim tab. The fin, integrated in the fuselage, mainly comprises the main and end spar in honeycomb sandwich design and a carbon-reinforced full laminate shell. The structural configuration of the tailplane is similar to that of the wings. The tailplane is attached to the fuselage by four fittings. The elevator has a left and a right part. The right elevator has a trim/servo tab with an inside mass balance. Both elevators have top and bottom CRP shells. The structural configuration of the rudder is similar to that of the ailerons. The rudder has horn balance which also supports the mass balance.

The total airframe is protected from moisture and ultra-violet radiation by a UP gel-coat. A white filler on the outer surface of the aircraft conducts electricity. This is part of the aircraft lightning protection system. A white two-component polyurethane lacquer covers the filler and completes the finish.

Fig. 7.2 Flight Controls



7.3 Flight Controls

The flight control system of the AIRCRAFT comprises conventional ailerons, rudder and elevators. All flight control surfaces are mechanically actuated via push-pull rods. Sealed self-aligning ball bearings or spherical bearings are used throughout the system.

<u>Elevator:</u> The aircraft has two control sticks with PTT- and trim-switches. Each stick is attached to a square connection tube. Levers and push rod transmit fore and aft stick movement to the elevator. The aircraft has manual and electrical elevator trim. The handwheel on the centre console moves a trim actuator/friction damper through push-rods and the trim indicator on the right side of the handwheel. Two control rods connect the trim actuator to the trim tab. The trim motor is operated by either of the double pole trim-switches. The trim wheel moves when electrical trim is used. If there is an electrical failure in the trim system, the trim wheel can still be used.

<u>Aileron:</u> Control rods and levers transmit stick movement to the ailerons. Each aileron has a servo tab. Duplicated rods connect each servo tab to the structure. The left aileron tab is a combined trim and balance tab. A rotary switch on the centre console controls an electric trim actuator in the left wing.

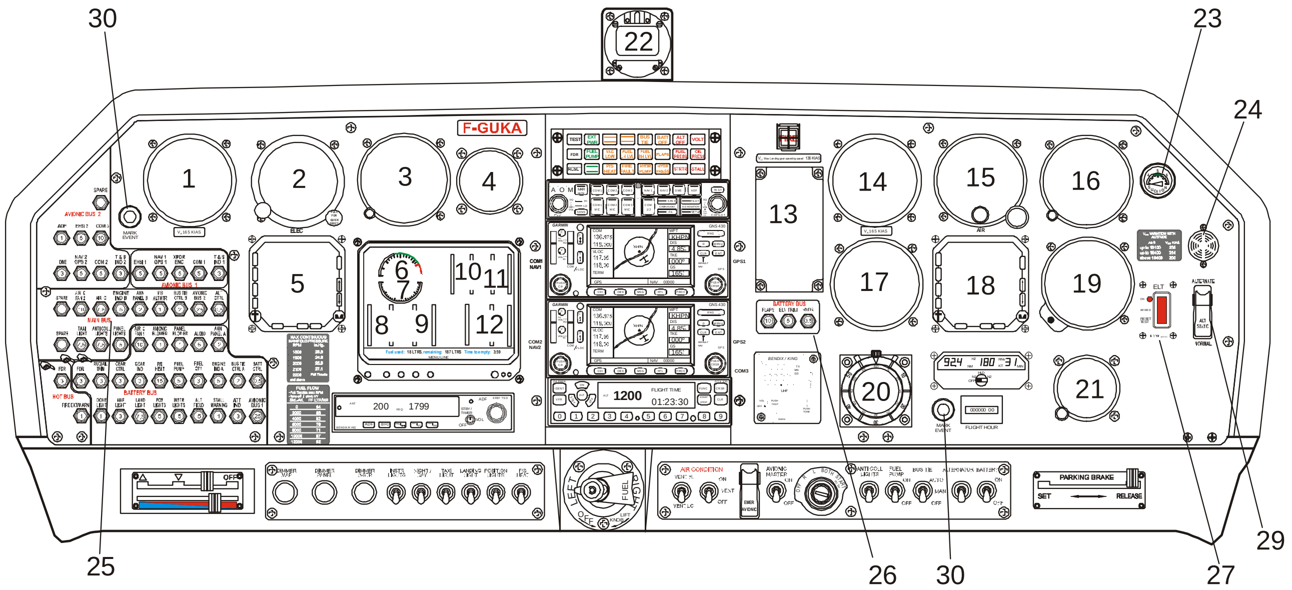
<u>Rudder:</u> The rudder control system has a rudder toe-brake pedal assembly and an adjuster device for each pilot in front of the seats. Rods connect the pedals to the adjuster device and to a middle lever assembly. Push-pull rods transmit the rudder pedal movement to the rudder actuator lever.

A spring system connects the rudder-middle lever assembly to the aileron-front lever-assembly. The system gives the correct balance between rudder and stick forces. The rudder has a spring-trim system. A rotary switch on the centre console controls an electric trim actuator in the rear fuselage. The actuator moves strong springs to offset the out-of balance forces on the rudder.

<u>Control Stops and Locks:</u> All primary controls have stops in the cockpit and at the control surface. All flight controls have adjustable stops in the cockpit and the ailerons and elevators also have adjustable stops at the control surface. All control levers have rigging holes for easy setting up during maintenance. External control locks are available for each control.

<u>Flaps:</u> Linear actuators – one for each flap - are driven via flexible torsion shafts by a electric motor to move the flaps. A selector lever on the centre console controls the flap position. A feedback cable moves a cam system to follow the selector lever movement and also to move the flap position indicator (**Fig. 7.2**).

Fig. 7.3 Left and Right Instrument Panels



LEGEND			
1.	Airspeed indicator 2	16.	Altimeter 1
2.	Artificial horizon 2 (Electric)	17.	Turn and slip indicator 1
3.	Altimeter 2	18.	Electronic horizontal situation indicator 1 (EHSI 1)
4.	Turn and slip indicator 2	19.	Vertical Speed Indicator 1
5.	Electronic horizontal situation indicator 2 (EHSI 2)	20.	Clock
6.	RPM indicator	21.	G meter
7.	Manifold pressure indicator	22.	Magnetic compass
8.	Cylinder head temperature, exhaust gas temperature	23.	Vacuum (Suction) indicator
9.	Oil temperature, oil pressure	24.	Stall warning horn
10	Fuel flow, fuel pressure	25.	Main circuit-breaker panel
11.	Fuel contents LH/RH	26	Critical circuit-breakers
12.	Volts, amps, OAT	27.	ELT cockpit remote switch
13.	Landing gear selector/indicator	29.	Alternate Static Switch
14.	Airspeed indicator 1	30	Event Marker Switch (FDR)
15.	Artificial horizon 1 (Vacuum)		

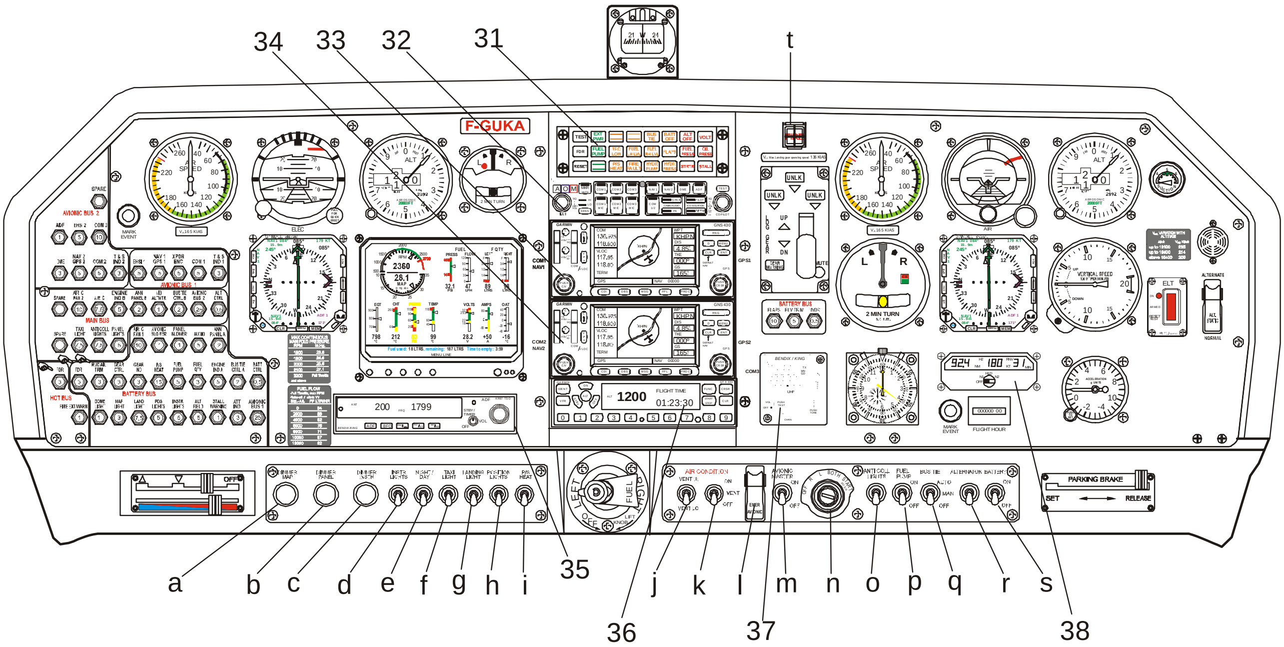
7.4 Instrument Panel

The instrument panel contains flight, navigation and engine instruments, the avionics as well as switches and controls for different systems. Flight and navigation instruments are grouped on the right instrument panel in front of the pilot. The important engine indicators and the second group of basic flight instruments are located on the left instrument panel. The communication and navigation equipment as well as the annunciator panel are housed in the middle of the instrument panel in the avionics rack. The HYDR, TRIM and FLAPS circuit breakers are in the right instrument panel, with the rest of the circuit breakers grouped in the left half of the instrument panel. The instrument panel beam below the main panels has heating, air conditioning and the parking brake controls. It also has most of the system and lighting switches. There is a magnetic compass mounted centrally on top of the glareshield.

Fig. 7.3 shows the instruments on the left and right instrument panels**. Fig. 7-4** shows the avionic rack and system switches on the center instrument panel.

Refer to Section 9 and to the maker's manuals for details on the avionic equipment and their operation.

Fig. 7.4 Avionic Equipment and General Switches



LEGEND			
AVIONIC RACK			
31.	Annunciator panel	35.	ADF
32.	Audio control panel	36.	XPDR
33.	COM/NAV/GPS 1	37.	COM 3 UHF control unit
34.	COM/NAV/GPS 2	38.	DME indicator
SWITCHES			
a.	Dimmer map lights	k.	Air conditioning – On/Vent/Off
b.	Dimmer panel lights	l.	Emergency avionic switch
c.	Dimmer instrument lights	m.	Avionic master switch
d.	Instrument lights switch	n.	Ignition switch
e.	Day/Night switch	o.	Anti collision lights switch
f.	Taxi light switch	p.	Fuel pump switch
g.	Landing light switch	q.	Bus tie switch
h.	Position lights switch	r.	Alternator switch
i.	Pitot static heat switch	s.	Battery switch
j.	Air conditioning – Vent high/low	t.	Fire warning light and extinguisher switch

7.5 Attitude and Direction Systems

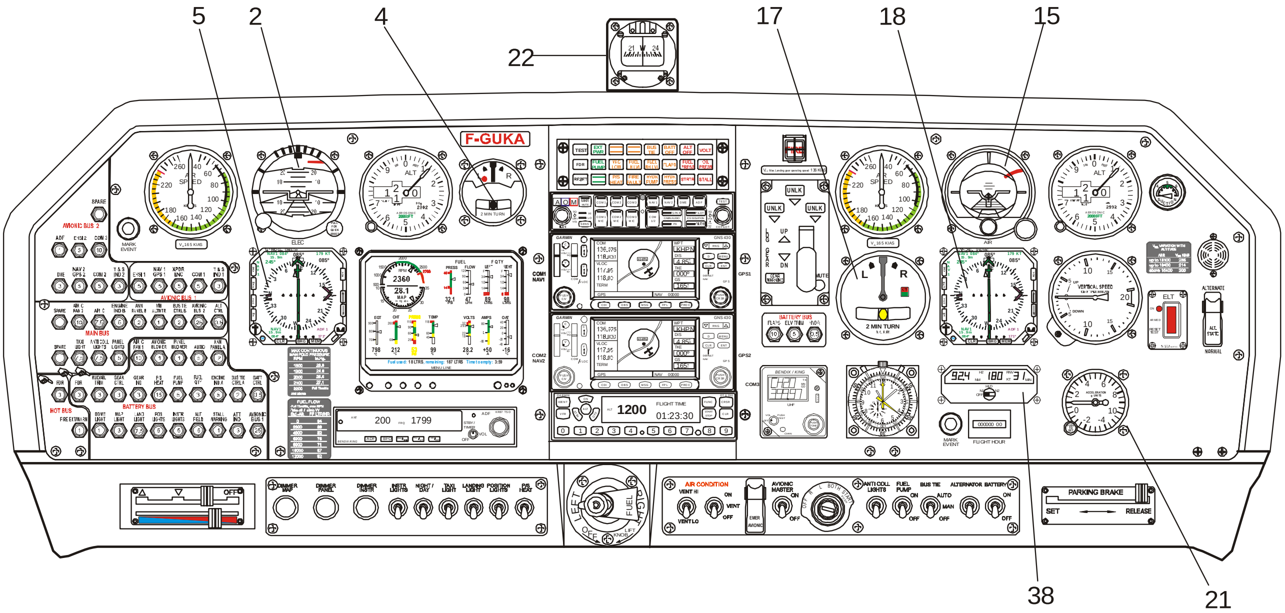
GENERAL

The aircraft has the following attitude and direction systems installed in the aircraft:

- Flight environmental data using the pitot/static system, Outside Air Temperature (OAT) and the flight instruments;
- Position fixing using VOR, ADF, DME and dual GPS;
- Standby instrumentation.
- Attitude and direction using data from directional slaved compass system.

Fig. 7.5 shows the positions of flight and navigation instruments and controls.

Fig. 7.5 Attitude and Direction Instruments in the Cockpit



LEGEND			
2.	Artificial horizon 2 (Electric)	18.	EHSI horizontal situation indicator 1
4.	Turn and slip indicator 2	21.	G-meter
5.	EHSI horizontal situation indicator 2	22.	Magnetic compass
15.	Artificial horizon 1 (Vacuum)	38.	DME indicator
17.	Turn and slip indicator 1		

SYSTEM DESCRIPTIONS

1. Flight Environment Data

The aircraft has these pitot/static instruments:

- Two altimeters connected to the static system, with electrical vibration,
- Two airspeed indicators (ASI) connected to both the pitot and static systems,
- A vertical speed indicator (VSI) connected to the static system,
- An altitude encoder connected to the static system for the transponder.

The pitot pressure also connects to the pitot pressure switch that controls the flight hour counter.

In case of a static system failure the alternate static system can be selected to supply the instruments.

The OAT gauge uses temperature information from a sensor in the left wing.

2. Attitude and Direction

The airplane has 2 attitude gyros and a remote-mounted directional gyro. The directional gyro supplies the EHSIs. A vacuum operated gyro in the RH instrument panel and an electric powered gyro in the LH instrument panel provide attitude information. There is also an accelerometer ('g' meter), which is mounted in the right instrument panel.

Turn and slip indicators are located in each instrument panel.

The aircraft has a magnetic compass mounted centrally on the top of the glareshield.

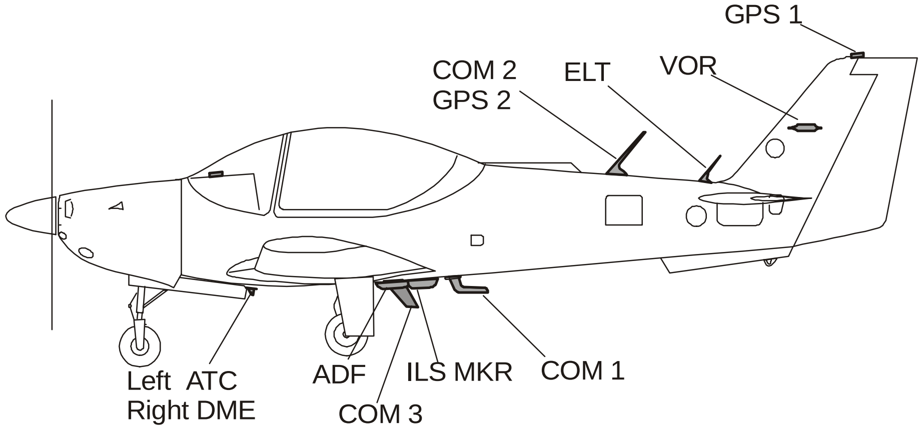
OPERATION OF THE ATTITUDE AND DIRECTION INSTRUMENTS

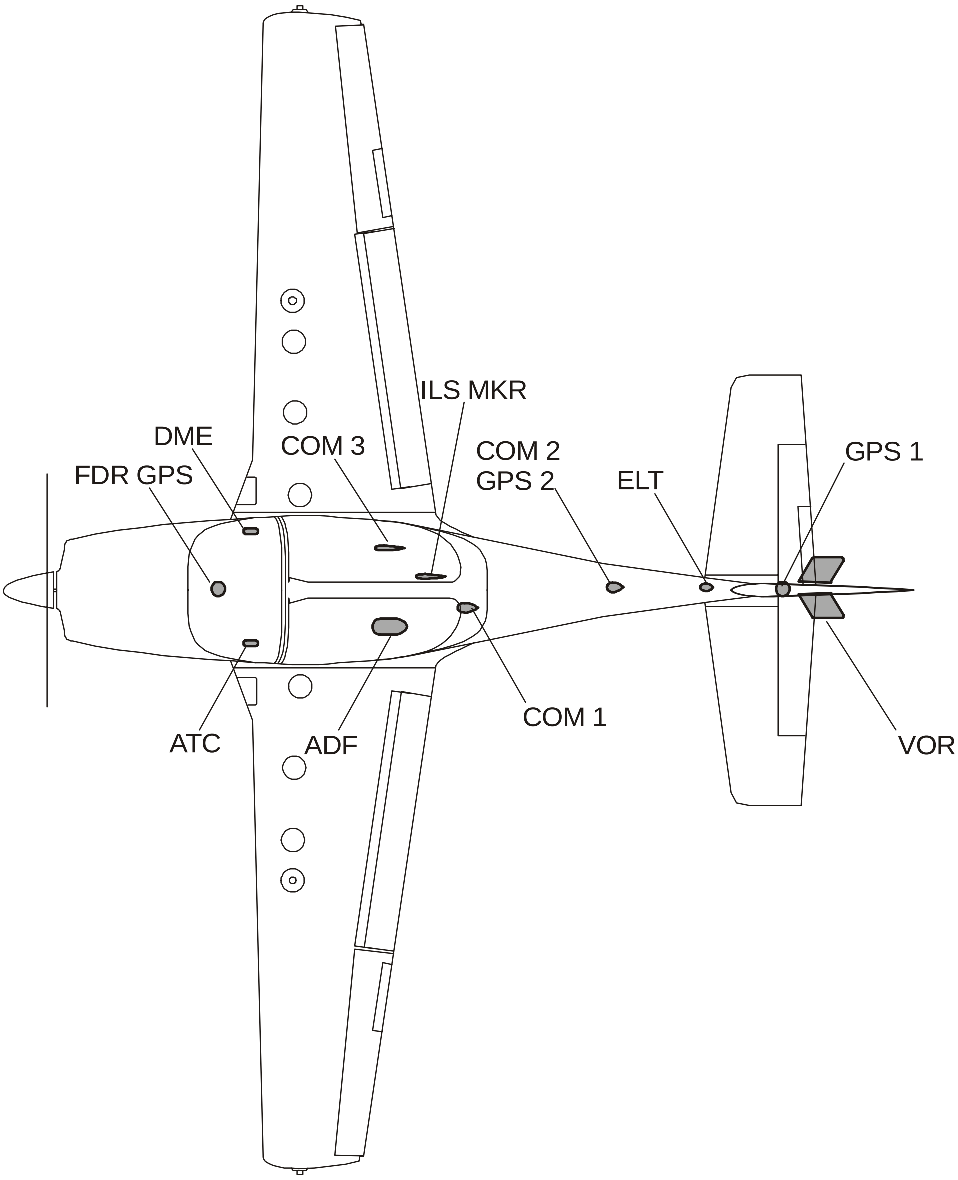
1. Electric Attitude Gyro

With battery and avionic master switches ON, the battery powers the electric attitude gyro and the remote-mounted directional gyro which is the data source for the EHSIs. The electric attitude gyro needs 2 minutes for the gyro spin-up before operating the Fast Erect.

Check the electric attitude gyro after acrobatics in flight. The toppling limits of the horizon are plus or minus 85° in pitch and 360° in roll. If required, cage at zero bank and pitch at approximately 140 to 170 KIAS in straight and level flight. Wait approximately 2 minutes and re-check the indication. Turn to the right and to the left about 90° each. Check the indications at approximately 30° of bank. Re-check indications in straight and level flight. A deviation of up to ±3° is normal.

Fig. 7.6 Antenna Positions of the Communication and Navigation Systems





2. Vacuum Horizon

After engine start, with suction pressure in green range, erect the horizon. During flight, monitor the vacuum gauge and cross-refer to the electric and outside horizon if possible to monitor the performance of the instrument. Re-erect the instrument in level flight if required.

3. Turn and Slip Indicators

The pointer of the turn indicator shows rate of turn to the left or right. The slip ball shows yaw. It is placed in a fluid-filled curved tube.

4. Accelerometer

The accelerometer is a simple mechanical instrument showing the maximum positive and negative 'g' during the flight and the instantaneous 'g' reading. It cannot be reset in the air. The reset is disabled and can only be reset by a technician.

INDEPENDENT INSTRUMENTS

There are 2 independent instruments on the left instrument panel:

- Clock: The Grob -Benz clock has its own battery that powers the stopwatch function and an internal light. The light comes on when the instrument light switch is ON.
- Flight Hours Counter: This battery powered electro-mechanical counter operates when the weight-on-wheels switches operate. (both main landing gear legs are off the ground) and the pitot pressure switch operates (just below stalling speed).

7.6 Central Indication System

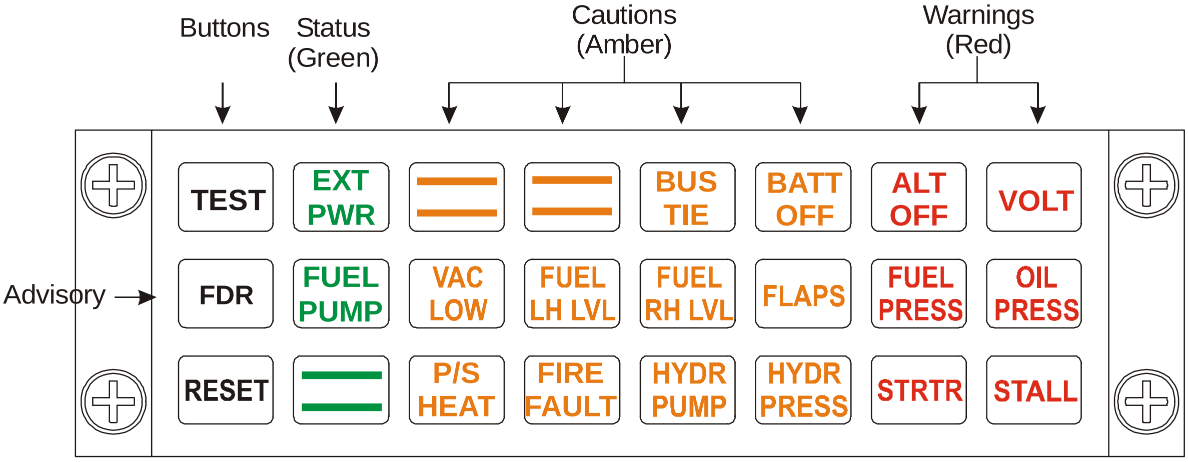
The system gives visual and aural indications to the pilot.

1. The Annunciator Panel

Fig. 7.7 shows the Annunciator Panel. The visual display has an annunciator panel at the top of the avionic rack. This has 6 red warning, 10 amber caution captions, 1 white alert caption and 2 green advisory captions. The warning alert and caution captions are lit by LEDs that dim when the night/day panel light switch is set to NIGHT.

A white alert caption on the left of the panel shows when the FDR has detected faults.

Fig. 7.7 Annunciator Panel



Red Warnings are:

ALT OFF.. Alternator OFF

VOLT... Voltage (low and high)

FUEL PRESS.. Fuel Low Pressure

OIL PRESS... Oil Low Pressure

STRTR... Starter Power ON

STALL.. Stall

The Amber Cautions are:

BUS TIE.. Bus Tie OPEN

BATT OFF.. Battery OFF

VAC LOW.. Vacuum low

FUEL LH LVL...Fuel Left Hand Tank Low Level

FUEL RH LVL.. Fuel Right Hand Tank Low Level

FLAPS..Flaps stopped by split sensor

P/S HEAT.........Pitot-Static Heat is selected ON but not operating or switched off

FIRE FAULT.. Fire detection system fault.

HYDR PUMP.. Pump overheated

Pull the hydraulic circuit breaker to avoid overheating

HYDR PRESS.. Hydr. Press Low

Green captions are ON, when the electrical fuel pump is operating and when external power is ON.. The reset and test captions dim when the “night switch” is ON.

2. The Audio Indication System

The audio circuit of the Central Indication System gives synthesized spoken indications to the pilots. This table shows what the voice in the indication system says and whether it can be reset.

Light name	Light color	Light delay	Audio	Audio Delay	Reset
EXT PWR	Green	---	---	---	---
BUS TIE	Amber	1 sec	Check electric	10 sec	Yes
BATT OFF	Amber	1 sec	Check electric	10 sec	Yes
FLAPS Asymmetry	Amber	---	---	---	---
ALT OFF	Red	1 sec	Check electric	10 sec	Yes
VOLT	Red	5 sec	Check electric	10 sec	Yes
FUEL PUMP	Green	---	---	---	Yes
VAC LOW	Amber	---	---	---	Yes
FUEL LH LVL	Amber	30 sec	Check fuel	---	Yes
FUEL RH LVL	Amber	30 sec	Check fuel	---	Yes
FUEL PRESS	Red	1 sec	Check fuel	---	Yes
OIL PRESS	Red	5 sec	Check oil	---	Yes
P/S HEAT	Amber	1 sec	Check heat	---	Yes
FIRE FAULT	Amber	---	---	---	Yes
HYDR PUMP	Amber	1 sec	---	---	No
HYDR PRESS	Amber	1 sec	---	---	Yes
STRTR	Red	1 sec	Check electric	10 sec	Yes
STALL	Red	<0.3 sec	---	---	No
---*	---	---	Check gear	5 sec	No**

* There is a separate audio warning for the landing gear position

** Yes with Flaps UP and T/O

3. Test Switch

This switch is on the left of the annunciator panel. When pressed it tests some of the sensor circuits, lights up each warning, caution and advisory caption including the gear warnings and gives a test of all the audio indications over the headphones/speaker.

4. Reset Switch

The reset switch mutes the audio indications which are mutable (See table above).

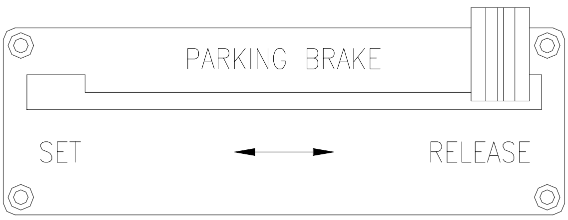
5. Stall Warning

A stall warning system is fitted to warn the pilot when the airplane is close to the stall. It uses an annunciator panel light, an acustical warning through the headphones and a warning horn on the right instrument panel. The stall detector is mounted on the right wing, and only works for positive angles of attack.

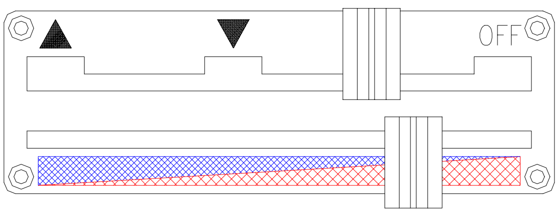
The central indication system provides the power for the stall warning system. When the airflow over the wing lifts the flap of the lift detector up enough at high angles of attack, the stall warning operates.

7.7 Inscriptions

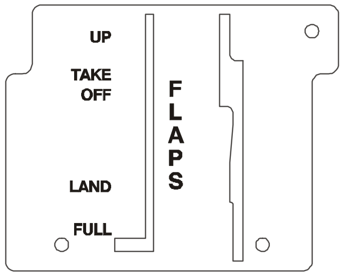
Parking brake lever:



Heating lever:



Flap Indicator:
In the centre console



Gyro compass deviation card.
Below flap indicator

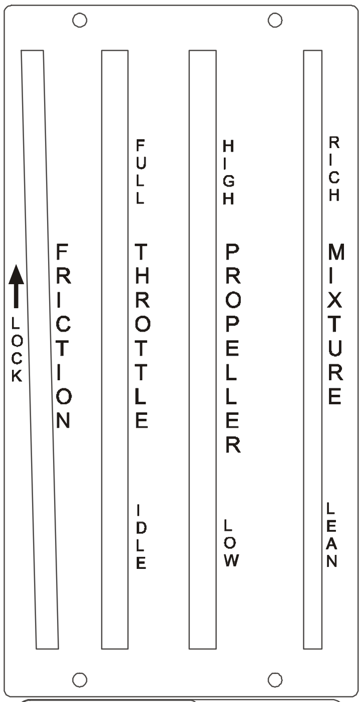
EHSI 2 Steer	For	EHSI 1 Steer
	N	
	30	
	60	
	E	
	120	
	150	
	S	
	210	
	240	
	W	
	300	
	330	
Calibration was made with all electric power and Radio ON !		
Date: Reg:		GROB

Magnetic compass deviation card.
Below flap indicator

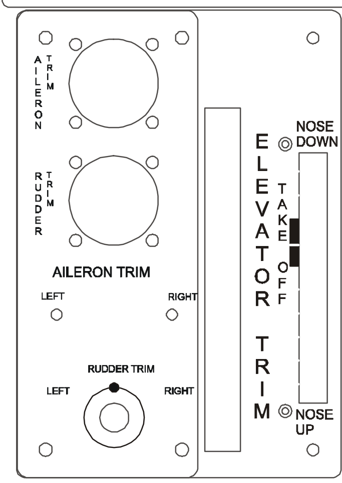
For	N	30	60	E	120	150
Steer						
For	S	210	240	W	300	330
Steer						
Date:	Reg:					

At the left cockpit side.
Left hand throttle lever

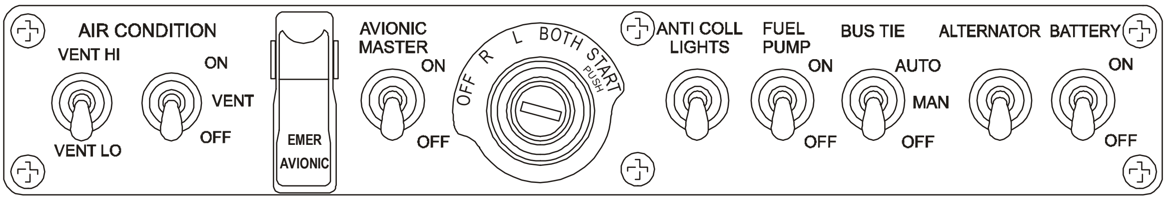
On the centre console.
Throttle, mixture and propeller lever.



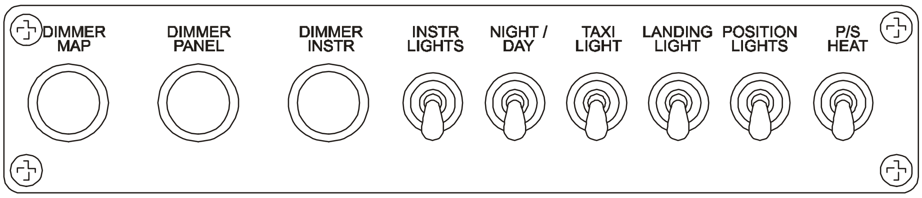
On the centre console.
Trim indicator



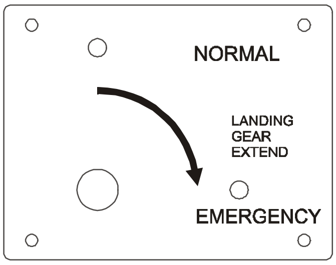
Switch panel - right side



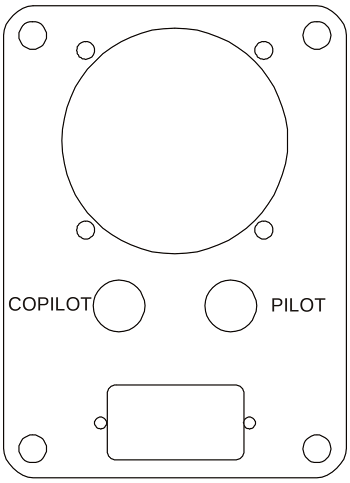
Switch panel - left side



On the centre console.
Landing gear emergency handle



On the centre console.
Loudspeaker and sockets
for headsets

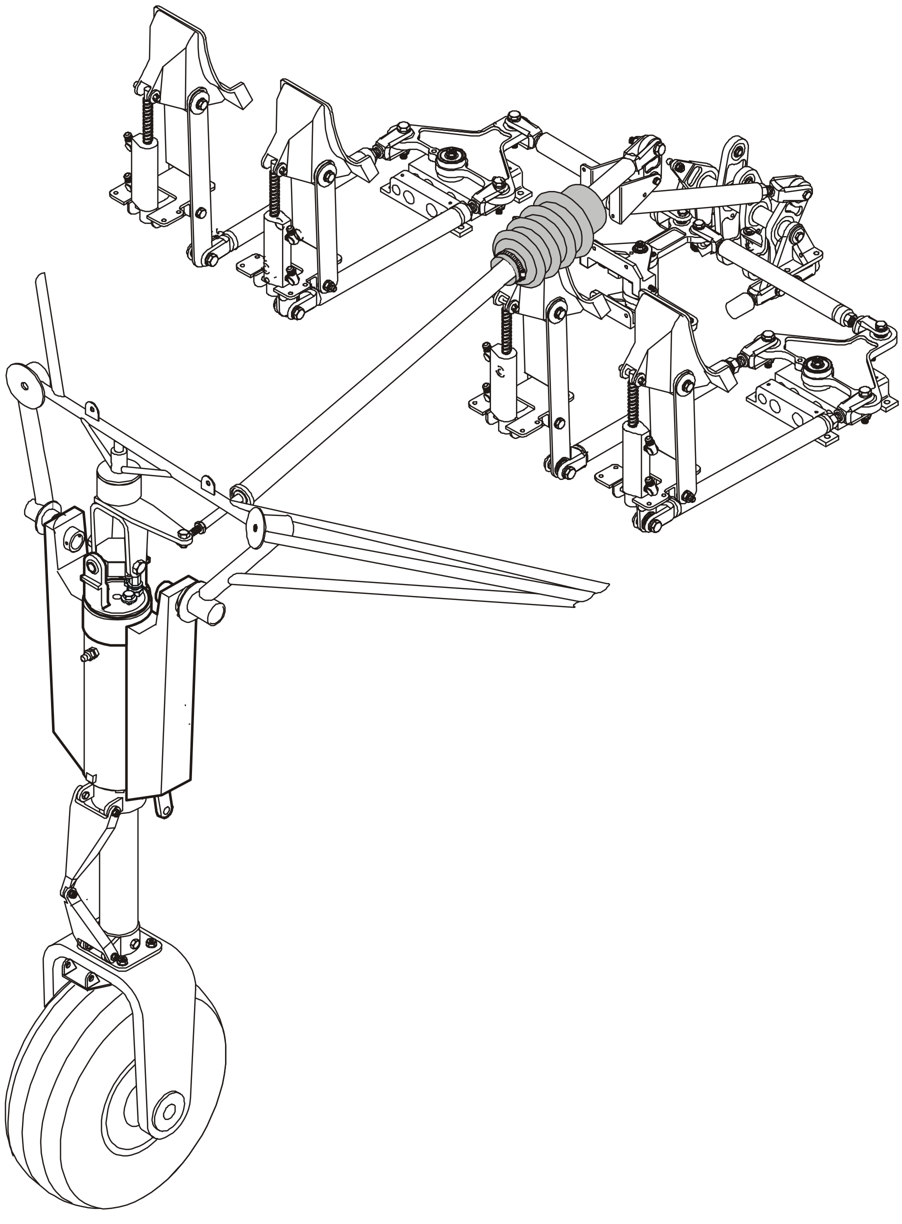


7.8 Ground control

On ground the aircraft is controlled by rudder pedals which are connected to the nose wheel. Total deflection of the nose wheel when using the pedals is 10°. The turning radius can be reduced considerably by using the inner brake. Under these conditions the spring coupling is compressed and allows the nose wheel to deflect up to maximum of 42° both directions.

When the landing gear is retracted, rudder pedals are mechanically disconnected from the nose wheel. The nose wheel centres itself during retraction.

Fig. 7.8 Nose Wheel Steering System



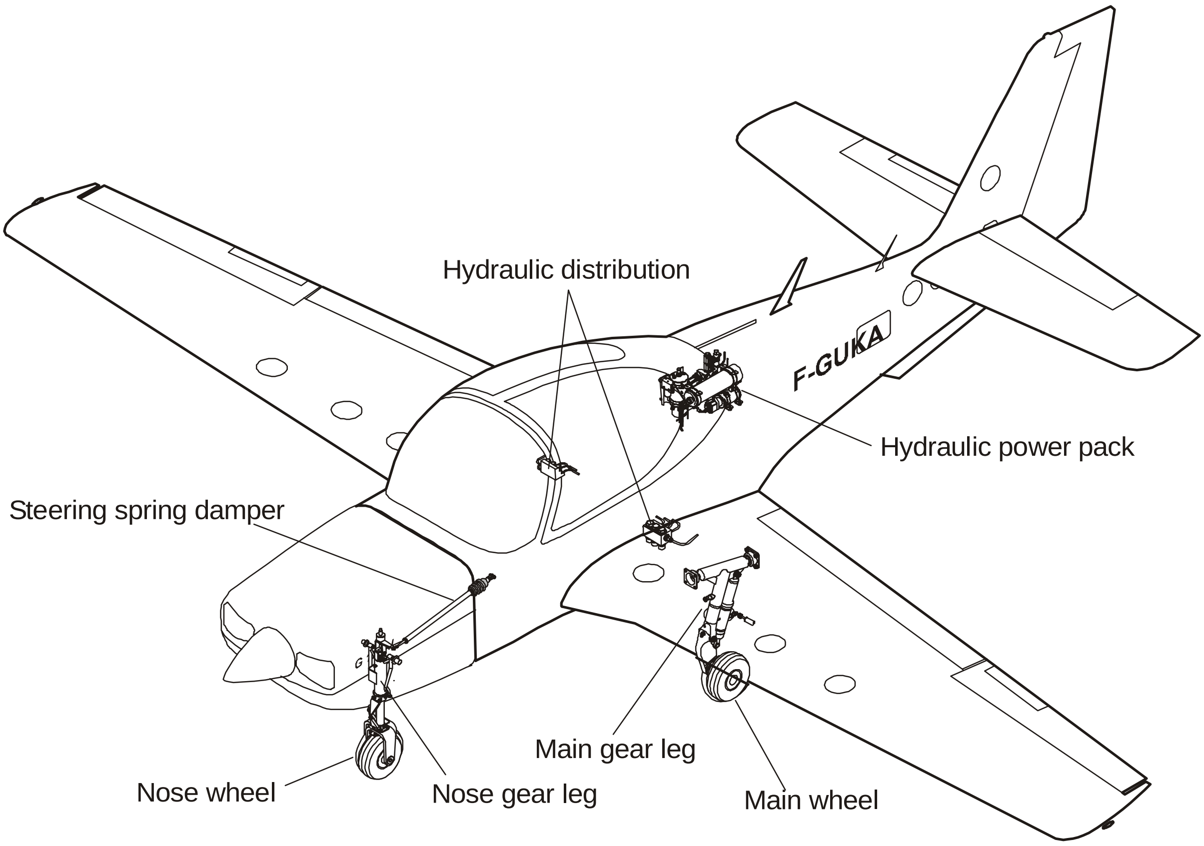
7.9 Wing Flaps

The aircraft has slotted flaps to improve lift characteristics.

The flaps are electric-powered and allow variable positions of 0°/UP to 60°/FULL. The flap handle is located in the centre console; it has four positions, marked UP, TAKE-OFF, LANDING and FULL. The flaps are powered from the battery bus. The flap indicator is placed beside the flap handle. When the flaps are in the pre-selected position, the motor stops.

Flap asymmetry protection is provided by an asymmetric detector switch operated by Bowden cables driven from the flaps to two normally parallel levers. The switch stops the flap if an asymmetry above a pre-set value is detected.

Fig. 7.9 Landing Gear



7.10 Landing Gear

The retractable tricycle landing gear is operated by its own electric hydraulic pump. The nose wheel landing gear is mounted on the engine frame in front of the firewall and retracts rearward. Both main landing gear legs retract inwards. The main legs have trailing arms which carry the main-wheel and brake unit. An oleo-pneumatic damper is attached to the trailing arm to give suspension and damping. All landing gear legs have CRP doors which fit flush when the gear is retracted. The left and right main gear legs have a weight-on-wheels switch to prevent inadvertent ground operation.

Emergency gear extension is by means of a pre-charged hydraulic accumulator. Each landing gear has an independent hydraulic disk brake, operated by either the pilot or the copilot pressing the top of their rudder pedals. Each rudder pedal has a main brake cylinder fed from a common reservoir.

Hydraulic Power Pack: The hydraulic system operates the landing gear only. The hydraulic power-pack is located behind the baggage area. It is a closed system with a hydraulic reservoir, hydraulic filters and an electric motor driving the hydraulic pump. The system operating pressure is 1500 psi. **Fig. 7.10**

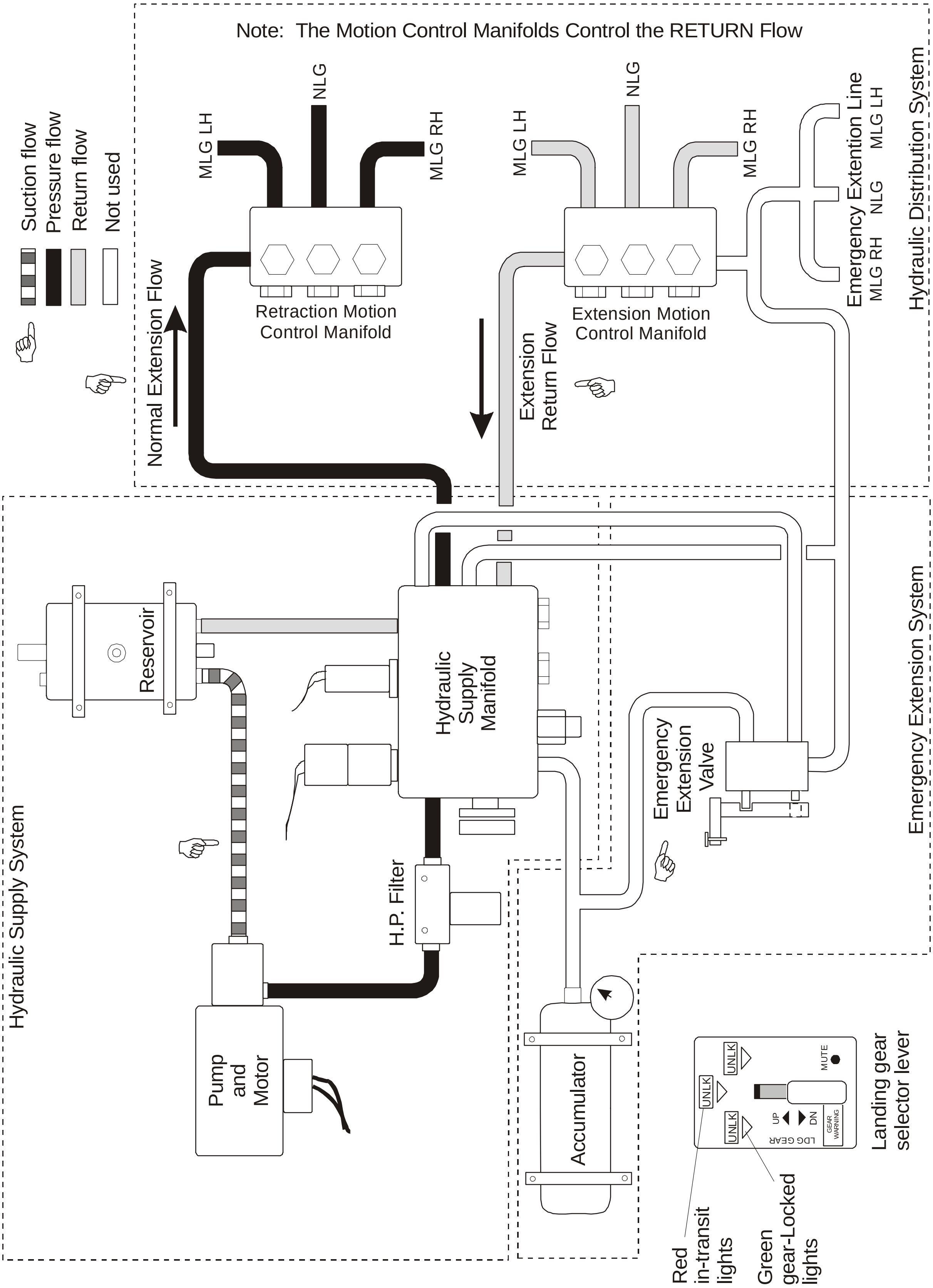
Landing Gear Control and Indicator: The landing gear lever and the indicator lights are located on RH instrument panel. The landing gear lever controls the hydraulic pump and simultaneously selects the electric control valves on the manifold. The lever is marked LDG GEAR and is marked with UP and DN. The system is powered by the battery bus.

The locked-down position is indicated by one green indicator light per landing gear (left lamp – left landing gear etc.). If a landing gear is not locked down, or if it is in transition, the red UNLK lamp light is ON and the green light of the respective landing gear remains out. In the up and locked condition the lights are out.

When airborne with the landing gear damper fully extended the landing gear handle can be selected UP; this will activate the hydraulic pump. When the landing gear is fully up, it is mechanically locked by hooks. The main landing gear-doors are mechanically connected to the landing gear legs. A pair of doors attached to the fuselage are closed by the final movement of the nose gear leg. Springs open the doors during the initial extension of the leg.

If the gear handle is selected DN, the hydraulic pump is activated and hydraulic pressure is supplied to the up-lock hooks and the actuators. The up-lock hooks release at a pressure of approximately 30 bar (435 psi), whereas the actuators start moving at approximately 40 bar (580 psi) pressure to its extension side and extend the gear legs. The actuators are mechanically locked in the fully extended position by means of downlocks, which are internal elements of the actuators.

Fig. 7.10 Landing Gear Control



Emergency Extension Operation: An emergency lowering handle on the centre console releases pressure from the emergency hydraulic accumulator in the event of hydraulic or electrical failure. The main gear and nose gear lowers after releasing of the uplocks until the legs are completely extended and locked. The emergency system is an independent line. **Fig. 7.10**

Landing Gear Position and Warning: The landing gear selector has a lever for retracting and extending the gear. The GEAR WARNING light indicates that the gear is not down and locked when the power lever is set to idle and / or the flaps are selected to LDG or FULL. The warning can be muted if it was triggered by the throttle position.

Position Indications:

Gear in UP position: All gear lights are out.

Select gear DOWN: All 3 gear lights are red UNLK. The gear lights turn green when the respective gear is down and locked.

Gear in the DOWN and locked position: All 3 lights are green.

Select gear UP: All 3 gear lights are red UNLK until the gear up lock engages, then they extinguish.

Gear Warnings. With the gear UP (or not fully locked down) setting the throttle to idle and/or selecting LAND flap gives the audio warning CHECK GEAR. The pilot can mute the warning activated by throttle position by pushing the MUTE switch on the gear selector. Opening the throttle re-sets the warning. The gear warning activated by flap position cannot be muted.

NOTE

Whenever the airplane is parked unsupervised, always chock the wheels and release the parking brake. Temperature changes may cause a release of the brake or an excessive increase of the brake system pressure.

7.11 Baggage Compartment

The baggage area extends from the rear of the pilot and co-pilot seats to the aft cabin frame. Loading the baggage area must be in accordance with the values as stipulated in section 6 "Weight and Balance". All baggage must be safeguarded by the GROB-supplied baggage net included in each airplane. For this purpose the baggage net must be secured to the strapping eyebolts incorporated in the baggage area.

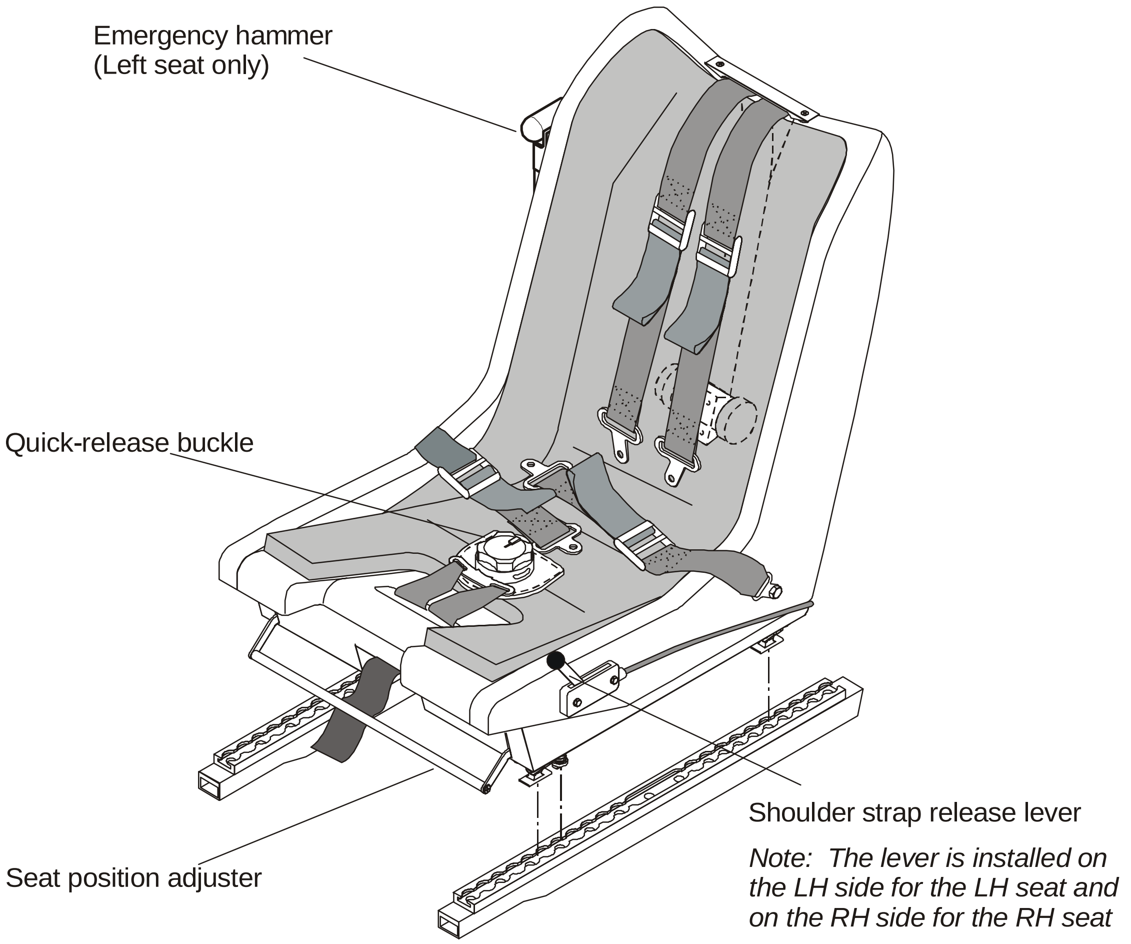
WARNING

Never accommodate a person in the baggage area.

Material which could be dangerous to the airplane or passengers must not be stowed in the airplane.

Acrobatic and spin manoeuvres are not approved with any baggage!

Fig 7.11 Seat and Seat Belts



7.12 Seats and Safety Belts

The G 120A is equipped with two safety-shell seats **Fig. 7.11.** The seats can be adjusted by using the seat adjuster bar (1) at the front of the seat. Both seats are fitted out with 5-point-seat belts. For attaching the SCHROTH harnesses insert belt and harness fittings in the „two way“ buckle. By pressing and turning the buckle all belts are released.

The shoulder straps can be pulled to allow the pilot to reach forward. A lever (2) on the left side of the left seat (and the right side of the right seat) allows to release the shoulder harness. Pulling this lever back locks the shoulder straps. Pushing the lever forward lets the shoulder straps extend with forward movement of the pilot´s body. (**Fig. 7.11**).

WARNING

Do not store anything under the seats. The seat collapses under high loads (crash) to protect the pilot:

7.13 Canopy

The G 120A has a rear-opening, generously glazed canopy, which allows an excellent view all round. An overhead handle in the center locks the canopy. The handle has an over-center lock which prevents accidental or inadvertent opening. Both the canopy and the canopy frame have rubber seals which seal the canopy. The canopy has a security lock that can be locked from the outside with a key. External handle grips on the canopy help with getting in and out of the cockpit, as well as with opening and closing the canopy.

WARNING

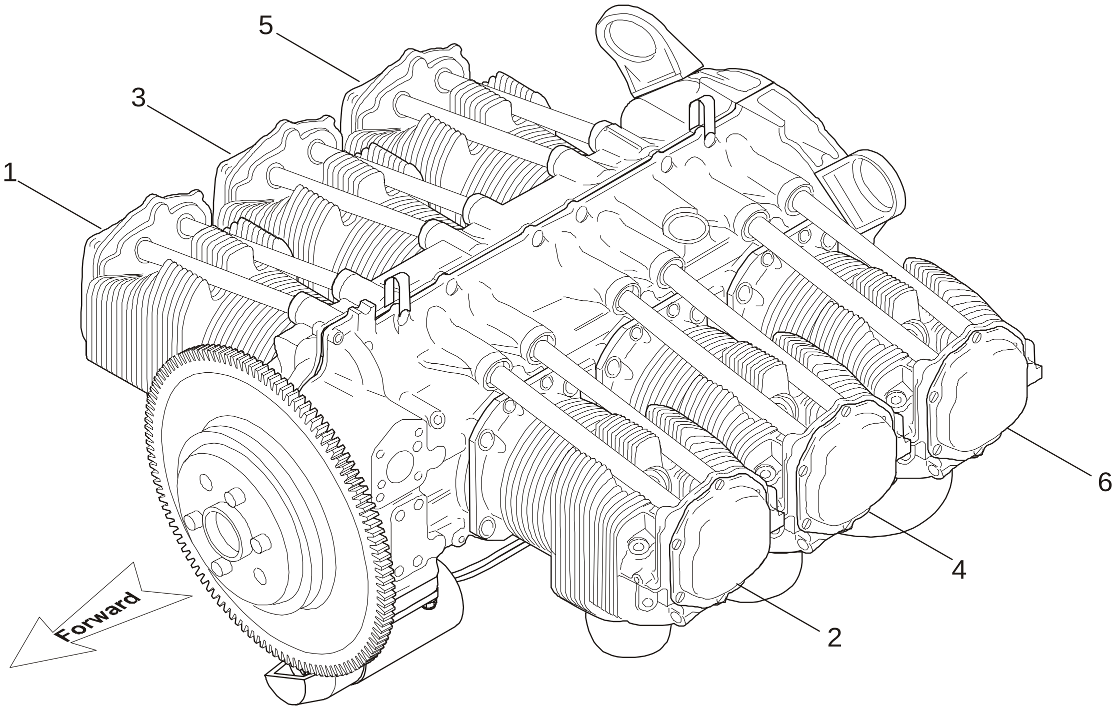
Before each take-off make sure that the canopy is secure and closed! The canopy should only be opened during flight in case of an emergency.

On the G 120A the canopy serves as an emergency escape hatch. A canopy emergency jettison system ensures that the aircraft can be abandoned quickly. Unlocking the red locking lever, opening the canopy handle and moving it back into the 170° position will release the attachment points on the guide rail. The canopy is then jettisoned by pushing it back and up simultaneously and allowing the slipstream to carry it away. The canopy can also be smashed in an emergency using a hammer. This is part of the standard equipment and is installed on the inner side of the LH seat backrest.

7.14 Control Locks

When parking the aircraft in areas where heavy winds and gusts occur, the control surfaces of left aileron, left elevator and rudder must be secured by sliding H-shaped security devices into the gaps. A rubber band keeps them in place.

Fig. 7.12 The Engine



7.15 Engine

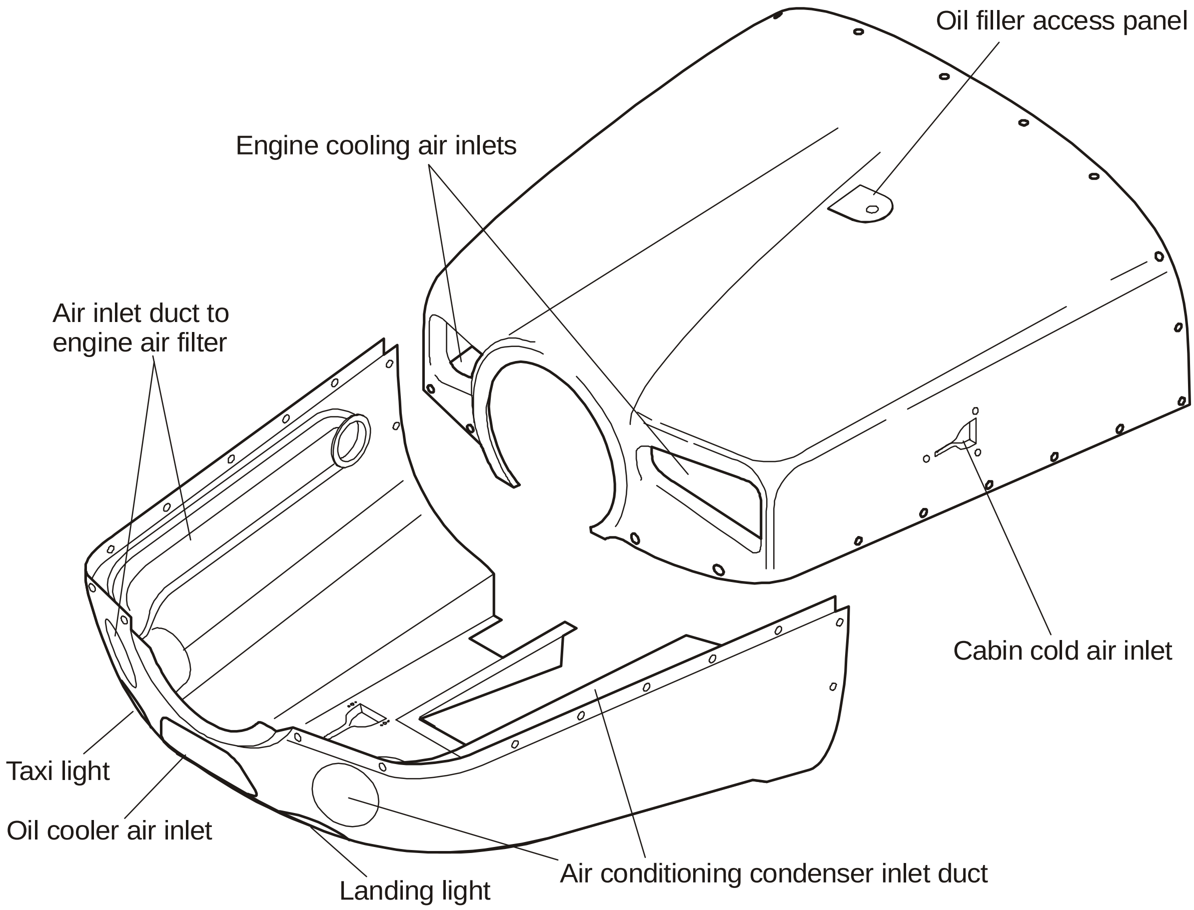
Fig. 7.12 shows the engine. The G 120A has a Lycoming AEIO-540-D4D5 air-cooled, six-cylinder, horizontally-opposed engine. It is rated at 260 HP at 2700 rpm at sea level. The engine has a light-weight electric starter, an ignition system with 2 magnetos and a vacuum pump that powers certain air-driven instruments.

The rotational direction of the crankshaft and thus the propeller is clockwise facing in flight direction. The cylinders are numbered front to rear and the odd cylinder numbers are on the right and the even numbers on the left.

Accessory Housing

The accessory housing attaches to the back of the crank case and carries the ignition magnetos, the mechanical fuel pump, the oil filter and the vacuum pump. The oil pump is fitted inside the accessory housing.

Fig. 7.13 Engine Cowling



Engine Cowlings

There is a top and a bottom cowling (see **Fig. 7.13**). The cowlings attach to the fuselage with quick release fasteners. On top of the upper cowling is a small panel that allows access to the oil filler.

The top cowling has the main inlet holes for engine cooling air. The bottom cowling has inlets for engine air, cabin air and an inlet for the engine oil cooler. The bottom cowling houses landing and taxi lights.

Engine Air Inlet

An inlet in front of the right lower cowling supplies air to the large engine air filter. Air from the filter flows to the fuel injector. The injector measures airflow and supplies a proportional fuel flow to the engine. Air flows from the injector goes through passages in the oil sump to each cylinder.

Engine Cooling

Cooling air for the engine enters the top cowling through 2 large intakes. Air baffles with seals direct the air over the cylinder cooling fins. After passing down between the cylinder cooling fins, the air leaves the engine compartment between the lower cowling and the fuselage.

Oil Cooling

Air enters an intake in the centre of the bottom cowling and flows through an oil cooler to cool the engine oil. The oil cooler is located between the engine and the bottom cowling. The oil is also cooled by the engine intake air passing through the inlet ducts in the oil sump.

Alternate Air

If the normal air flow is disturbed, e.g. clogging of the air filter, an alternate inlet can be opened by the pilot using the ALTERN AIR knob at the center console. This connects to the inlet using a Bowden cable. Unfiltered warm air from the engine bay is then used for the fuel/air mixture.

CAUTION

Only use the alternate air on the ground when testing the system. Operating the engine with alternate air selected can result in unnecessary engine wear.

Engine Fuel System

The engine is fitted with a Bendix RSA Injector System. It has a mechanical engine driven fuel pump, the injector regulator, a fuel distributor, the injector nozzles and associated pipes. The cockpit center console has the throttle lever and a mixture lever for the manual mixture regulator. Both controls connect to the fuel injector.

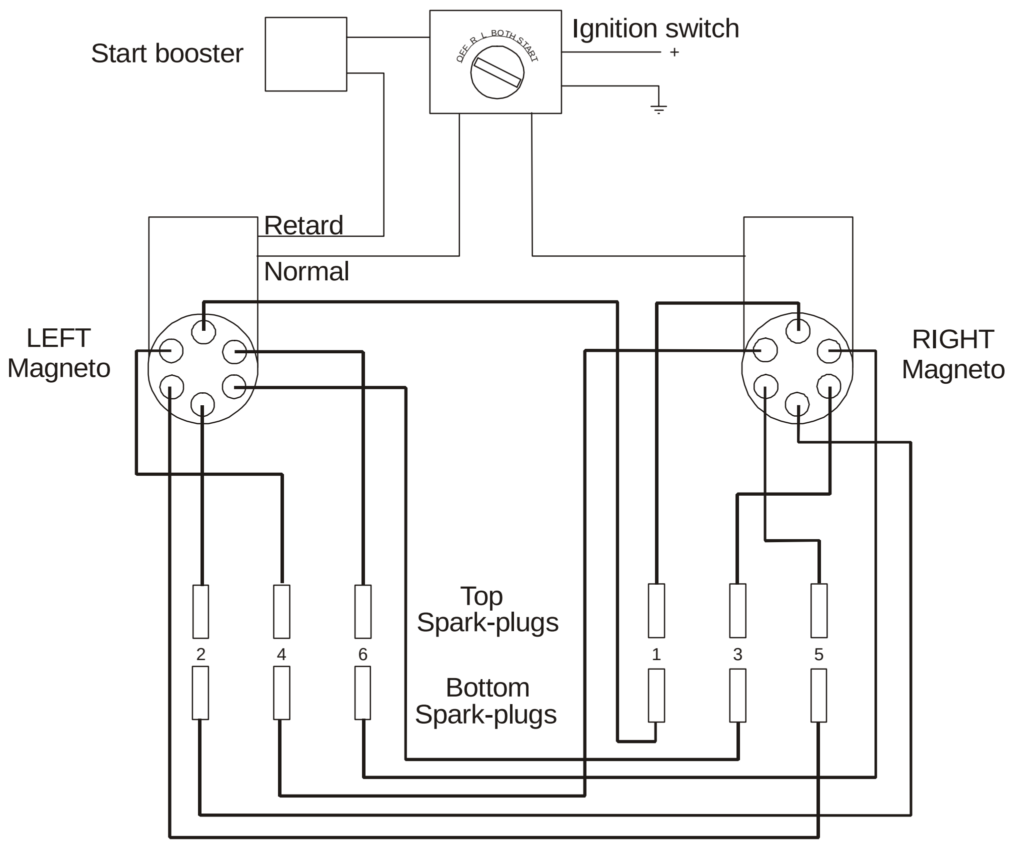
The rotary-vane engine-driven fuel pump supplies fuel from the aircraft fuel system at a pressure of 22-23.5 psi to the injector. This meters fuel flow in proportion to the air flow through the injector. This metered fuel then flows to the distributor and on to the injection nozzles in the cylinders. The mixture lever in the cockpit manually changes the engine air-fuel mixture through the range from max. RICH to LEAN.

Start and Ignition Systems

Fig. 7.14 shows the schematic diagramm of the start and ignition system. The engine is started from the cockpit using a keyed ignition/start switch that connects to a lightweight geared starter. Start procedure: turn the key to the right and push. The dual ignition system is based on 2 Slick magnetos. The ignition sequence of the cylinders is 1-4-5-6-3-2.

There are 2 spark plugs per cylinder. The left magneto has a set of retard contact-breaker points that operate during start and this magneto is automatically used to start the engine. Once the engine is running BOTH magnetos are selected for normal operation. To test each of the magnetos turn the ignition key to the L (left) position to measure the drop in RPM then return to BOTH. Then carefully turn the key to the R (right) position to measure the RPM drop, then return to BOTH. Care is needed to avoid switching the ignition to OFF at medium RPM.

Fig. 7.14 Start and Ignition System



A red STRTR warning on the annunciator panel comes on when the starter operates. It shows that the starter has engaged the engine. If the STRTR warning stays on after starting the engine, shut down immediately. In flight, land as soon as possible.

CAUTION

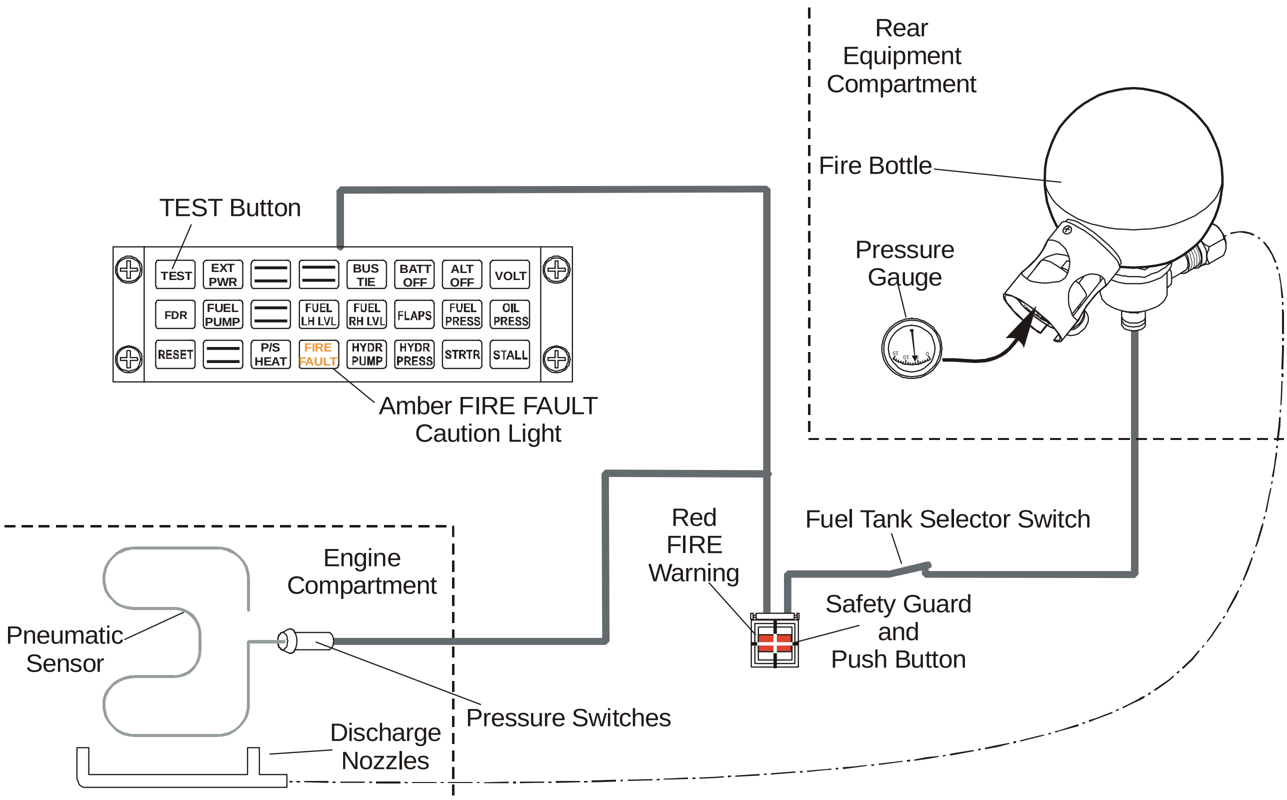
The starter may cause mechanical damage if it is engaged with the engine running. If the STRTR warning comes on in flight, consider an emergency landing.

Ignition Switch

The ignition switch is on the right instrument beam and operates with a key. There are 5 ignition switch positions:

- OFF — Both magnetos are grounded. Starter OFF.
- R — The right magneto is live, the left is grounded. Starter OFF.
- L — The left magneto is live, the right is grounded. Starter OFF.
- BOTH — Both magnetos are live. Starter OFF.
- START & Push — Left magneto retard breaker live, start booster on, right magneto grounded, starter solenoid (relay integral with the starter) ON.

Fig. 7.15 Fire Detection and Extinguishing System



Fire Detection and Extinguishing

Fig. 7-15 shows the fire detection and extinguishing system.

A 4 m long pneumatic fire detection sensor monitors temperature in the engine compartment. Increased temperature causes increased pressure in the sensor. The sensor reacts quickly to local high temperatures such as a fire, and also to general overheating at lower temperatures. The system also monitors the integrity of the sensor.

The sensor connects to a combined FIRE warning light and push button on the right instrument panel. A hinged guard covers the push button to prevent inadvertent operation.

A fire bottle in the rear equipment compartment contains HALON fire extinguishing fluid. Pipes and hoses connect the outlet from the bottle to discharge nozzles in the engine compartment. An electrically-detonated cartridge in the outlet from the bottle releases the fluid into the engine compartment. A pressure gauge on the bottle can be examined through a window in the access panel for the rear equipment compartment during the pre-flight check. The bottle is serviceable when the indication is in the green range.

The hot battery bus supplies power for the system through a 1 amp circuit-breaker on the left instrument panel. The push-button connects to the cartridge through a switch on the fuel tank selector. The fuel tank selector must be set to OFF to operate the fire extinguisher.

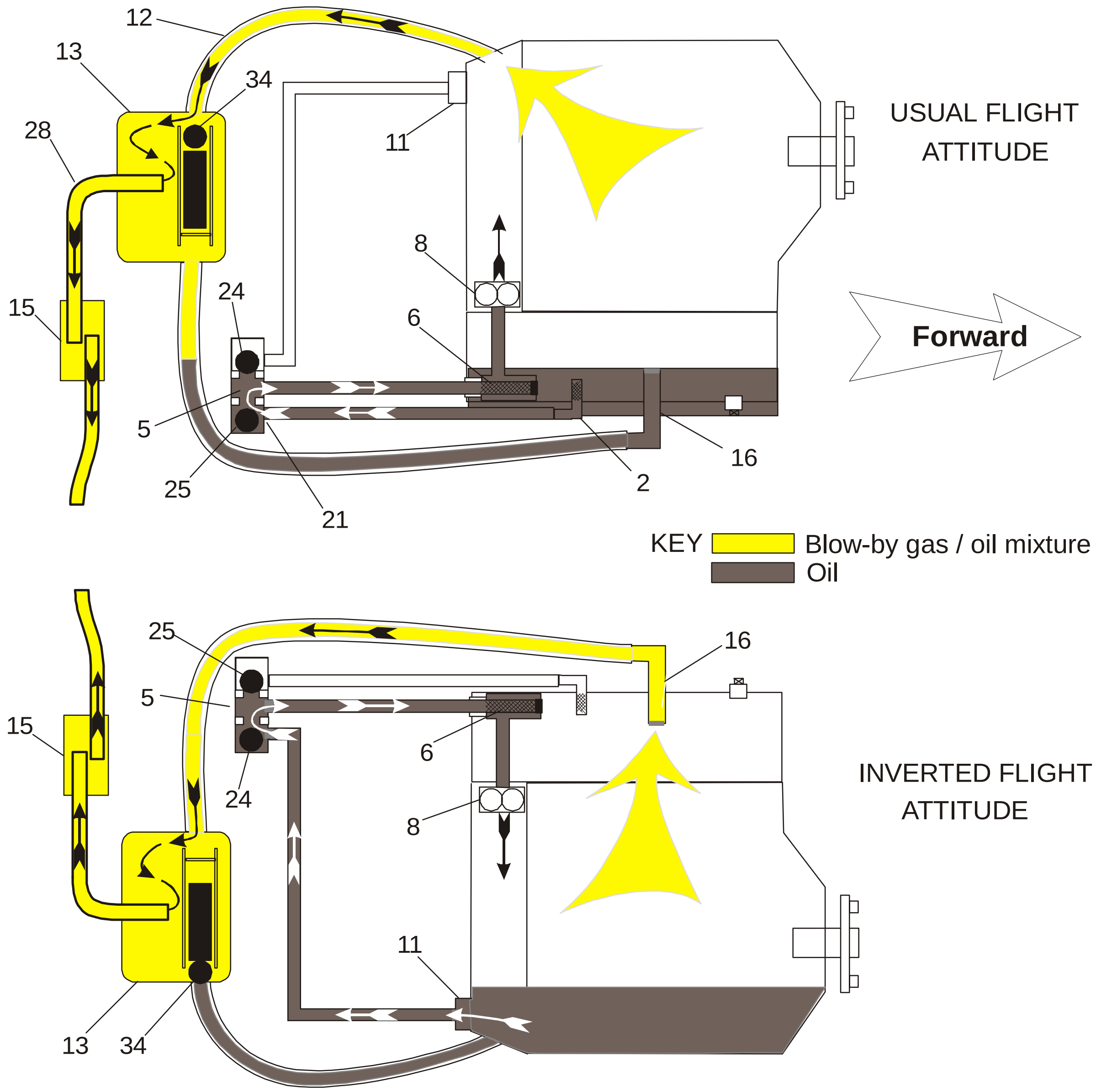
If the temperature in the engine compartment is too high, the system senses an overheat and the red FIRE warning light comes on. Setting the fuel tank selector to off, lifting the switch guard and pushing the button operates the extinguisher. All of the extinguishant is discharged into the engine compartment.

NOTE

Operate the fire extinguisher at not more than 95 KIAS. At higher speeds, the Halon extinguishant may be blown out of the engine compartment too quickly to extinguish the fire.

Push the TEST button on the annunciator panel to test the warning lights in the system. An amber FIRE FAULT light shows on the panel and the red FIRE warning comes on in the push button. The system also continuously monitors the sensor and the cables connecting the system during normal operation. If the system detects a fault, the FIRE FAULT warning on the annuciator panel comes on.

Fig. 7.16 Inverted Oil system



LEGEND			
2.	Connector in sump	15.	Oil trap
5.	Oil valve	16.	Oil return connector
6.	Oil suction screen	21.	Bottom connection on oil valve
8.	Oil pump	24.	Inverted flight ball in oil valve
11.	Drive pad connection on accessory housing	25.	Normal flight ball in oil valve
12.	Flexible pipe to top of oil separator	28.	Overboard breather line
13.	Oil separator	34.	Ball valve in oil separator

7.16 Oil System

The oil system of the G 120A engine is suitable for inverted flight and can provide sufficient engine lubrication during inverted flight and other negative load factors manoeuvres with minimal oil loss. A wet-sump-pressure oil system provides all important engine components with pressure and spray lubricating. Lubricating oil from the crank shaft housing is used also by the propeller governor for RPM regulation. The system has a capacity of 12 US Qt (11.4 litres).

The lubricating system has components such as the oil pump, filters, oil cooler, pipes and valves. In addition it has an inverted oil valve, oil separator and oil trap with associated pipes to provide lubricating oil supply during inverted flight.

When the oil pressure is less than 25 psi the oil pressure switch lights up a warning on the Annunciator panel.

Electronic oil pressure and oil temperature sensors on the rear housing of the engine give signals to the pressure and temperature displays in the combined engine instrument module.

System Function

Fig. 7.16 shows the inverted oil system operation for normal and inverted flight.

Normal Flight

Oil from the sump flows through the sump connector (2) to the bottom connection of the oil valve (21). Gravity holds the bottom ball (25) in the oil valve open, the oil flows to the suction screen (6) in the sump and to the engine oil pump (8).

The top ball valve in the oil valve (24) is closed. Therefore no oil or gases can flow between the accessory housing connection (11) and the oil valve.

When the engine runs, gases leak past the piston rings into the crankcase. The gases flow out of the engine breather at the top of the crankcase and also through the flexible pipe (12) to the top connector of the oil separator (13). The ball valve (34) in the separator is open and the gases flow out of the center connection through the oil trap (15) to atmosphere.

NOTE

Recommended oil levels for acrobatics - max. 9.5 Qt. (9 litres). If more oil than this is carried, oil loss will be excessive during acrobatics.

Inverted Flight

If the aircraft is inverted, oil from sump falls to the camshaft area of the crankcase and also onto the area of the drive pad on the accessory housing (11). Gravity closes the normal inlet ball valve (25) in the oil valve (5). Therefore no oil or gases can flow from the sump to the oil valve.

Gravity opens the inverted flight ball valve (24) in the oil valve. Oil flows from the drive pad (11) to the oil valve, further on to the suction screen (6), and to the oil pump (8).

Gravity closes the ball valve in the oil separator (34). No oil or gases can flow out of the normal breather connection. The engine gases flow through the oil return connector (16), into the sump and to the oil separator. The oil separator traps any oil which was in the hose. The gases flow out of the centre connection of the oil separator to the oil trap, then to the atmosphere.

Return To Normal Flight

When the aircraft returns to the normal flight attitude, the oil falls back into the sump, and the ball valves in the oil valve allow oil supply from the sump.

The ball valve in the oil separator opens to allow the normal breather to operate. The oil separator traps any oil from the usual breather pipe. The oil in the oil separator flows through the bottom connection to the sump.

7.17 Engine Operation

Fig. 7.16 shows the engine controls.

The engine and propeller are controlled by three levers in the centre console:

THROTTLE lever, PROP lever and MIXTURE lever.

The throttle and propeller lers are duplicated on the Left cockpit wall.

A friction lever (on the left side of the centre console) controls the forces for the control levers.

The THROTTLE lever is used to set engine power by the manifold pressure between IDLE to MAX. It is connected to the injector. The PROP lever is used to set the desired propeller rotational speed (and also engine RPM) from HIGH to LOW. The MIXTURE lever controls the fuel/air mixture and therefore the performance and efficiency of the engine.

If power alterations are made with the throttle lever, the propeller controller changes the blade angle to hold the RPM steady. When the propeller blade angle reaches its limit, further throttle changes will result in changes to the rpm in the corresponding sense.

On the other hand, when the RPM is changed with the prop lever at constant throttle lever setting, the engine manifold pressure remains constant as long as blade adjustment is possible.

Since the flying speed has an essential aerodynamic influence on the propeller, small RPM alterations with speed variation are normal.

Fig. 7.16A Engine Controls

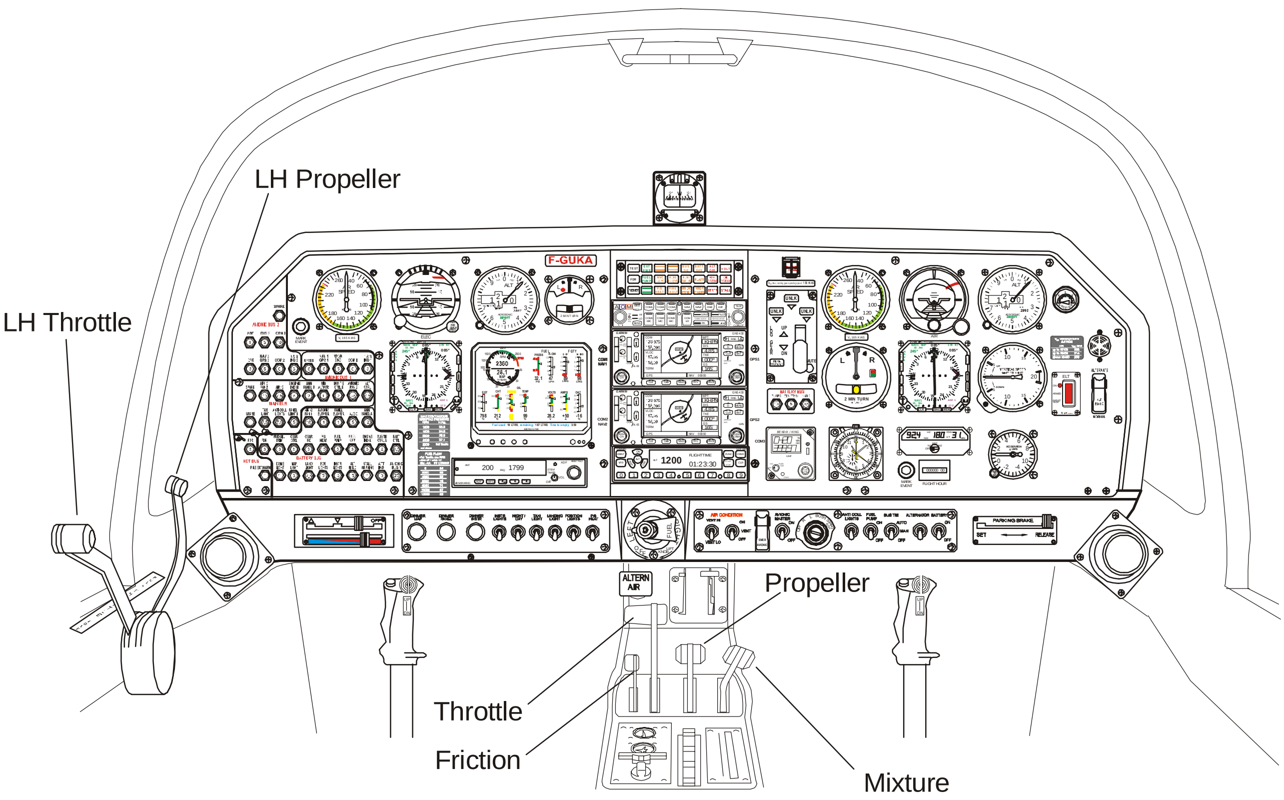
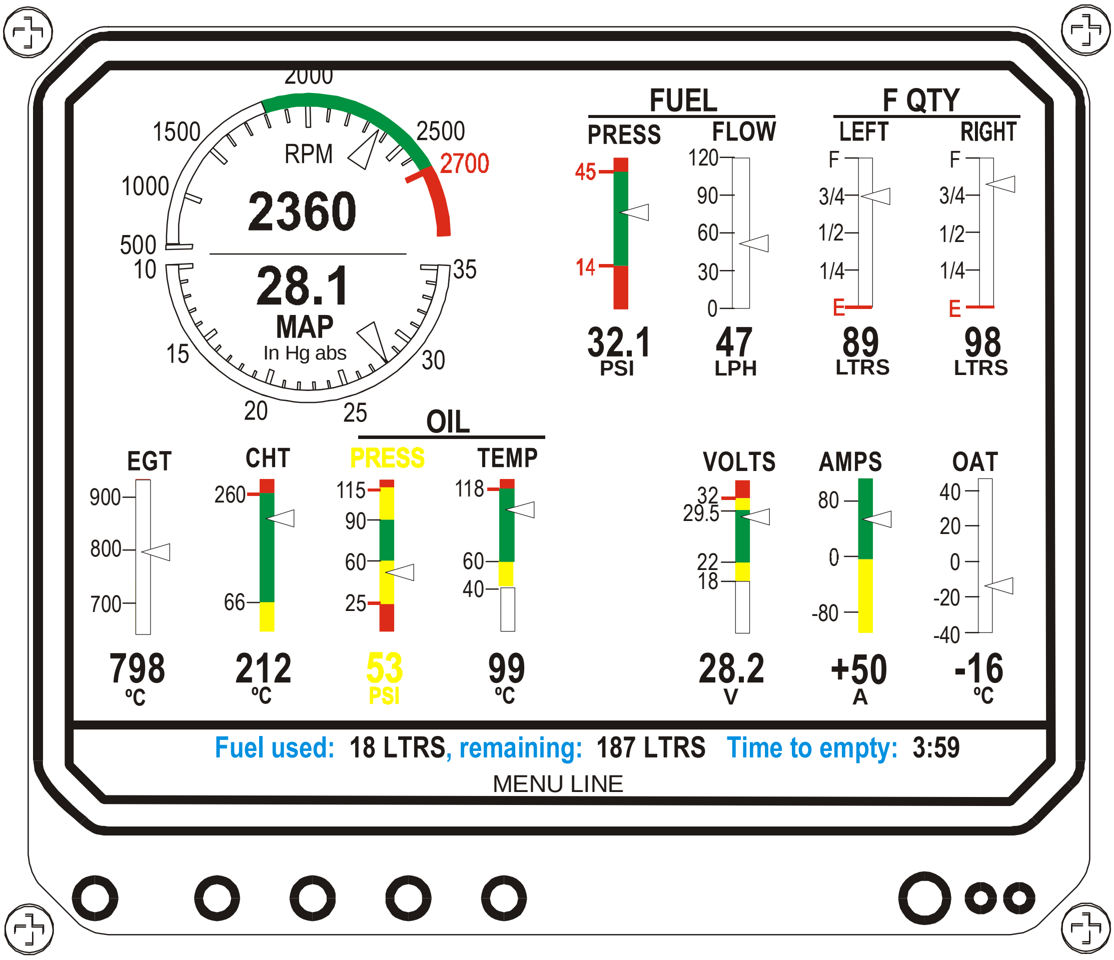


Fig. 7.17 Engine Instrument Module



7.18 Engine Instruments

Fig 7.17 shows the engine instrument module.

The engine instruments are grouped in a module with analog and digital indications, located on the left instrument panel. The top left of the module shows rpm and manifold pressure. The bottom left shows EGT, CHT, oil pressure and oil temperature. The right side has 7 vertical displays for fuel pressure, fuel flow, LH & RH fuel quantity, volts, amps and OAT.

NOTE

In case of discrepancies between digital and analog indication, the digital indication is to be taken.

MAP and Prop RPM

The top left pair of instruments indicates RPM and manifold pressure in in.Hg. The pressure tapping is taken from No. 5 cylinder. The RPM indication shows engine RPM/propeller rotation taken from the right magneto.

EGT, CHT, OIL PRESS, OIL TEMP

The bottom left row of vertical instruments indicates exhaust gas temperature (EGT) in °C, cylinder head temperature in °C, (both from number 2 cylinder), oil pressure in psi taken at the engine main oil gallery in the accessory housing and oil temperature in °C taken from the engine oil filter attachment bracket.

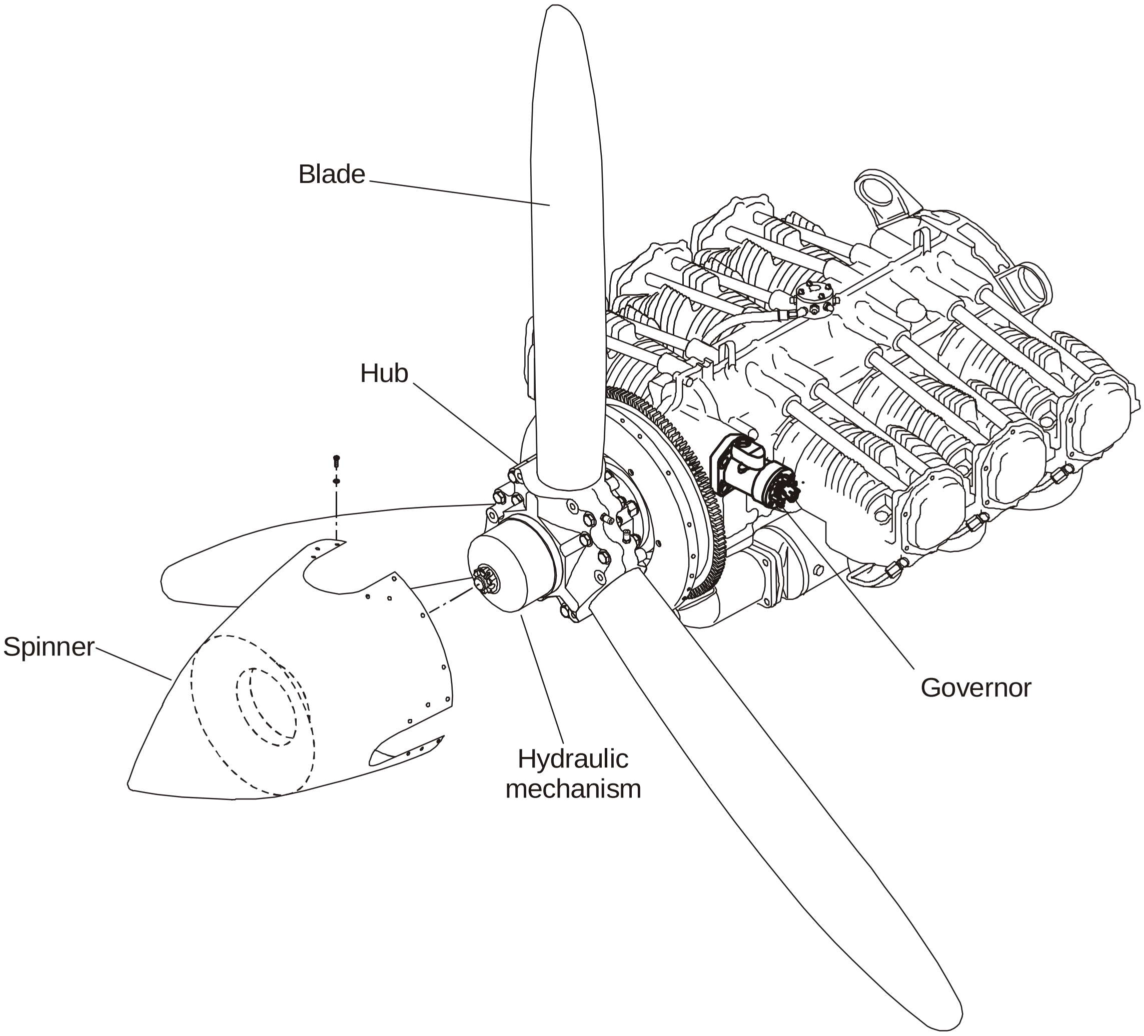
FUEL PRESS ,FUEL FLOW and F QTY

The top right row of vertical instruments indicates fuel pressure in psi taken at the firewall manifold, fuel flow in litres/hour taken at the fuel line to the injector, and the LH and RH fuel quantity in litres.

VOLTS, AMPS, OAT

The bottom right row of vertical instruments indicates the voltage on the battery bus, the current (+ or -) flowing to or from the battery, and the outside air temperature.

Fig. 7.18 Propeller Installation



7.19 Propeller

The GROB G 120A has a Hartzell, three-blade, constant speed propeller. **Fig. 7.18** shows the propeller installation. The propeller is hydraulically adjusted to give an infinitely variable blade angle, within the propeller limits. The propeller hub bolts directly to the crankshaft of the engine and contains the blade adjustment mechanism.

The propeller blades move towards fine pitch if the oil supply fails. In addition, a large spring inside the hub moves the blades towards fine pitch even if the propeller is stationary.

Propeller Control

The Woodward propeller governor is located, looking in direction of flight, on the front, left of the engine. The governor controls engine speed by changing propeller blade angle. A reduction gear drives a gear pump in the governor to bring oil from the lubricating circuit of the engine up to the necessary pressure for propeller control. A relief valve regulates the oil pressure. In the propeller governor, fly weights act against a regulator spring to move a spool valve that allows oil to flow to or from the propeller. A bowden cable connects the prop lever in the cockpit centre console to the propeller governor. The lever presets the force of the regulator spring. The spring counteracts the fly weights. The spring and fly weights move the spool to maintain a constant RPM.

The propeller hub has a cylinder with a hydraulic piston. The piston connects to the propeller blades. Oil from the governor acts on the piston to move the blades.

Operation

The propeller uses oil pressure to increase blade angle. If the engine speed increases, the flyweights overcome the control spring in the governor and move the spool valve. The spool valve allows oil to flow into the propeller. The oil moves the blades towards higher pitch, and the RPM decreases. When the RPM reaches the selected speed, the flyweights balance the spring force and the spool valve cuts-off the oil supply to the propeller. If the engine speed is too low, the control spring force overcomes the flyweights and moves the spool valve to allow oil to flow out of the propeller to the engine sump. The blades move towards fine pitch. When the engine reaches the selected speed, the force on the flyweights balances the spring force and the spool valve cuts off all oil flow from the propeller.

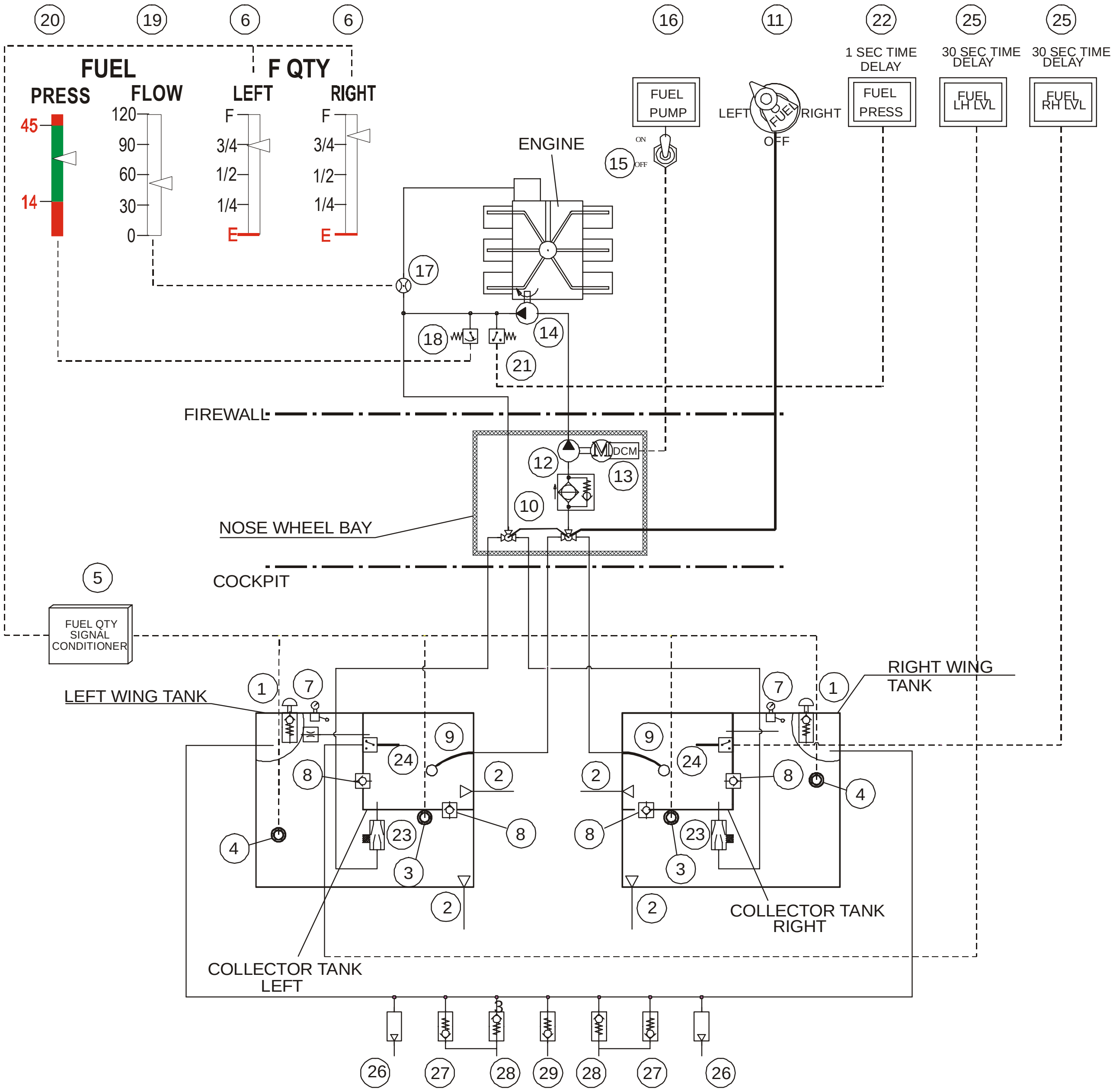
If the governor fails, the propeller blades move automatically to the minimum pitch position.

The propeller fine pitch stop limits maximum static RPM (brakes on, cross wind) to approximately 2550 RPM. A head wind will increase the RPM slightly.

During ground roll for take off, the RPM increases to 2700 RPM and the propeller governor continues to control the RPM at this value.

During flight, (particularly during aerobatics), transient overspeeds can occur. This is normal.

Fig. 7.19 Fuel System Schematic



LEGEND			
1.	Fuel tank filler cap.	16.	Fuel pump control light.
2.	Wing tank drain valve.	17.	Fuel flow sensor.
3.	Fuel qty. sensor, inner.	18.	Fuel pressure sensor.
4.	Fuel qty. sensor, outer.	19.	Fuel flow indicator.
5.	Fuel qty. conditioner unit.	20.	Fuel pressure indicator
6.	Fuel qty. indicator.	21.	Fuel low pressure switch.
7.	Mechanical fuel gauge.	22.	Fuel low pressure indicator.

8.	Inward non-return valves.	23.	Jet pumps.
9.	Flexible fuel pick-up.	24.	Collector tank, lo-level switch.
10.	Fuel selector/shut-off valve.	25.	Fuel lo-level indicator.
11.	Fuel selector/SO valve knob.	26.	Fuel vent drain port.
12.	Fuel filter.	27.	Inward relief check valve.
13.	Electric fuel pump	28.	Overpressure relief check valve.
14.	Engine driven fuel pump.	29.	Vacuum relief valve.
15.	2-Position fuel pump switch.		

Fig. 7.19 shows a schematic diagram of the fuel system. The aircraft has an integral fuel tank in each wing. The tank filler (1), with an integral non-return valve, is located on top side of the wing at the outer end of the respective tank. The front inner corner of each tank has a collector tank, which holds 8 litres (12 lbs, 2 US gal). Each wing tank contains approx. 130 litres (208 lbs, 34.4 US gal), of which approx. 5 litres (8 lbs, 1.3 US gal) is unusable. The fuel quantity in the wing tanks is measured and indicated in the cockpit. It is also indicated on a mechanical gauge (7) installed next to the filler-cap. Two drain valves (2) in the bottom of each tank allow fuel to be drained from the main tank and collector tank.

One fuel transfer jet pump (23) feeds each collector tank. From the collector tank fuel flows to a combined fuel selector/shut-off valve (10) and then through a large filter (12). An electrical backup fuel pump (13) and an engine-driven pump (14) feed fuel to the engine. Vent pipes in the top of each tank are connected to inward and outward overpressure relief check valves (28) and to a vacuum relief valve (29) in the baggage compartment. A fuel pressure sensor (18) and a fuel low pressure switch (21) monitor the system.

A flexible pick-up pipe(9), with a mass at the end to follow the fuel under positive or negative “g”-forces, is fitted in each collector tank. The fuel tank selector lever in the cockpit (11) controls the fuel flow selector/shut-off valve. Fuel flows from the selected pick-up to the fuel flow selector/shut-off valve and then through the filter. The mechanical pump (14) and/or the electrical pump (13) draw the fuel and feed it to the fuel injector.

Part of the fuel flow from the pumps returns to operate the jet pumps. This "motive flow" is controlled by a return line selector which is part of the fuel tank fuel flow selector/shut-off valve (10).

Each collector tank has a low level switch (24) which operates a caution light (25) on the annunciator panel with an automatic 30 second delay.

The electric fuel pump is necessary for engine starting and also provides back-up for the engine-driven pump during critical phases of flight. The FUEL PUMP annunciator light comes on when the electric fuel pump (13) is ON. The fuel sensor (17) gives the signal to the fuel flow indicator (19).

A low fuel pressure switch (21) senses the outlet pressure from both fuel pumps. The FUEL PRESS warning (22) in the annunciator panel comes ON if the pressure is too low for more than 1 second.

Both fuel tanks are vented by valves (located on the rear of the seat frame in the baggage compartment) to the outside of the airplane.

Each tank has 2 fuel quantity sensors (3 & 4) which are connected to the fuel quantity indicator (6) that is part of the combined instrument in the instrument panel.

Combined Fuel Flow Selector and Shut-off Valve

The fuel flow tank select/shut-off valve (10) is located in the center of the row of switches below the instrument panel. It has the positions LEFT, RIGHT and OFF. The button on the lever has to be pulled to allow it to turn to the OFF position. An el. Switch is activated in the OFF position allowing the fire extinguisher to be activated.

Electr. Fuel Pump

The electr. fuel pump switch (15) is located in the row of switches below the right instrument panel. The switch has the positions OFF and ON. It activates the electric fuel pump (13), which delivers a maximum pressure of 38 PSI at the engine. Selecting the electric fuel pump ON gives a rise in the fuel pressure. When the electr. fuel pump is operating a green FUEL PUMP annunciator (16) comes on. See Sections 3 and 4 regarding the operation of the electric fuel pump.

Fuel Quantity Indicator

The fuel quantity in each wing tank is indicated by combined engine instrument module in the left instrument panel as sensed by two fuel sensors (3 & 4) in each tank. The mechanical fuel gauge (7) on top of the wing uses a float to measure the fuel quantity.

Low Fuel Indication

In the upper area of the fuel collector tank there is a fuel-sensitive probe.

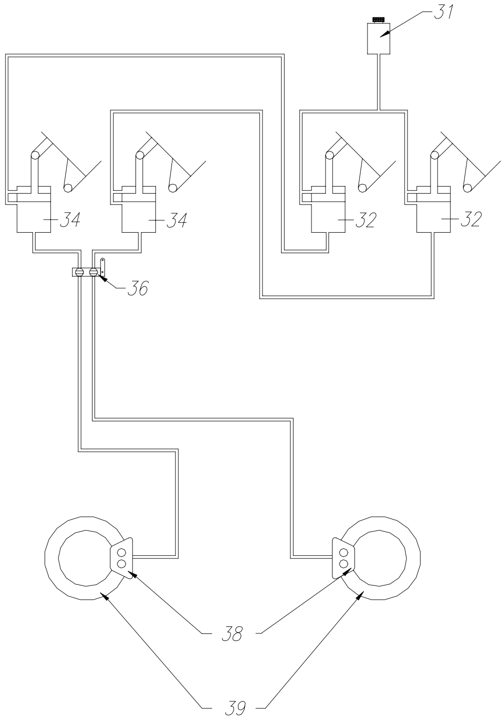
In case of fuel level goes below about 5 litres (9 lbs, 1.3 US gal) in the collector tank, the probe gives a signal to the annunciator panel where an amber caution FUEL LH/RH LVL indicating “low fuel” comes on.

Thus the pilot will be reminded to switch to the other fuel tank prior to a malfunction of the engine due to lack of fuel.

The probe signal is dampened so that normal fluctuations (for example due to aerobatic manoeuvres) do not cause the light to come on.

7.20 Brake System

Fig. 7.20 Wheel Brake System Schematic Diagram



Wheel Brake

Fig. 7.20 shows the wheel brake system. Each pilot has his own brake controls. The aircraft has a hydraulic disc wheel brake on each main landing gear. The brakes have their own hydraulic system which use a brake fluid reservoir (31), pipes, master cylinders (32 & 34), brake callipers (38) and discs (39). Pressing the top of the rudder pedal operates the master cylinder and applies fluid pressure to a calliper that acts on the brake disc. The brake pressure is directly proportional to the pedal pressure.

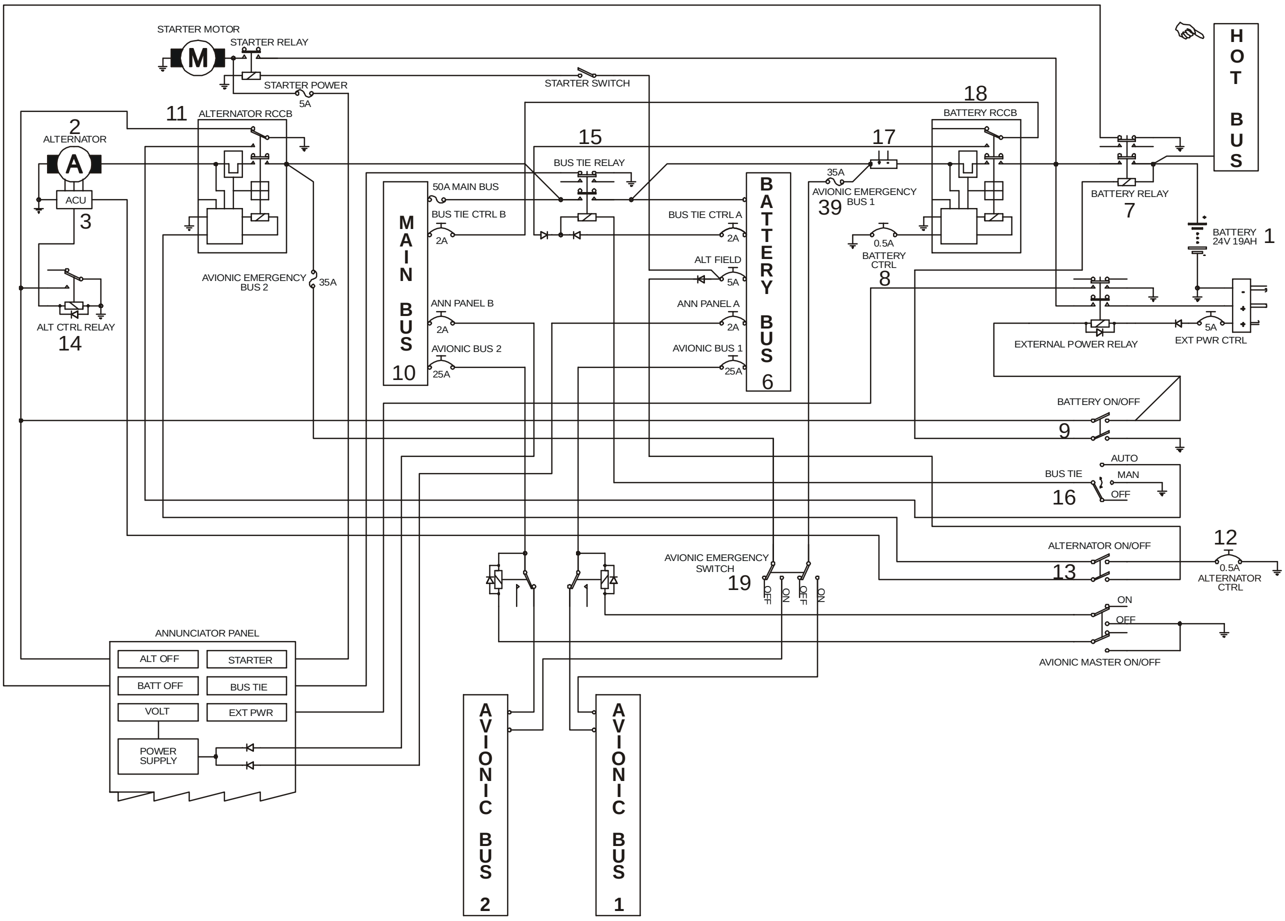
Parking Brake

The parking brake uses a mechanical valve (36), which locks the brake pressure. The parking brake lever is located on the lower right instrument panel. It is marked PARKING BRAKE and has the positions SET (On) and RELEASE (Off). To release the parking brake move the lever from SET to RELEASE. To apply the parking brake, press and hold the pressure on each pedal and move the lever to the SET position; then release the pedal pressure.

CAUTION

The hydraulic pressure will slowly decrease - therefore always insert wheel chocks if leaving the aircraft.

Fig. 7.21 Schematic Diagram of the Electrical System



7.21 Electrical System

General

Fig. 7.21 shows a schematic diagram of the 28V DC electrical system. The 80 amp alternator (2) is the main current source. A 24V 19Ah aircraft battery (1) delivers current to the engine starter motor and serves as an emergency power supply in case of alternator failure. Both alternator and battery are connected to their busses by RCCB's (Remote Controlled Circuit Breakers) with a rating of 75 A.

The aircraft also has an external power supply socket and external power can be used to start the engine and to power the systems. The external power socket is on the left side of the fuselage behind the cockpit. A diode prevents an incorrect polarity connection and a circuit breaker inside the access panel protects the system.

The electric current distribution is by a 28V DC Main bus (10), a Battery bus (6), and two Avionic busses. In the cockpit an analog/digital ammeter monitors the battery charging and a and an analog/digital voltmeter shows battery bus voltage.

Normally 28V DC is supplied to the MAIN BUS by the alternator. If the alternator fails or is disconnected, the battery can provide power to the MAIN BUS.

The avionic installation is connected to two avionic busses, which are connected by the AVIONIC MASTER switch to the MAIN BUS and/or the BATTERY BUS. The EMER AVIONIC OFF/ON switch (19) connects the Avionic Bus 1 directly to the BATT-Remote Control Circuit Breaker (RCCB) and Avionic Bus 2 to the ALT-RCCB.

Circuit breakers protect the electrical systems. They can be reset by the pilot in flight.

Battery and Alternator

The Battery (9) and the Alternator (13) switches are located below the center instrument panel. Both switches can be controlled individually. The aircraft has 2 electrical busses in the power generation system:

- Battery bus (6), connected via the RCCB (18), which is controlled by a CB (8), and the battery relay (7) to the battery (1). The BATT ON/OFF switch (9) controls the battery relay.
- Main bus (10), connected via the RCCB (11) with the alternator (2). The ALT OFF/ON switch (13) controls the relay (14) with an CB (12) which controls the ALT-RCCB.

Alternator

The alternator (2) is located on the right side of the engine and is driven by 2 V-belts from the crankshaft. The voltage is controlled at 28V DC by an integrated alternator control unit located on the firewall (3).

The ALTERNATOR switch (13) connects the alternator to the distribution system (ON) or isolates it from the system (OFF). A red warning with the designation ALT OFF in the annunciator panel comes on if the alternator has a defect or is switched off.

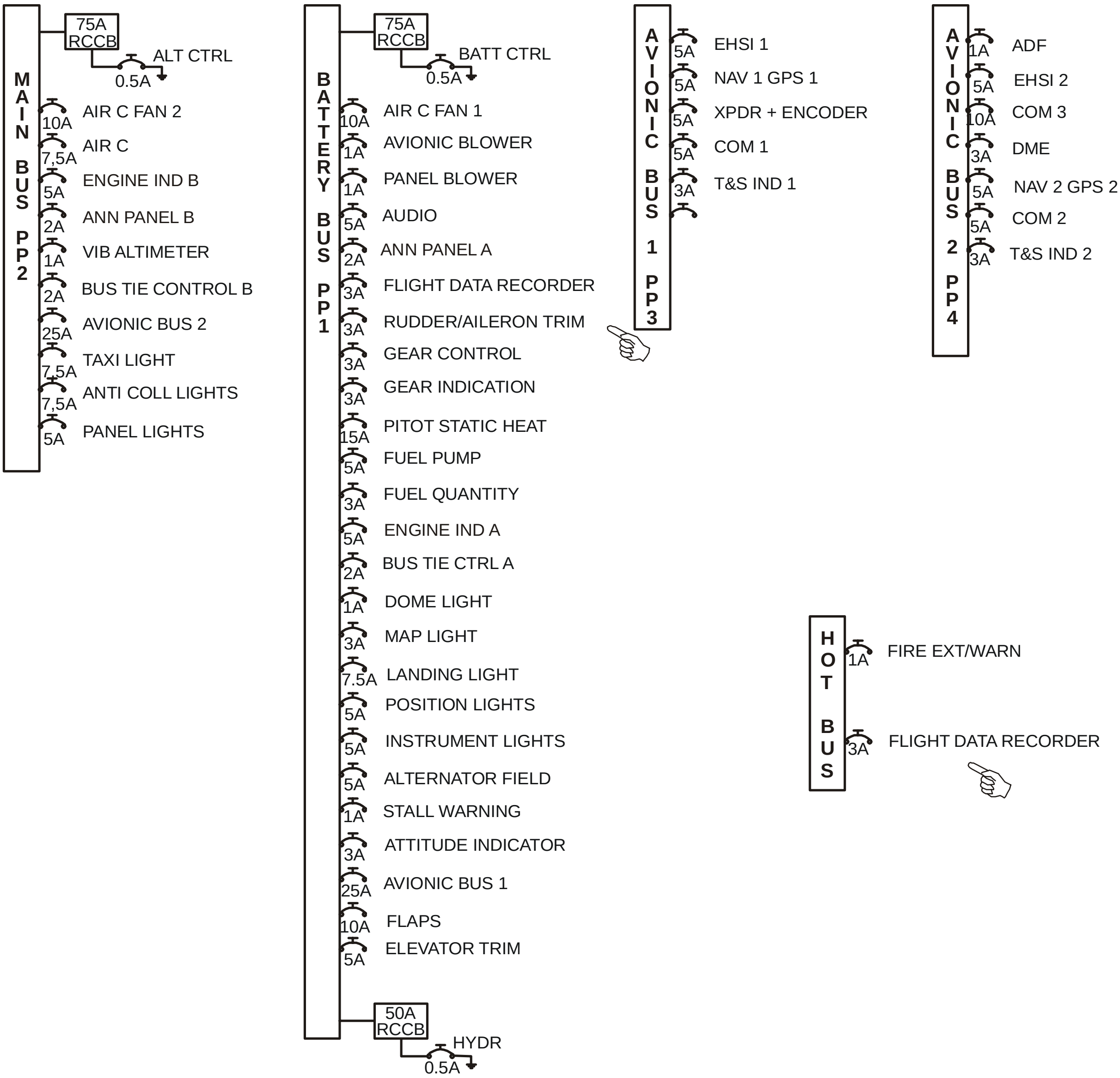
Battery

A 24V 19 Ah sealed lead-acid battery (1) is installed in the rear fuselage. The battery is switched on or off by the BATTTERY switch (9). The battery is charged via the Battery bus (6), when the BUS TIE relay connects the Battery Bus to the alternator. The amber BATT OFF caution on the annunciator panel comes on when the battery is switched off.

Ammeter and Voltmeter

An ammeter and a voltmeter are part of the engine instrument module located on the left instrument panel. The ammeter indicates if the battery is discharging (negative indication) or the battery is charged. The normal indication, once the battery has recovered from starting the engine, should be slightly on the positive side. The voltmeter shows the voltage on the battery bus. This should be about 24 volts without the alternator and 28 volts with the alternator ON.

Fig. 7.22 Schematic Diagram of the Bus Structure



The Bus Tie System

If the alternator fails the pilot has the option to select the battery to power the main bus by selecting the bus tie switch (16) to connect the battery bus (6) to the main bus (10). The bus tie switch has 3 positions - OFF/MAN/AUTO; these control the bus tie relay (15) setting. The normal position for the bus tie switch is at AUTO. If the bus tie relay opens, because of a alternator failure for example, a BUS TIE warning appears on the Annunciator panel. This means that the battery is not charged and the battery bus and avionic bus 1 are powered by the battery. Selecting the BUS TIE switch to MAN connects the main bus to the battery. The battery discharge rate will be high - monitor the voltmeter and select the landing gear and flaps down before the battery voltage drops below 18 volts.

CAUTION

With the alternator off line, and the bus tie switch selected to MAN, the battery can discharge quickly. Selectively load-shed the non-essential electric systems if possible and monitor the voltmeter frequently.

Busses

Fig. 7.22 shows the bus structure. The aircraft has 4 electric busses listed below, the first 2 are power generation systems:

Battery Bus

Connected via the battery relay, battery RCCB,and the BATTERY switch. The RCCB is controlled by a CB. It powers the critical systems through 3 circuit breakers in the right instrument panel. It powers all other important systems through the battery bus circuit-breakers in the left instrument panel.

Main Bus

Powered by the alternator through the alternator RCCB. A circuit breaker controls the system. The ALTERNATOR ON/OFF switch controls the circuit. The main bus supplies power to the less important systems.

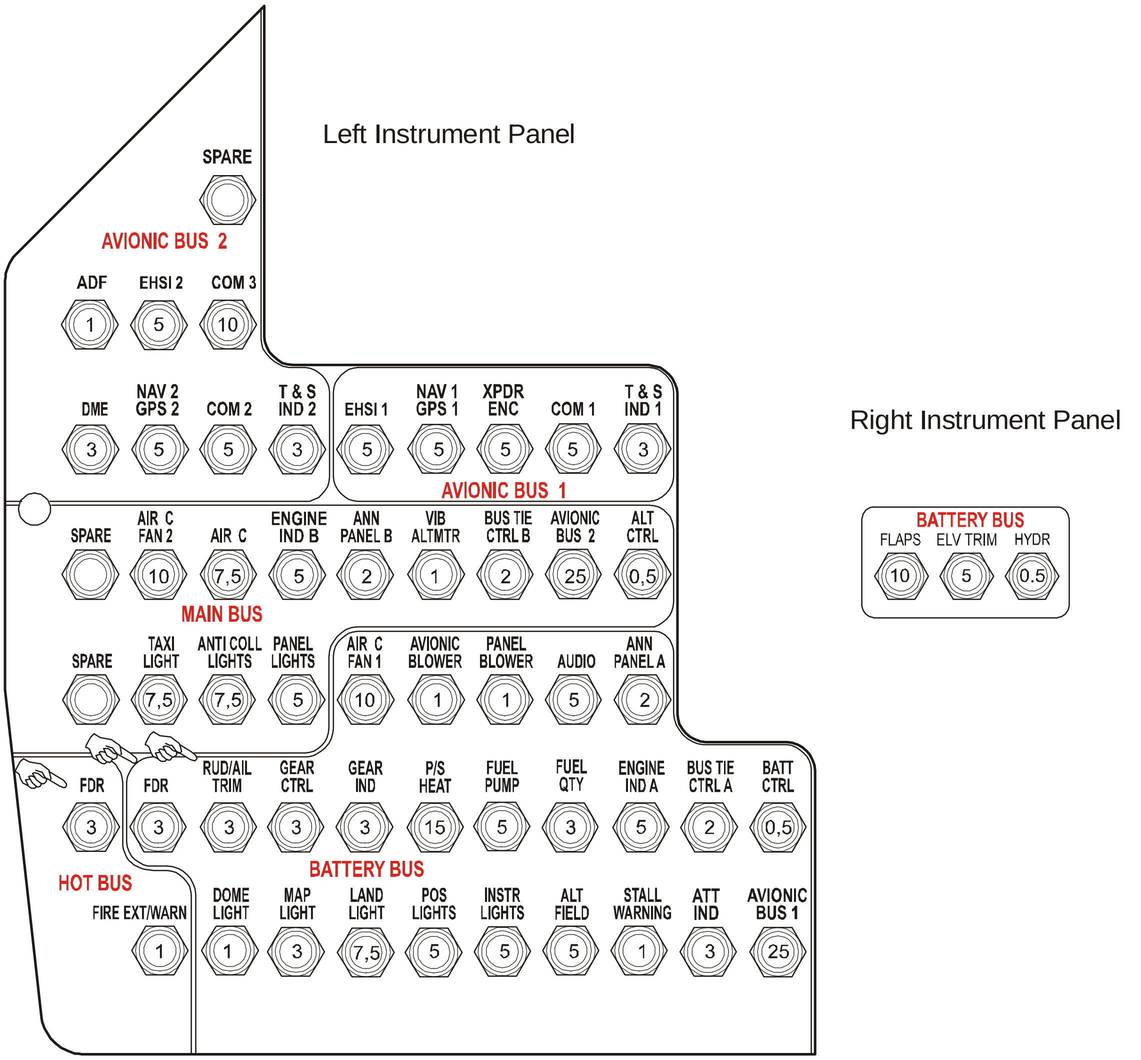
Avionic Bus 1

Powered by the battery bus. Supplies power to the most important avionic systems. One part of the avionic master switch connects the main bus to the avionic bus 1. An RCCB protects the battery bus.

Avionic Bus 2

Powered by the main bus, supplies power to the less important avionic systems. One half of the avionic master switch connects the main bus to the avionic bus 2. An RCCB protects the main bus.

Fig. 7.23 Circuit Breaker Panel



Circuit Breakers

Fig. 7.21 shows the circuit breaker panel. There are 3 locations for the circuit breakers:

- Circuit breakers for easy access for the hydraulic pump (HYDR), elevator trim motor (ELV TRIM) and flap motor (FLAPS) are located on the right instrument panel.
- On the left instrument panel all other circuit breakers that protect important circuits are located; these are accessible by either pilot in flight.
- The external power access panel has an external power circuit breaker and another circuit breaker for the flight hour counter.

Each circuit breaker will open automatically when the system current exceeds a certain value.

CAUTION

The pilot can pull the circuit breaker to disconnect the power from the system. It is common practice to reset a circuit breaker only once, because an electrical problem can be assumed, if a circuit breaker pops again after being reset.

External Power

The external power socket is on the left side of the fuselage behind the cockpit. The 28 volt DC external power system can supply the entire aircraft electrical systems when on ground. A diode prevents an incorrect polarity connection and a circuit breaker inside the access panel protects the system.

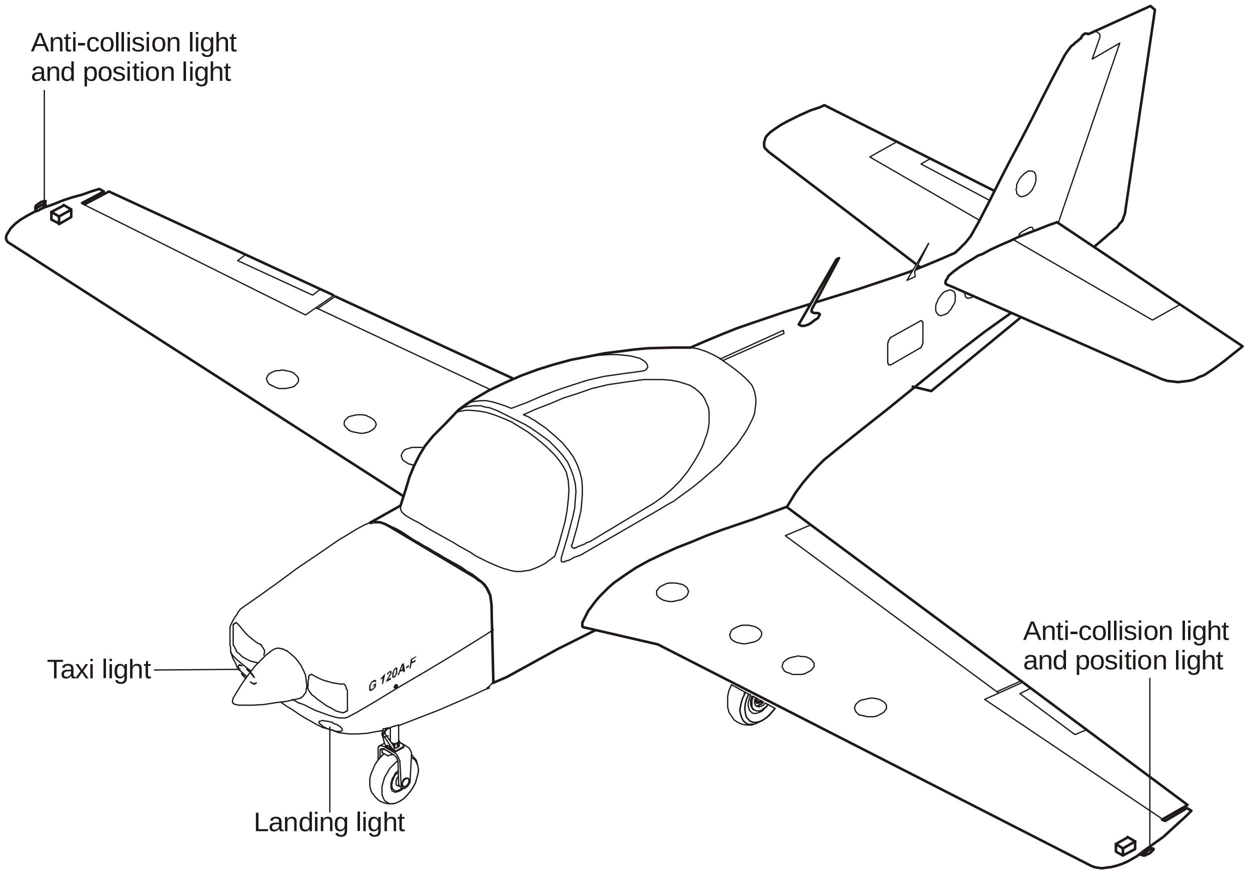
7.22 Lighting

The airplane has internal and external lights. **Fig. 7.24** shows the location of the external lights.

Internal Lighting

There are 4 separate instrument lighting systems: 6 dimmable panel lights, 1 map light, dimmable internal instrument lights and 3 dome lights. The circuit breakers for the 4 systems are on the left instrument panel. The instrument light switch and the dimmers for the panel lights and instruments are below the left instrument panel. The dome light switches are located on the dome lights mounted in the center of the canopy.

Fig. 7.24 Location of the External Lights



External Lights

There are 2 light clusters at the tip of each wing. Each cluster has an anti-collision light and a position light. There is a taxi light and a landing light mounted at the engine cowlings.

Position Lights

Each position light has a colored part - the left wing is red, the right wing is green - that faces outwards and forwards. Both lights also have a white part that faces backwards. The position lights are powered by the battery bus.

Anti-Collision Lights

The white anti-collision lights can be seen from the required angles externally. Do not switch on the anti-collision lights when close to people. The main bus supplies power for the anti-collision lights.

Landing Light

The landing light is in the left lower side of the engine cowling. It is powered by the battery bus.

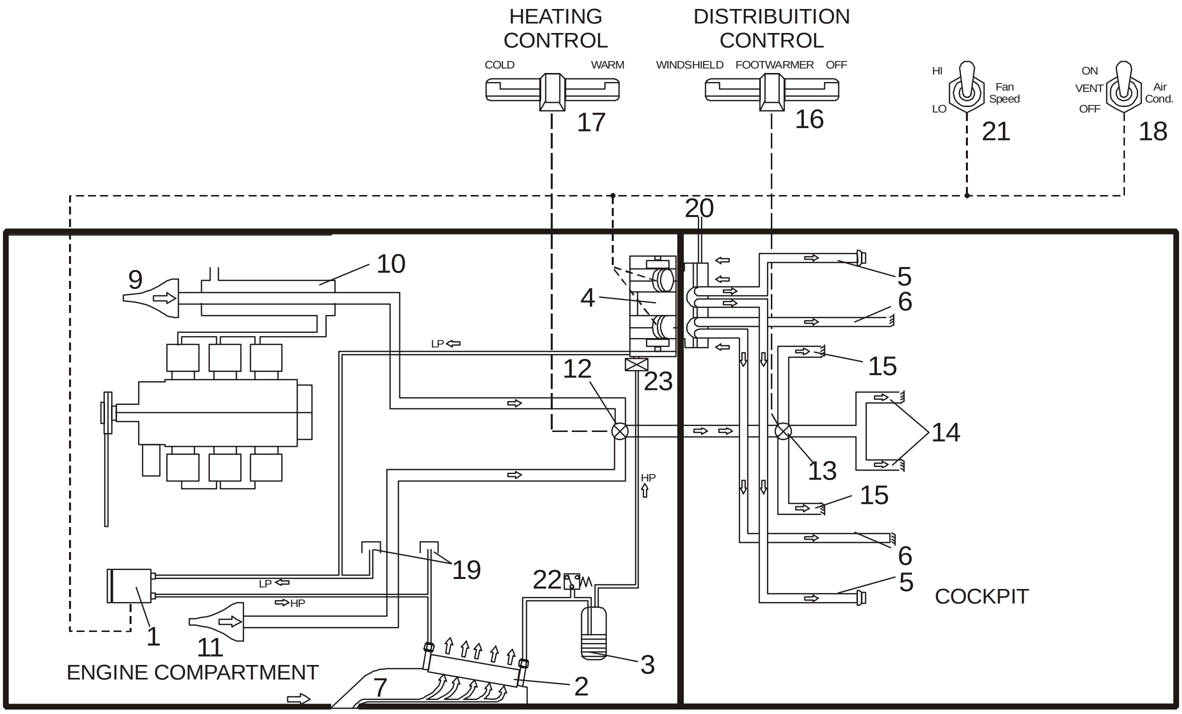
Taxi Light

There is one taxi light mounted on the right lower engine cowling. The main bus supplies power to the taxi light.

Switches

All the external light switches are below the left instrument panel. The circuit breakers are on the left side of the instrument panel.

Fig. 7.25 Schematic Diagramm of the Heating and Ventilation System



LEGEND			
1.	Compressor	13.	Distributor Valve
2.	Condenser	14.	Foot-warmer Outlet
3.	Receiver	15.	Windshield Demister
4.	Evaporator	16.	Distribution Control Lever
5.	Instrument Panel Cover Air Outlet	17.	Heating Control Lever
6.	Instrument Panel Air Outlet	18.	Air-conditioning Mode Selector
7.	Condenser Inlet	19.	Service Ports
9.	Heater NACA Inlet	20.	Water Drain
10	Exhaust Air Heat Exchanger	21.	Fan Speed Selector
11.	Cold Air NACA Inlet	22.	LO/HI Press Switch
12.	Mixing Valve	23.	Expansion Valve

7.23 Heating and Ventilation

Fig.7.25 shows the heating and ventilation system.

The aircraft has a heating and ventilation system. It also has a separate air conditioning system. The pilot has 2 ventilation/heating selectors on the left lower instrument panel; the upper lever controls distribution, the lower one temperature. Ventilation air can be distributed to the footwells, windshield or to both areas. Ventilation air can be heated.

Fresh air for heating is taken from an engine cowling air inlet (9), directed through the exhaust gas heat exchanger (10) and delivered as warm air to the mixing valve (12). Fresh air is also taken directly from an air inlet (11) in the cowling to the cool side of the mixing valve. The temperature selector lever is connected to the mixing valve. It is a slider control with cold at the left and warm on the right (17). With the selector in the cold position only fresh ambient temperature air is supplied to the ventilation system and warm air from the heat exchanger is diverted to the underside of the cowling..

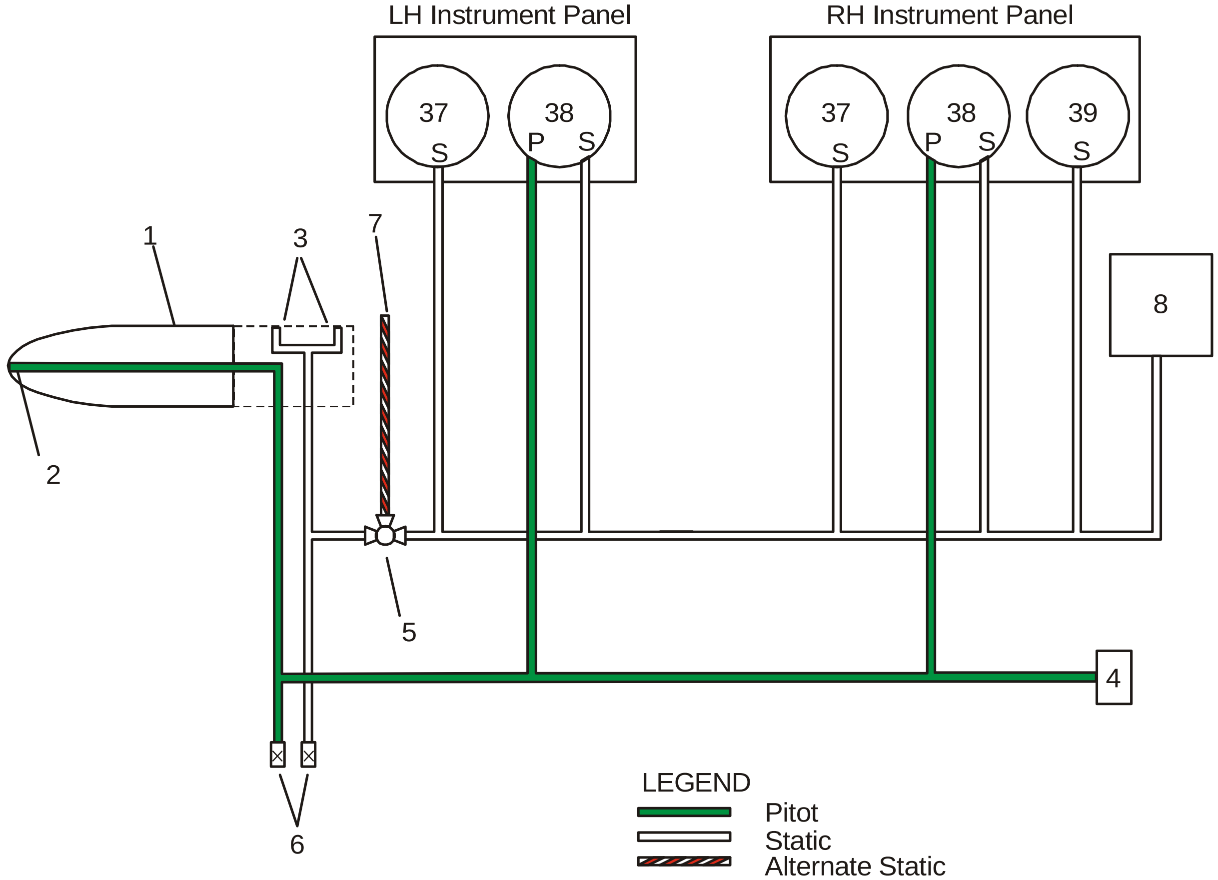
The distribution control lever has three notched settings (16): OFF on one side and HEATING between the middle and the other side. In the (OFF) position all air flow is switched off. If the ventilation/heating lever is in the middle notch, air is directed to the outlets in the foot wells. With the lever set to the left, air is directed to the windshield through an outlet underneath the windshield. Intermediate positions of the distribution lever are possible.

The heating system can operate with the engine running on the ground but it is more efficient when airborne.

7.24 Air-Conditioning

The air conditioning system provides refrigerated cold air through ducts in the cockpit to cool the cockpit. The engine drives a compressor that passes refrigerant to the air conditioning components mounted in the engine compartment. Cockpit air is forced over a cooled evaporator matrix and then passes through hoses to feed cold air to an adjustable nozzle at the outer end of each instrument panel and vents in the top of the instrument panel cover. The air conditioning is switched on with the air conditioning ON/VENT/OFF switch (18) on the right panel. In VENT position the air conditioning compressor is switched off but the condenser fans move uncooled air through the cockpit. A HI/LO switch (21) controls the fan speed blowing air through the condenser and therefore the rate of flow to the cockpit. There is no direct temperature control of conditioned air.

Fig. 7.26 Pitot/Static System



LEGEND			
1.	Pitot/static tube	7.	Alternate static source
2.	Pitot tube	8.	XPDR encoder
3.	Static vents	37.	Altimeter (LH and RH)
4.	Pitot pressure switch	38.	Air speed indicator (LH and RH)
5.	Alternate static switch	39.	Vertical speed indicator (RH)
6.	Water traps and drain valves		

7.25 Pitot/Static System

The pitot static system supplies static and total pressure to operate both airspeed indicators, both altimeters and the vertical speed indicator (**Fig. 7.26)**.

Total and static pressure are sensed by a heatable pitot tube located at the lower side of the left wing. Pitot heat should only be operated in moisture and possible icing conditions. A functional check during preflight check is performed by „hand-check“. Pitot and static ports are heated.

Alternate static pressure is selected by the switch in the RH instrument panel. Both pitot and static systems have water traps with drain valves in the pipes below the left wing adjacent to the wing root.

Alternate Static System

The use of this system is recommended if the normal static system is unservicable. The pick-up is by means of combined and adjustable over- and underpressure tubes in the engine compartment (attached to the fire wall).

The airspeed deviation during climb and cruise of this system is less than ±5 kts of the calibrated airspeed.

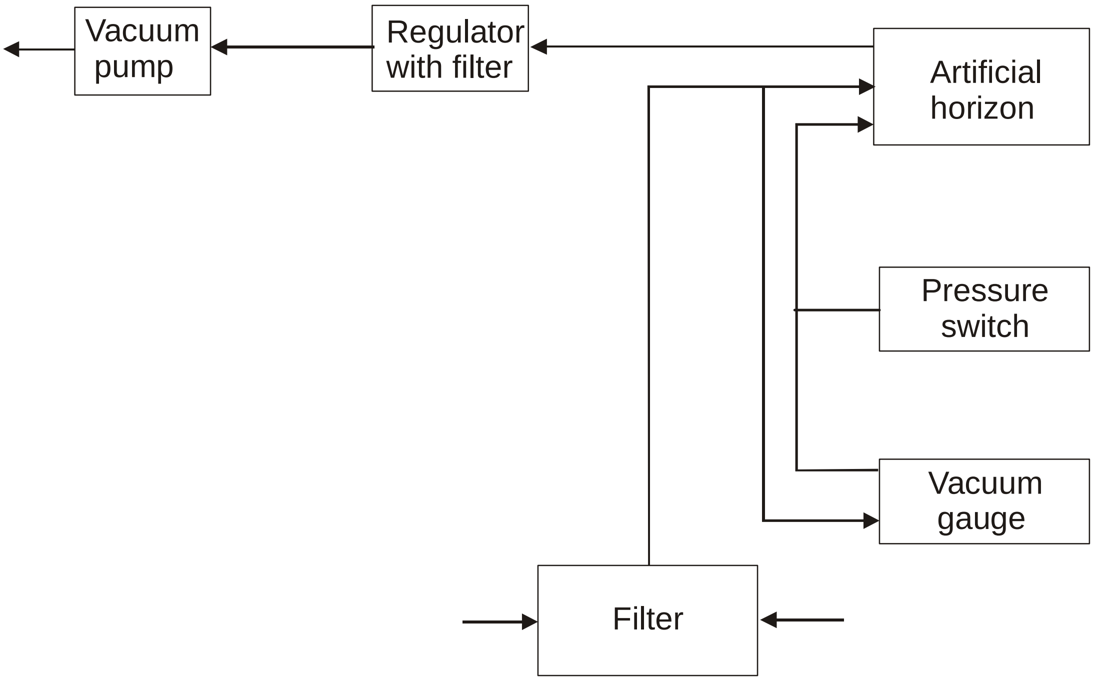
The alternate static system is selected by a guarded toggle switch in the right instrument panel.

7.26 Vacuum System

The suction pump is mounted on the accessory housing and is driven by the engine. It supplies suction power to an attitude gyro in the RH instrument panel. There is a vacuum gauge mounted at the top right of the right instrument panel. The normal gauge reading should be 4.5 to 5.4 in Hg at 1800 RPM.

A pressure switch operates the VAC LO amber caution light on the annunciator panel.

Fig. 7.27 Vacuum System Schematic Diagram



7.27 Stall Warning

The electric stall warning system warns the pilot against an imminent stall.

The system consists of a moving plate stall warning sensor on the front of the right wing that triggers an audible and visual cockpit warning. Stall warning is set to occur 5-10 knots before the actual stall in 1g flight. It remains active until the angle of attack of the aircraft is reduced to a normal flying angle of attack.

WARNING

A stall in the inverted position does not trigger the stall warning.

7.28 DME

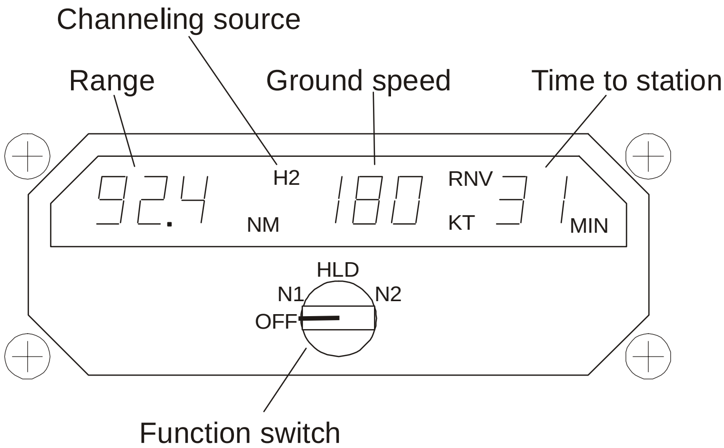
Fig. 7.28 shows the DME indicator.

The KN 63 is a remote mounted, 200 channel DME. It is designed to operate with the panel mounted KDI 572 indicator. The KDI 572 indicator accepts channeling data from either of two external NAV control heads.

A rotary switch on the indicator selects OFF, N1, HOLD, or N2 channeling.

The indicator receives DME range, ground speed, and time-to-station from the KN 63.

Fig. 7.28 DME Indicator KDI 772



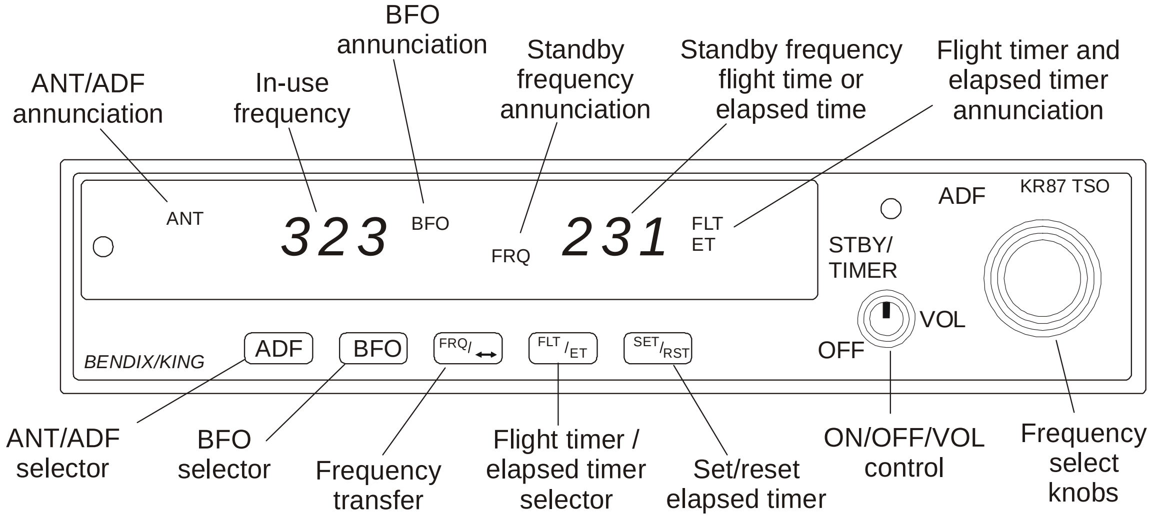
7.29 ADF

The Bendix/King KA 87 Digital ADF is a panel-mounted, digitally tuned automatic direction finder. It is designed to provide continuous 1 kHz digital tuning in the frequency range of 200 kHz to 1799 kHz and eliminates the need for mechanical band switching. The system is comprised of a receiver, a built-in electronics timer, a bearing indicator, and a KA 44B combined loop and sense antenna. Operating controls and displays for the Bendix/King Digital ADF are shown in the **Fig. 7.29**.

The ADF can be used for position plotting and homing procedures, and for aural reception of amplitude-modulated (AM) signals.

The 'flip-flop' frequency display allows switching between preselected 'STANDBY' and 'ACTIVE' frequencies by pressing the frequency transfer button. Both pre-selected frequencies are stored in a non-volatile memory circuit (no battery power required) and displayed in large, easy-to-read, self-dimming gas discharge numerics. The active frequency is continuously displayed in the left window, while the right window will display either the standby frequency or the selected readout from the built-in electronic timer.

Fig.7.29 ADF Controls



The built-in electronic timer has two separate and independent timing functions.

- An automatic flight timer that starts whenever the unit is turned on. This timer functions up to 59 hours and 59 minutes.
- An elapsed timer which will count up or down for up to 59 minutes and 59 seconds.

When a preset time interval has been programmed and the countdown reaches :00, the display will flash for 15 seconds. Since both the flight timer and elapsed timer operate independently, it is possible to monitor either one without disrupting the other. The pushbutton controls and the bearing indicators are internally lighted. Intensity is controlled by the instrument lights potentiometer.

ANT/ADF MODE ANNUNCIATOR - Antenna (ANT) is selected by the 'out' position of the ADF button. This mode improves the audio reception and is usually used for station identification.

The bearing pointer is deactivated and will park in the 90° relative position. Automatic Direction Finder (ADF) mode is selected by the depressed position of the ADF button. This mode activates the bearing pointer. The bearing pointer will point in the direction of the station relative to the airplane heading.

IN-USE FREQUENCY DISPLAY - The frequency to which the ADF is tuned is displayed here. The active ADF frequency can be changed directly when either of the timer functions is selected.

BFO (Beat Frequency Oscillator) ANNUNCIATOR - The BFO mode, activated and annunciated when the 'BFO' button is depressed, permits the carrier wave and associated morse code identifier broadcast on the carrier wave to be heard.

NOTE

CW signals (Morse Code) are unmodulated and no audio will be heard without use of BFO. This type of signal is not used in the United States air navigation. It is used in some other countries and marine beacon.

STANDBY FREQUENCY/FLIGHT TIME OR ELAPSED TIME ANNUNCIATION - When FRQ is displayed the STANDBY frequency is displayed in the right hand display. The STANDBY frequency is selected using the frequency select knobs. The selected STANDBY frequency is put into the ACTIVE frequency windows by pressing the frequency transfer button. Either the standby frequency, the flight timer, or the elapsed timer is displayed in this position. The flight timer and elapsed timer are displayed replacing the standby frequency which goes into 'blind' memory to be called back at any time by depressing the FRQ button. Flight time or elapsed time are displayed and annunciated alternatively by depressing the FLT/ET button.

FLIGHT TIMER AND ELAPSED TIMER MODE ANNUNCIATION - Either the elapsed time (ET) or flight time (FLT) mode is annunciated here.

FREQUENCY SELECT KNOBS - Selects the standby frequency when FRQ is displayed and directly selects the active frequency whenever either of the time function is selected. The frequency selector knobs may be rotated either clockwise or counterclockwise. The small knob is pulled out to tune the 1´s. The small knob is pushed in to tune the 10´s. The outer knob tunes the 100´s with rollover into the 1000´s up to 1799. These knobs are also used to set the desired time when the elapsed timer is used in the countdown mode.

ON/OFF/VOLUME CONTROL SWITCH (ON/OFF/VOL) - Controls primary power and audio output level. Clockwise rotation from OFF position applies primary power to the receiver; further clockwise rotation increases audio level. Audio muting causes the audio output to be muted unless the receiver is locked on a valid station.

SET/RESET ELAPSED TIMER BUTTON (SET/RST) - The set/reset button when pressed resets the elapsed timer whether it is being displayed or not.

FLIGHT TIMER/ELAPSED TIMER MODE SELECTOR BUTTON (FLT/ET) - The Flight Timer/Elapsed Time mode selector button when pressed alternatively selects either Flight Timer mode or Elapsed Timer mode.

FREQUENCY TRANSFER BUTTON (FRQ) - The FRQ transfer button when pressed exchanges the active and standby frequencies. The new frequency becomes active and the former active frequency goes into standby.

BFO (Beat Frequency Oscillator) BUTTON - The BFO button selects the BFO mode when in the depressed position. (See note under item 3).

7.30 Slaved Gyrocompass System

The Gyro Compass System includes the KMT 112 Magnetic Slaving Transmitter and the KG 102 Directional Gyro. The system provides heading data to the panel-mounted SN3500 EHSIs.

KMT 112 Magnetic Slaving Transmitter

The unit senses the direction of the earth´s magnetic field and continuously transmits this information through the slaving circuitry to the directional gyro which is automatically corrected for precession or 'drift'. This sensor is mounted in the right wing to eliminate the possibility of magnetic interference.

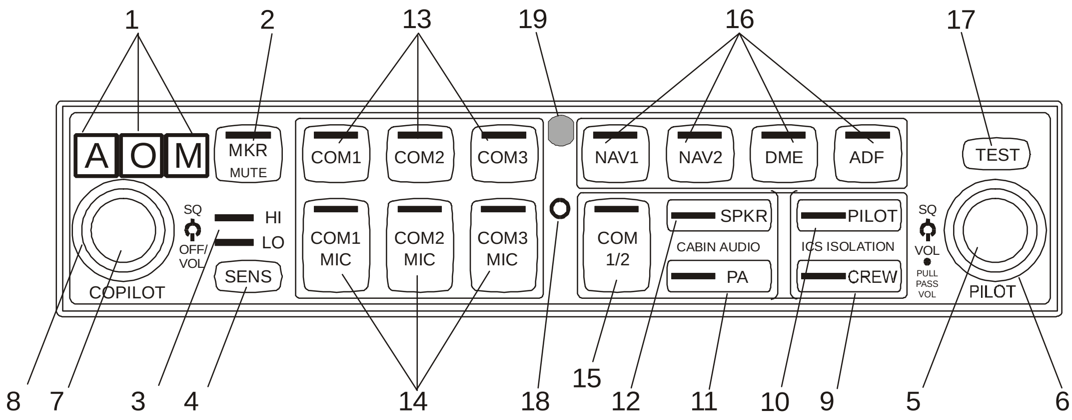
KG 102A Remote-Mounted Directional Gyro

The KG 102A Directional Gyro provides gyro stabilisation for the system. It also contains the slaving circuitry necessary for the operation of the system. The unit is mounted in the avionics compartment behind the baggage compartment.

7.31 Audio Selector Panel GMA 340

Fig. 7.30 shows the Audio Selector Panel. The GMA 340 is located in the avionic rack near the top.

Fig. 7.30 Audio Selector Panel GMA 340



The GMA 340 is a solid-state audio amplifier and audio selector with an automatic voice activated (VOX) intercom system. It can switch up to 3 transceiver and 5 receivers (NAV 1,NAV 2, ADF, DME, MKR). COM 3 is not used in this installation.

The audio selector panel has these controls:

Marker beacon lamps (1). The usual white (airway/inner), blue (outer) and amber (middle) lamps are located at the top left of the unit.

Marker Beacon Receiver Audio Select/Mute button (2). Pressing the button selects the marker receiver on. If no marker signal is received, then pressing again will de-select the marker receiver. If a marker signal is received, then pressing the button will mute the marker audio without de-selecting the marker receiver.

Marker Beacon Receiver Sensitivity Indicator LEDs (3). The LEDs show when either the high (HI) or low (LO) sensitivity is selected.

Marker Beacon Receiver Sensitivity button (4). Push the button to toggle between the HI and LO sensitivity settings.

Pilot Intercom System (ICS) Volume Control knob (5). The centre knob controls pilot ICS volume.

Pilot ICS Voice Activated (VOX) Intercom Squelch Level (6). Turn the outer knob clockwise to amount of microphone audio to break the squelch level. Turn the knob fully counter-clockwise to give a ‘Hot Mic’.

Copilot ICS Volume Control knob (7). The centre knob is the ON/OFF switch and also controls copilot ICS volume. Turn the knob fully counter-clockwise to turn the unit off.

Copilot ICS VOX Intercom Squelch Level (8). Turn the outer knob clockwise to amount of microphone audio to break the squelch level. Turn the knob fully counter-clockwise to give a ‘Hot Mic’.

NOTE

The unit has 4 intercom modes. Two involve music/entertainment and passengers and are not used.

Crew Isolation Intercom Mode button (9). Crew mode (Crew LED lit) puts the pilot and copilot on a common communication channel.

Pilot Isolation Intercom Mode button (10). Pilot mode (Pilot LED lit) isolates the pilot from the copilot and dedicates the aircraft radios to the pilot exclusively. The copilot cannot communicate with the pilot or use the aircraft radios.

Passenger Address (PA) Function button (11). Not used in this installation.

Speaker Function button (12). The SPKR button toggles the cockpit speaker on and off. The speaker is muted when a COM microphone is keyed.

Transceiver Audio Selector Buttons (13). Press COM 1 or COM 2 to select the related COM as an audio source. The selected COM audio will remain active even when the related MIC is not selected. Transmitter (Audio/Mic) Selection buttons (14). Press the COM1 MIC or COM2 MIC to select the related COM to both transmit and receive. The LED in the button blinks approximately once per second when the related transceiver is transmitting.

Split COM button (15). Press the COM1/2 button to dedicate COM 1 to the pilot for MIC/audio and COM 2 to the copilot for MIC/audio. The pilot and copilot can transmit simultaneously over the two radios. Both pilots can still listen to selected NAV aids. Press the COM 1/2 button a second time to cancel Split COM mode.

Aircraft NAV Radio Audio Selection buttons (16). Push the related button to select a NAV audio source. Push the button a second time to deselect the source.

Annunciator Test Button (17). Push the TEST button to test the LEDs and lamps.

Locking Screw Access (18). The hole in the middle of the panel gives access to the usual locking screw that holds the unit in the avionic rack.

Photocell - Automatic Annunciator Dimming (19). The photocell automatically controls the brightness of the LEDs and the marker lamps.

Operation

On, Off and Failsafe Operation

The GMA 340 is powered off when the small knob on the left of the unit (17) is set fully counter-clockwise.

Turn the knob clockwise past the click to turn the unit on.

A failsafe circuit connects the pilot’s headset and microphone directly to COM 1 if the power is interrupted or the unit is turned off.

Normal Operation

Audio from the selected radio(s) and NAV aids will be heard in the pilot’s and/or copilot’s headset depending on the selected mode.

Keying a microphone by either the pilot’s or copilot’s push-to-transmit button operates the selected transmitter.

7.32 COM/NAV/GPS GNS 430

Fig. 7.31 shows the Garmin GNS 430 VHF COM/NAV/GPS unit.

Each COM/NAV/GPS receiver/processor is located in the avionic rack in a tray. The usual hold-down screw (1) holds the COM/NAV/GPS in the tray.

Description

The GNS 430 has these functions:

Two-way voice communication in the frequency range 118 MHz to 136. 975 MHz in 25 kHz increments. This can be changed through the setup menu to 8.25kHz increments.

Receiving navigation signals in the frequency range 108. 10 MHz to 111.95 MHz in 50 kHz increments.

Receiving glideslope signals in the frequency range 329.15 MHz to 335 MHz in 150 kHz increments.

Access to any frequency in the NAV database.

The GNS 430 has the communications and VLOC controls on the left and it has the GPS controls on the right. It has these COM/NAV controls:

COM Power/Volume knob. The COM Power/Volume knob (30) controls unit power and communications radio volume. Press the knob momentarily to disable the automatic squelch control.

COMM/VLOC Frequency Select knobs. Two concentric knobs (1) at the bottom left of the unit let you select frequencies for the VHF communications and navigation functions:

The large knob tunes the megahertz (MHz) value of the standby frequency for the COM transceiver or the VLOC receiver, whichever is currently selected by the tuning cursor.

The small knob tunes the kilohertz (kHz) value of the standby frequency for the COM transceiver or the VLOC receiver, whichever is currently selected by the tuning cursor. Press the knob momentarily to toggle the tuning cursor between the COM and VLOC frequency fields.

COM Display. The COM display (2) is at the top left of the display panel. It shows the active (top) and standby (bottom) frequencies. The area in the top right of the COMM window is usually blank. When the COMM transmits, TX shows in this area. When the COMM receives, RX shows.

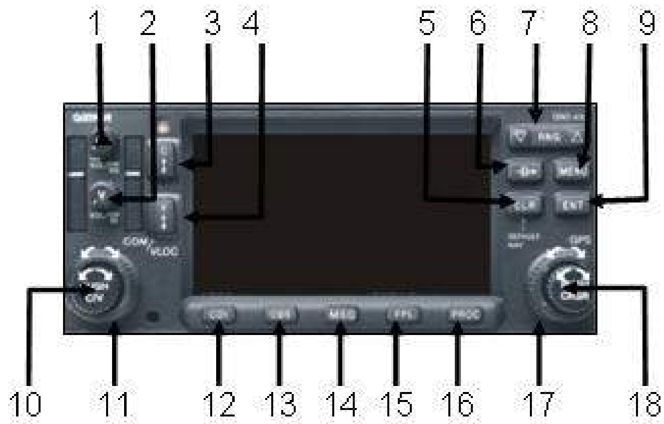
COM Flip-flop key. The COM Flip-flop key (3) transfers the standby frequency to the active frequency and the active frequency to the standby frequency.

NAV Flip-flop key. The NAV Flip-flop key (4) transfers the standby frequency to the active frequency and the active frequency to the standby frequency.

NAV Display. The NAV display (5) is at the middle left of the display panel. It shows the active (top) and standby (bottom) frequencies.

GPS Controls. The bottom and right of the unit has the GPS controls (6).

Fig. 7.31 COM/NAV/GPS GNS 430



1 COM Power/Volume
2 VLOC Volume
3 COM Flip-flop
4 VLOC Flip-flop
5 CLR (clear)
6 Direct-to
7 RNG (map range)
8 MENU
9 ENT (enter)
10 Small left knob
11 Large left knob
12 CDI
13 OBS
14 MSG (message)
15 FPL (flight plan)
16 PROC (procedures)
17 Large right knob
18 Small right knob

Operation COM /NAV VHF

Power and Volume Control

Turn the COM Power/Volume knob (1) clockwise to set the COM/NAV/GPS ON. Turn the knob fully counter-clockwise to set the COM/NAV/GPS OFF.

The unit has an automatic squelch control that gives maximum sensitivity to weak signals while rejecting local noise. You can override the squelch when listening to a distant station or setting the COM volume control.

Press the COM Power/Volume knob (1) momentarily to disable the automatic squelch control. Press the knob again to set the automatic squelch control.

When squelch is disabled, the COM audio is open continuously.

Power-Up Test

After turning the unit on, a Welcome page appears while the unit does a self-test. This is followed by a Land Data page. Next, a Database Confirmation page appears. This gives the current database information on the NavData card with the valid operating dates, cycle number and database type. The database is updated every 28 days and must be current for approved instrument approach operations.

Push the ENT key (9) on the right of the unit to continue the self-test. The Instrument Panel Self-Test page will appear.

Confirm the following instrument panel indications:

Course deviation - half left / no flag.	Glideslope - half up / no flag
TO/FROM flag. TO.	Time to destination - 4 minutes
Bearing to destination - 135º.	Desired track - 149.5º
Distance to dest. 10 nautical miles.	Ground speed - 150 knots
All external annunciators (if installed) - on	

The Instrument Panel Self-Test page shows the currently selected OBS course,. Push the ENT key to complete the self-test.

COM Tuning

The tuning cursor defaults to the COM window after 30 seconds of inactivity in the NAV window. If the tuning cursor is in the NAV window, press the small left knob (10) momentarily to toggle the tuning cursor into the COM frequency field.

Turn the large let knob (11) to set the MHz part of the standby frequency. Turn the small left knob (10) to set the kHz part of the standby frequency.

Press the COM Flop-flop key (3) to transfer the standby frequency to the active frequency.

Auto-Tuning

You can quickly select any frequency in the GPS window as the COMM standby frequency. Refer to the GNS 430 Pilot’s Guide and Reference for more data about this function.

Emergency Channel

Press and hold the COM Flip-flop key for approximately 2 seconds to set the active frequency to the emergency channel 121.500 MHz.

Stuck Microphone

When the GNS 430 transmits, TX shows in the COM window. If the microphone is stuck or accidentally left in the keyed position, or continues to transmit after the key is released, the COMM transmitter will automatically stop transmitting after 35 seconds of continuous broadcasting. The COM will also give a 'COM push-to-talk key stuck' message for as long as the condition exists.

Global Positioning System (GPS) and VHF NAV Description

The aircraft has dual GPS systems each of which is part of an integrated VHF COM, VHF NAV and GPS.

GPS Description

The GPS displays position and navigation data to the pilot. The data is stored internally and can be added to by the pilot.

Each GPS is protected by a 5 amp circuit-breaker; NAV1 GPS1 on the Avionic #1 Bus and NAV2 GPS2 on the Avionic #2 Bus.

Each GPS has a data cartridge which is installed in the front, left of the unit. Aeronautical and Cartographic data can also be loaded by a PC using a special cartridge reader.

The GPS 1 antenna is mounted on the top surface of the vertical stabiliser. The GPS 2 antenna is part of the integrated VHF COM 2 and GPS 2 antenna located on the top of the rear fuselage.

The main data for the GPS is from orbiting satellites. This gives a computed position for the GPS receiver. In order to improve accuracy, the GPS uses barometric height data from the altitude encoder. This is shared with the Transponder but is diode protected to prevent a fault on one system degrading the others.

GPS Operation

Refer to the Garmin GNS 430 Pilots' Guide and Reference for all operational data for the GPS.

VHF NAV Description

Fig. 5 shows the Garmin GNS 430 VHF COM/NAV/GPS unit. The GNS 430 has these VHF NAV functions:

Receiving navigation signals in the frequency range 108. 10 MHz to 111.95 MHz in 50 kHz increments.

Receiving glideslope signals in the frequency range 329.15 MHz to 335 MHz in 150 kHz increments.

Access to any frequency in the NAV database

The unit has these NAV controls:

\NAV Flip-flop key. The NAV Flip-flop key (5) transfers the standby frequency to the active frequency and the active frequency to the standby frequency.

NAV Display. The NAV display (6) is at the middle left of the display panel. It shows the active (top) and standby (bottom) frequencies.

The two-blade NAV antenna is located on the vertical stabiliser.

Refer to the Garmin GNS 430 Pilots' Guide and Reference for all operational data for the VHF NAV.

Traffic Information Service (Aircraft with Mode S Transponder Only)

In regions with a mode S traffic service, the Garmin GTX 330 Mode S transponder can display traffic data on the GNS 430 screen. Traffic can be displayed on a 'Traffic' page or on a 'Map' page. The COM/NAV/GPS screen shows the data as targets within 7 NM, 3,000 ft below and 3,500 ft above. The data is updated approximately every 5 seconds. The system also provides aural warnings through the audio system when new traffic enters the target zone, or when a target will approach within 0.5 NM horizontally or 500 ft vertically.

Refer to Garmin '400/500 Series Optional Displays Addendum to the Pilots Guide' for details of this capability.

7.33 The UHF System

The KTR909B contains two receivers with the second receiver fixed at the internationally recognized 243.000 Mhz emergency guard frequency and allows continuous monitoring of that frequency while simultaneously receiving on the tunable Main receiver.

The UHF system has the following components:

The King KTR 599A control unit is located in the right instrument panel, (Fig. 7.32). The No. 1 Avionic bus provides the power for the UHF transceiver and a circuit breaker protects the circuit.

The King KTR 909 UHF transceiver is fitted below the baggage compartment floor.

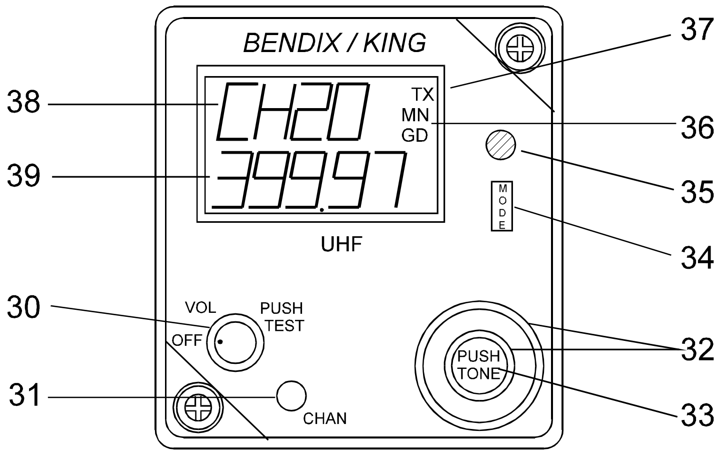
The UHF antenna is located under the rear fuselage under the baggage compartment.

a) The Control Unit

Fig. 7.32 shows the UHF Control Unit. It has the following controls:

OFF/ON/VOL/TEST knob (30). Fully anti-clockwise is the OFF position. Turning the knob clockwise switches the unit ON and increases the volume. Push the knob momentarily to stop the squelch operation, push it again momentarily to re-set the squelch.

Fig. 7.32 UHF COM Control Unit



LEGEND			
30.	On/OFF/VOL/TEST switch.	35.	Photocell.
31.	Channel select button.	36.	Receive annunciation.
32.	Frequency/Channel select knob.	37.	Transmit annunciation.
33.	Transmitter tone button.	38.	Channel number display.
34.	Receive mode select button.	39.	Frequency display.

CHAN button (31). Pressing this button momentarily switches the unit from manual frequency selection to preset or vice versa. Push the button for a longer time to set the channel programming mode.

FREQUENCY/CHANNEL SELECT knob (32). In the Preset/Guard Channel mode both the knobs change the channel number in the display. In the manual frequency mode the function of the knobs changes to the following:

The outer knob controls the 3 digits to the left of the decimal point of the frequency - (1 MHz steps).

The inner knob controls the 2 digits to the right of the decimal point (25 kHz steps).

Turn clockwise to increase, anti-clockwise to decrease the numbers.

PUSH TONE button (33). Push this button to give a 1 kHz tone for the transmitter test.

MODE button (34). Push momentarily to set the next available receiver mode. The receiver modes are:

MAIN. The unit transmits and receives on the set frequency.

BOTH. The unit scans both the set frequency and the guard frequency for a received signal. If the unit receives a signal it stops scanning and displays the frequency together with the receive annunciator mode. When the unit stops receiving the signal, it returns to scanning both frequencies again.

The UHF Control Unit has the following displays:

Channel Number Display (38). The top line of the display shows the channel number when in the Preset/Guard mode. The top line is blank in the Manual mode.

Frequency display (39). The bottom line always shows the selected preset or manual frequency in use. The farthest right digit can be a 0, 2, 5, or 7, denoting the last number in the .xxx MHz setting.

TX Annunciator (37). The transmit Annunciator (TX) comes on when the UHF transmits.

MN/GD Annunciator (36). The main annunciator (MN) comes on when the unit receives a transmission in either the Main or the Both mode. The guard annunciator (GD) comes on when the unit detects a guard transmission when in the Both mode, or when the guard frequency is in use.

b) Operation

1. Power and Volume Control

With the battery and avionics master switches on, turn the OFF/ON knob clockwise to switch ON and control the volume, turn it fully counter-clockwise to switch OFF.

2. Squelch Test Function

When you turn the unit ON at first there is no squelch - there is a hissing noise. After a short time the unit operates with squelch - the hissing stops. You can cancel squelch to do a radio system test or listen to a weak signal. To cancel squelch:

Push the Mode button to set the MAIN mode (MN in the display).

Push the OFF/ON/VOL/TEST knob to cancel automatic squelch. Push it again to reset the automatic squelch.

3. Receiver Mode

Push the receive MODE button to set the required mode.

4. Preset/guard Channel Programming

You can program any one of the 20 preset channels and also the Guard channel. To set the programming mode:

Push the CHAN select button for about 2 seconds until the top line shows the letter "P" followed by the channel number, or GdP shows for the Guard channel.

Now use the FREQUENCY/CHANNEL SELECT knobs to change the channel number.

Do the following steps to set the frequency:

- Momentarily push the MODE button until the frequency display starts to flash.
- Use the FREQUENCY/CHANNEL SELECT knobs to change the frequency.
- You cannot change the frequency of the Guard channel.
- If you need semi-duplex operation do the following steps:
- Momentarily push the PUSH TONE button in the FREQUENCY/CHANNEL SELECT knob to set the displayed frequency to the transmit frequency.
- Use the FREQUENCY/CHANNEL SELECT knobs to set the frequency.
- If you must program another channel, momentarily push the MODE button until the top display line starts to flash. Then use the FREQUENCY/CHANNEL SELECT knobs to set the frequency.
- In all cases to leave the programming mode momentarily push the CHAN button, or wait 20 seconds.

5. Preset or Guard Channel Selection

Do these steps to select a preset channel or the Guard frequency:

Momentarily press the CHAN button until the top display line shows "CH" followed by a number. Alternative push the CHAN button until you get "Gd".

Use the FREQUENCY/CHANNEL SELECT knobs to change the number. You will only get the programmed channels. Guard frequency is between the highest and lowest programmed frequencies.

6. Manual Frequency Selection

Use the CHAN button to select either manual or preset selection. When you set a frequency manually the semi-duplex operation is not available. Do the following steps to set a frequency manually:

Momentarily push the CHAN button until the top display goes blank.

Turn the inner FREQUENCY/CHANNEL SELECT knob to change the frequency in 25 kHz steps. Clockwise increases, anti-clockwise decreases the frequency.

Turn the outer FREQUENCY/CHANNEL SELECT knob to change the frequency in 1 MHz steps. Clockwise increases, anti-clockwise decreases the frequency.

7. Transmitting

Push the PTT button on the control stick (or the throttle if installed) to operate the selected radio transmitter.

8. Transmit Time-out

If the transmitter operates for more than 90 seconds a transmit time-out error occurs. The display flashes and you cannot transmit again until you eliminate the fault.

The usual causes of this fault can be the PTT switch sticking, (look for a "TX" on the unit display with no PTT switch pressed in this case), an inadvertent pressing of the PTT while handling the stick, or a 90 second transmission.

If a transmit time-out occurs, switch the unit OFF and then ON again.

7.34 Transponder GTX 330

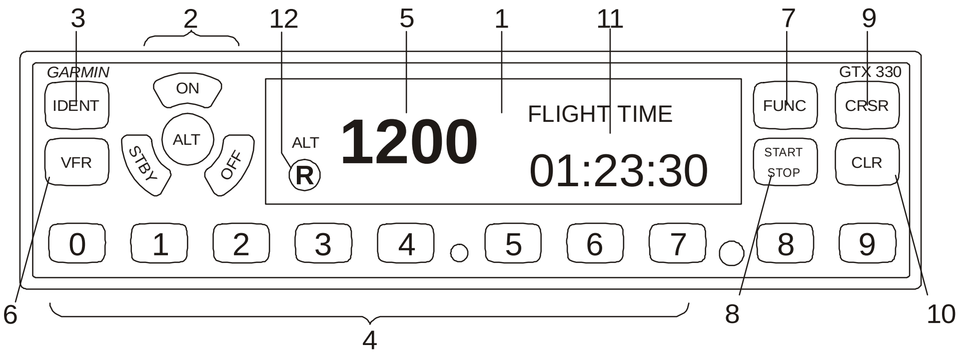
Fig 7.33 shows the transponder.

A four digit identification number is assigned to each aircraft by the Air Traffic Controller. This code is entered into the GTX 330 by the pilot. When the transponder is interrogated (Mode A) by a ground radar station the assigned code is transmitted back allowing Air Traffic Control to identify each aircraft. The transponder also responds to interrogation by TCAS equipped aircraft.

The Transponder is located in avionic rack in the centre instrument panel at the bottom. An altitude encoder senses the aircraft altitude and sends the data to the Transponder. The transponder sends the altitude data to an interrogating ground radar station (Mode C). The altitude encoder is located behind the instrument panel. The Transponder antenna (ATC Antenna) is located on the fuselage lower surface, forward of the wing, on the left side.

The GTX 330 also has Mode S data transmission. When interrogated, the transponder transmits a flight identification code

Fig. 7.33 XPDR GTX 330



Operation

The avionic bus 1 supplies power to the Transponder and Altitude Encoder circuits when the Battery and the AVIONIC MASTER switches are set ON. A 5 amp circuit-breaker protects the circuit.

The Altitude Encoder will not output any data until it has reached its proper operating temperature after approximately 7 minutes. The encoder uses static pressure and encodes it into altitude data for use by the Transponder.

During power-up, the transponder does a self-test. The screen shows the software version and 'Self Test In Progress'.

The transponder has continuous internal self-test. If the system detects a failure the screen shows 'FAIL' and the transponder stops transmitting data.

The Transponder has a liquid-crystal display (1) and these controls:

OFF/STBY/ON/ALT Mode Selector Buttons (2). Push the OFF button to turn the transponder **OFF**. Push ON, STBY or ALT to turn the transponder **ON** and to select one of these functions:

STBY. Sets the transponder to the standby position.

ON. Use this to operate the transponder without altitude encoding.

ALT. Use this to operate the transponder with altitude encoding.

IDENT Button (3). Push this button momentarily to transmit a coded identification signal to Air Traffic Control. You must only press this button at the request of Air Traffic Control.

CODE Selector Buttons (4). Use these buttons to select the required transponder code. The code appears in the left window (5).

VFR Button (6). Momentarily push the VFR button to select a pre-programmed VFR code and display it in the code window.

NOTE

Note: You must not switch the Transponder **ON** with codes **0000, 7500, 7600, 7700, or 7777** selected. Codes **7500**, **7600** and **7700** are emergency codes and must only be used in an airborne emergency.

FUNC Button (7). Pressing the FUNC button cycles through the available displays in the right window.

START/STOP Button (8). This button starts and stops the altitude monitor and flight timers.

CRSR Button (9) This initiates entry of the starting time for the count-down timer. It also cancels transponder code entry.

CLR Button (10). This resets the timers. It also cancels the previous button-push during code entry and count-down time entry. Push the CLR button within 5 seconds of code entry to return the cursor to the 4th code digit.

Number 8 Button. Enters the number 8 for the count-down timer. Reduces contrast and display brightness when these fields are displayed.

Number 9 Button. Enters the number 9 for the count-down timer. Increases contrast and display brightness when these fields are displayed.

The right window (11) can show a number of displays as follows:

PRESSURE ALT - shows the altitude reported by the altitude encoder in hundreds of feet (flight level) or metres.

FLIGHT TIME - starts when the aircraft takes off.

ALTITUDE MONITOR - Push the START/STOP button to start or stop the function. It shows when an altitude limit has been exceeded.

COUNT UP TIMER - Counts up from zero. Push the START/STOP button to start or stop the timer. Push the CLR button to clear the time.

COUNT DOWN TIMER - Counts down from a Pilot-entered time. Enter the starting time with the 0 to 9 buttons. Push the START/STOP button to start or stop the function. Push the CLR button to clear the time.

A arrow pointing up or down to the right of the PRESSURE ALT display shows the altitude trend. Two sizes of arrow show greater or lesser rate of climb or descent.

A reply indicator (12) comes on when the transponder replies to interrogations.

The GTX 330 transponder can receive traffic data from ground stations equipped with mode S. This data can be shown on a Garmin 400 or 500 series COM/NAV/GPS. The COM/NAV/GPS screen shows the data as targets within 7 NM, 3,000 ft below and 3,500 ft above. The data is updated approximately every 5 seconds. The system also provides aural warnings through the audio system when new traffic enters the target zone, or when a target will approach within 0.5 NM horizontally or 500 ft vertically.

Refer to Garmin ‘400/500 Series Optional Displays Addendum to the Pilots Guide’ for details of this capability.

7.35 EHSI SN 3500

General

One EHSI is located in the middle of each instrument panel. Each EHSI can display data from the following avionic equipment:

Slaved Gyro Compass.

NAV 1 and NAV 2 receivers.

GPS 1 and GPS 2 receivers.

DME.

ADF.

Marker Beacon receiver.

The following functions are not available in this installation:

Weather detection.

Traffic.

Data can be displayed on a 360º compass rose or an enlarged 70º arc. In the 360º mode, the aircraft is at the centre of the display. In the 70º ARC mode, a small aircraft symbol at the bottom of the display shows the aircraft position.

The EHSI has 3 memories that can hold Flight Plan data.

Memory 1: GPS flight plan.

Memory 2: Airports, airspace and GPS flight plan data.

Memory 3: VORs and GPS flight plan data.

On power-up, the EHSI does a comprehensive built-in test. The screen shows the software version and navigation data expiry date while the test is running.

After a few seconds, the usual EHSI display appears.

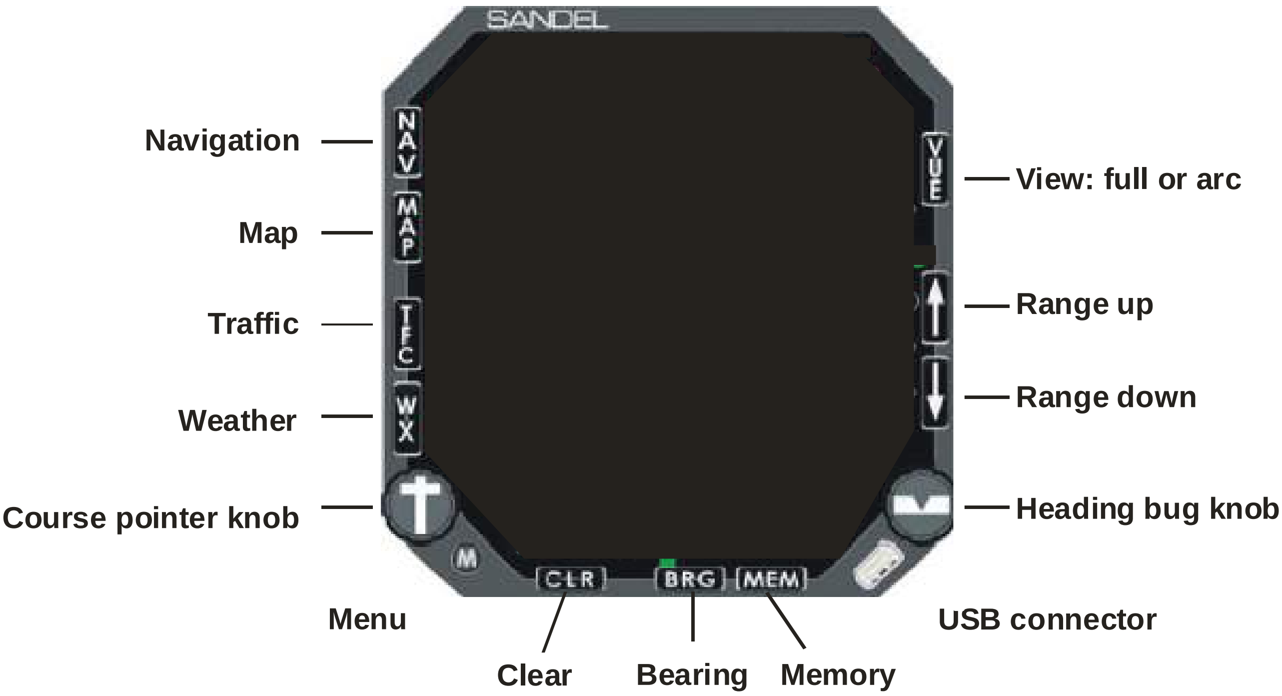
The EHSI does a continuous built-in test during operation. If the EHSI detects a fault, an appropriate warning flag shows on the screen.

A. DISPLAY OVERVIEW

SN3500 Physical Features

The SN3500 EHSI physical layout consists of a full three inch display, eleven backlit pushbuttons, two knobs with push to select, and one USB connector.

Fig. 7.35.1 SN3500 physical features



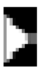
The following section of the manual describes the appearance of the SN3500 display and identifies each functional element. Detailed descriptions of these elements and a tutorial guide to their use are presented in later sections. **Display Areas** The primary display area shows either a 360-degree FULL view or a 70-degree ARC view, as indicated by the white compass ring. The white airplane or triangle represents the aircraft's current position. The primary display area may also depict the current GPS flight plan, airports, navaids, intersections, airspace, traffic, FIS-B datalink weather and/or Stormscope® data if the map feature has been enabled. Several indicators (see below) are also presented within the primary display area.

Fig. 7.35.2 Display Areas

The upper display area presents data from the selected course navigation instrument. The data displayed depends upon the navigation source (VOR/DME or GPS) but it will generally include bearing, distance, and ground speed, if available. The upper display area also includes information on the map status, WX-500 Stormscope® status (if installed), and an annunciation on whether the VOR NAV display is currently receiving either a localizer or a full ILS (localizer/glideslope) signal. The lower display area presents the numeric data associate with the two bearing pointers. This includes the NAV source, bearing and distance (if available). The right section of this area contains a display of the marker beacon lights if configured. The left section includes GPS annunciators, if configured.

Indicators

Several different symbols, or indicators, are used in each of the display areas. These are described below:

 **Lubber line [white]:** Points to the magnetic heading. It is always at the top of the display.

 **Heading bug [white]:** This can be set to a desired heading by rotating the Heading Select knob (right knob). Pressing the Heading Select knob will SYNC the heading bug with the lubber line, allowing the pilot to immediately set the heading bug to the current heading.

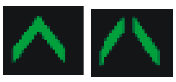
Fig. 7.35.3

Parked heading bug: When the display is in the 70-degree ARC mode using the [VUE] button, it is possible for the heading bug to be positioned off of the screen. When this happens, the heading bug “parks” at the side of the screen nearest to its actual position, with the symbol displayed smaller than normal and close to the edge of the screen.

Course pointer: By rotating the Course Select knob (left knob), you can set the course pointer to the desired course to a VOR NAV source. When a long-range NAV source is selected, the course pointer can automatically rotate to the desired track being sent by the NAV source (i.e. “Auto-slew”). A unique course pointer setting is maintained for each NAV source selection.

Fig. 7.35.4

Parked course pointer: When the display is in the 70-degree ARC mode, it is possible for the head of the course pointer to be positioned off of the screen. When this happens, the course pointer “parks” at the side of the screen nearest to its actual position, with the symbol displayed smaller than normal and close to the edge of the screen.



Bearing pointers 1 and 2: Two bearing pointers are provided. Bearing pointer 1 (BRG1) is represented by the closed tip arrowhead symbol. Bearing pointer 2 (BRG2) is represented by the open tip arrowhead symbol. Depending on the user-selected settings, these pointers may show the bearing to a VOR, ADF, or GPS waypoint. The numeric information from the instruments assigned to these pointers is displayed in the lower display area. The information is displayed in the same color as the associated bearing pointer. Also note that the tail of each pointer can be used to determine the bearing from the selected NAV source.

Inner Course and Vertical Deviation Indicators:

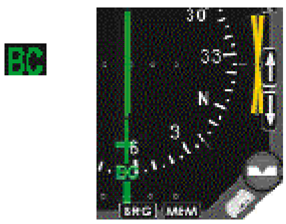
Fig. 7.35.5

The course deviation indicator bar (CDI; also known as the deviation bar or "Dbar") is the movable center section of the course pointer that depicts deviation to the left or right of course. The vertical deviation indicator bar (VDI) is the movable center section that depicts vertical deviation above or below glideslope or GPS final approach path. The VDI is only available when tuned to a glideslope or a vertical deviation from the GPS. Note that the inner CDI and VDI are not visible when the map display is enabled.

Outer Course and Vertical Deviation Indicator: The CDI and VDI are also repeated at the bottom and right side of the display – this is referred to as the outer CDI and outer VDI.

Back course:

Fig. 7.35.6



When flying a back course approach, the course pointer should be set to the published front course. The CDI will automatically reverse sense when the course pointer is more than +/- 90 degrees from the lubber line. The label "BC" will appear above the CDI and a yellow "X" will block the outer VDI during a back course approach as a reminder to the pilot as shown in the adjacent Fig..

Data Color Coding

Data displayed on the SN3500 is color coded as follows:

Color	• Data displayed
GREEN	• Information associated with the primary VHF NAV1 receiver (or NAV2 if in co-pilot configuration) • GPS annunciators: ACTV, AUTO and LEG • Class B and C airspace
CYAN	• Information associated with the GPS receiver text • Map status bar icons • Moving map icons • Current position symbol, either airplane or triangle
WHITE	• Compass rose under normal conditions • Magnetic heading and button labels • Non-active legs and waypoints of flight plan • To/From indicator • Inner marker indicator • Heading bug and associated data
RED	• Flags indicating failed glide slope or CDI data • Prohibited airspace
AMBER	• GPS annunciators: MSG and WPT and HOLD • Compass rose when either gyro or Magnetic slaving transmitter has failed • Middle marker indicator
YELLOW	• Information associated with the cross-side NAV receiver (NAV2 if in the pilot configuration, NAV1 if in the co-pilot configuration) • Restricted and warning areas • Flag indicating invalid glide slope • Marker test • Decluttered map status icons
MAGENTA	• Active leg and waypoint of flight plan • ADF bearing pointers • Map range
BLUE	• Outer marker indicator
PURPLE	• Military Operations Area

B. BASIC OPERATION

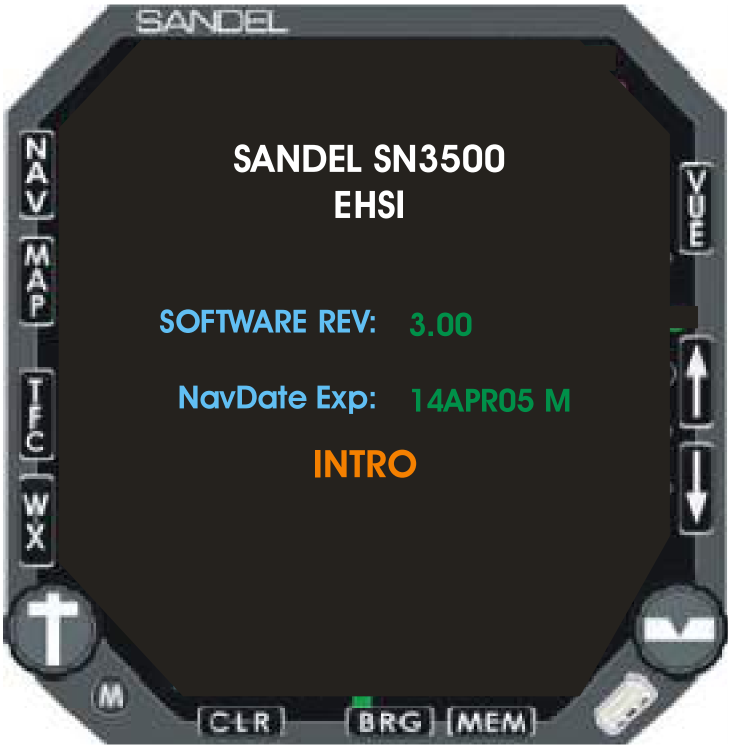
Overview

The SN3500 is configurable and controllable to provide the information needed at any point in the flight. Configuring the SN3500 refers to selecting the data for a given display. For example, either the VOR or the GPS receiver can drive a bearing pointer. Controlling the SN3500 refers to tailoring the display to suit the immediate situation. For example, the pilot may decide to turn off a bearing pointer completely during the enroute portion of the flight and use it only during an approach.

Power-up Displays

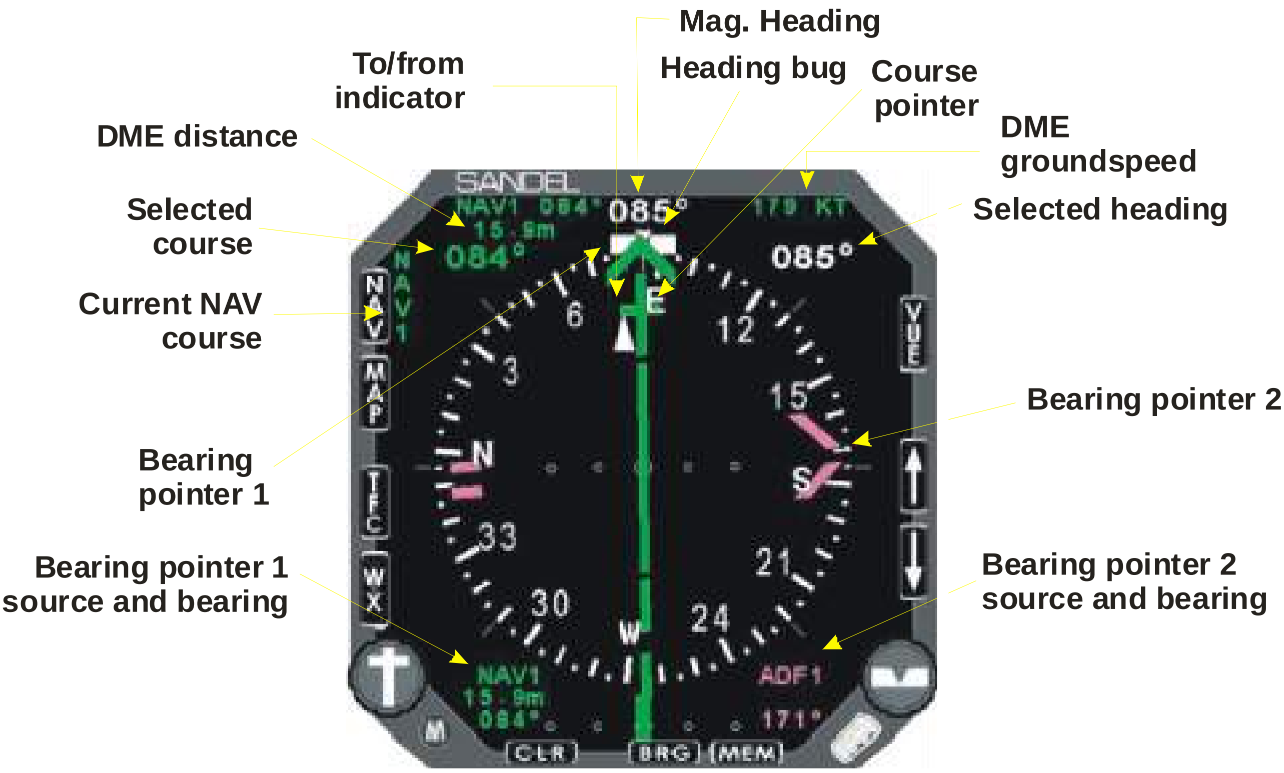
On initial power-up, a short introduction screen will be displayed which includes the software and database versions.

Fig. 7.35.7



After a few seconds this display will be removed and the compass card will be shown as below:

Fig. 7.35.8 SN3500 display with compass card



Selecting the Data

Sensor data is data that comes from avionic sources within the aircraft. This includes primary navigational instruments as well as sensors. The SN3500 can display data from the following sources:

- Compass system (directional gyro and Magnetic slaving transmitter)
- NAV1 and NAV2 receivers
- GPS1 and GPS2 receivers
- DME1
- ADF1
- Marker beacon receiver

Heading data from the directional gyro and Magnetic slaving transmitter compass is always applied directly to the SN3500's compass card display, while other types of sensor data can be displayed in several different ways. You can control these displays by configuring the course pointer, the bearing pointers, the map data and the weather data.

Selecting the Primary NAV Source

The SN3500's course pointer and CDI can be driven from VOR or GPS data.

The [NAV] button on the SN3500 is used to select the primary NAV source.

Pressing the [NAV] button will cycle through the available choices.

The current NAV source selection will be annunciated next to the NAV button as shown below.

Fig. 7.35.9

The available choices are NAV1, NAV2, GPS1, GPS2. If the selected NAV source is a VOR receiver tuned to a localized frequency, the annunciation will be either LOC1 or LOC2. If a valid glide slope signal is detected then the annunciation will be either ILS1 or ILS2.

Numeric data from the primary NAV source, such as distance, bearing and groundspeed will be displayed in the upper display area if available.

Selecting and Displaying Bearing Pointers 1 & 2

To display the bearings pointers, press [BRG] to cycle through available selections. In addition to no bearing pointer display, there are three selections:

- Push [BRG] once: Bearing pointer 1 only
- Push [BRG] twice: Bearing pointer 2 only
- Push [BRG] third time: Bearing pointers 1 and 2

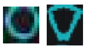
Details about the bearing pointers are in sub-section D.- Bearing Pointers.

Displaying the Map Data

Map data consists of flight plan waypoints from the LNAV receiver (GPS), as well as nearby airports, navaids, intersections and airspace from the SN3500's internal database. The different categories of map information can be enabled or disabled individually.

To display the map data, press [MAP] to cycle through the available map memory locations. The currently displayed map memory setting is displayed next to the MAP button. In addition to the no map data display, there are three default map memory settings. These setting are shown below with the displayed map status bar icons:

Map Memory 1: [no icon] GPS flight plan

Map Memory 2:  Airports, Airspace, and GPS flight plan

Map Memory 3:  VORs and GPS flight plan

When map data is being displayed, press [☐] or [☐] to increase or decrease the map range respectively. The currently selected map range is displayed in the upper right display area in magenta. The value of the map range represents the distance from the aircraft symbol to the outer edge of the compass rose.

Map operation is covered in more detail in MAP Operation.

360-degree FULL View and 70-degree ARC View

The SN3500 allows the pilot to switch between a traditional 360- degree FULL view of the compass rose and a forward-looking 70- degree ARC view. The ARC view places the airplane symbol at the bottom of the screen and the top 70-degrees of the compass rose is displayed. The ARC view maximizes the display of the ground track ahead of the aircraft and provides the greatest amount of screen area for map data.

Fig. 7.35.10 Full view

Fig. 7.35.11 Arc view

Press [VUE] to switch between the 360-degree and 70-degree ARC views. This action only affects the screen display – all navigation sources, bearing pointers, and other settings remain the same.

Auto-Slewing the Course Pointer

One unique feature of the SN3500 is its ability to automatically rotate the course pointer to the desired course being sent digitally from the GPS. This feature is called “auto-slew”, and is especially useful when flying a complex flight plan as it eliminates the burden of manually setting the course pointer for each leg of the flight plan.

When auto-slew is activated and a GPS is selected as the NAV source, rotating the course select knob will have no effect on the course pointer. The message ‘AUTO – SLEW ACTIVE” will be displayed in the center display area.

Note that certain GPS receivers such as the KING KLN-90 and Garmin GNS 430/530 support an “OBS” or “HOLD” mode which will override auto-slew when active.

The auto-slew function is enabled/disabled in the NAV menu as described in NAV Operation

Heading Bug Sync

To rapidly set the heading bug to the aircraft's current heading, press and release the Heading select knob.

Course Pointer Sync

To rapidly set the course pointer to the current direct-to course, press and release the course select knob.

When no valid course information is available, such as when flying a LOC/ILS approach, pressing the course select knob inwards will rotate the course pointer to the current heading.

Transitioning from GPS to ILS

During an ILS approach, when the selected NAV source changes from GPS to LOC/ILS, it is necessary to rotate the course pointer to the proper inbound course setting. The course pointer is NOT set automatically by the SN3500.

MEM Function

Fig. 7.35.12

The SN3500 maintains two different groups of display configuration memories that are toggled by pressing [MEM]. By pressing the [MEM], one can rapidly swap back and forth between the two display configurations. This allows the pilot to set up a particular screen display and easily access the settings for later use.

The MEM Function remembers the last settings prior to pressing [MEM]

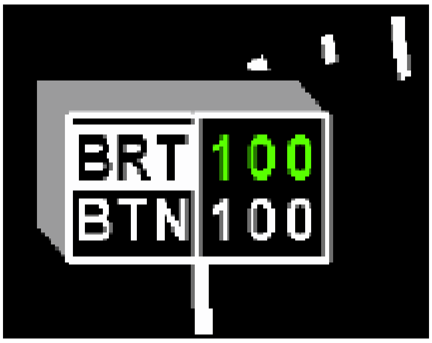
For example, a preferred “enroute” setup might be 70-degree ARC view with only bearing pointer 1 displayed, connected to a VOR Navaid. The “approach” setup might be 360-degree view with bearing pointer 2 displayed, connected to an ADF. To configure these two screens, first set up the “enroute” screen with the proper settings. Then press [MEM] to toggle to the second screen. The second screen can now be configured with the “approach” settings. Press [MEM] to toggle between the two screens conFig.d for “enroute” and ‘approach”.

Pressing and holding the [MEM] button will cause the two memories to have the same display settings. “COPY MEM” will be displayed momentarily to confirm this action.

Display and Button Brightness

Both the display and button backlight brightness can be controlled through the menu. The display brightness “BRT” and the button backlight brightness “BTN” are adjusted using the same technique as follows.

Fig. 7.35.13 Brightness menu



- Press [M] to activate menu mode.
- Press [CLR] to display the brightness menu.
- Rotate left knob until “BRT” (for display brightness) or “BTN” (for button brightness) is highlighted in the far left column.
- Turn the Right knob to increase (larger number) or decrease (smaller number) the brightness to the desired level.
- Press [M] to exit the menu and return to normal operation.

To rapidly change display to full brightness, press and hold [CLR] until the display changes to full brightness. Power cycling the SN3500 will also return the unit to full brightness.

C. NAV OPERATION

GPS Mode Selection

GPS units can be set for automatic or manual sequencing of waypoints in the active flight plan. This can be set on the SN3500 through the NAV Menu.

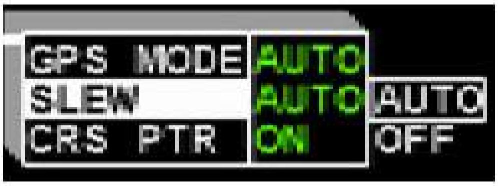
Fig. 7.35.14 NAV menu

- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu.
- Rotate the left knob until “GPS MODE” is highlighted in the far left column.
- Press the Right knob to toggle the setting between “AUTO” and “OBS”.
- Press [M] to exit the menu and return to normal operation.

Auto-Slew Function

Auto-slew function enables the automatic operation of the course pointer when a GPS is selected as the main NAV source.

Fig. 7.35.15 Auto-Slew setup menu

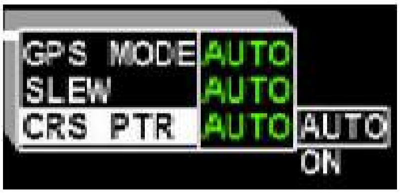


- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu.
- Rotate the left knob until “SLEW” is highlighted in the far left column.
- Turn the Right knob to select the desired option on the right.
- Press [M] to exit the menu and return to normal operation.

Course Pointer Display Function

Controls the display of the course pointer when GPS is selected as the NAV source and the moving map is displayed. Options are AUTO and ON. When set to AUTO, the course pointer is removed when the flight plan waypoints and course lines are displayed. This reduces the on-screen clutter. The course pointer will be displayed momentarily when the course select knob is turned.

Fig. 7.35.16 Course pointer setup menu



- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu..
- Rotate the left knob until “CRS PTR” is highlighted in the far left column.
- Rotate the heading bug knob to select the desired option.
- Press [M] to exit the menu and return to normal operation.

D. BEARING POINTERS

Bearing Pointers

The SN3500 provides two independent bearing pointers which function in much the same way as a traditional radio magnetic indicator (RMI). The head of each bearing pointer indicates the bearing to the NAV source. The tail of each pointer indicates the bearing from the NAV source. Either pointer can be driven by any navigation source interfaced to the SN3500: VOR, GPS, or ADF. When a GPS is selected as the bearing pointer source, the bearing pointer indicates the bearing and distance to the current active waypoint.

To display the bearings pointers, press [BRG] repeatedly to cycle through displaying bearing pointer 1 only, displaying bearing 2 only, displaying both bearing pointers 1 & 2 and disabling both bearing pointers.

The color of each bearing pointer, and its associated numeric display, follow the color-coding when on-side:

ADF: Magenta

GPS: Cyan

VOR: Green (NAV1), Yellow (NAV2)

The cross-side color of the bearing pointer, and its associated numeric display, is yellow when NAV1 is selected and green when NAV2 is selected.

The digital numeric bearing to the navigation source of the bearing pointer is displayed at the bottom of the screen. When the data is invalid, “---“ is displayed and the associated bearing pointer is removed from the screen. The selected bearing pointer name is displayed above the numeric bearing display.

BRG Menu

The NAV sources for the bearing pointers are selected using the BRG menu function.

Fig. 7.35.17 BRG main menu

- Press [M] to activate menu mode.
- Press [BRG] to display the BRG menu
- Rotate the left knob to select BRG1 or BRG2 in the leftcolumn.
- Rotate the right knob to select the desired option.
- Press [M] to exit the menu and return to normal operation.

E. MAP OPERATIONS

Overview

MAP operations allow you to display navigation information in the form of a "moving map" directly on the SN3500 display. You have extensive control over what kinds of navigation information are displayed on the map:

- Airports and Runways
- Controlled and Special Use Airspace
- VORs
- NDBs
- Intersections
- GPS Flight Plans and Approaches

Within each of these classes of map objects you may fine-tune exactly which items you want displayed. For example, you may choose to exclude military or private airports, or those with unpaved runways or runways shorter than a particular length. Similarly, you may elect not to display terminal VORs or low-powered NDBs, or to display Class B airspace and Restricted Areas but exclude Class C airspace and MOAs. As you will see, the SN3500 offers great flexibility in how you configure your moving map display.

Finally, you may store up to four different map configurations, and then quickly switch from one to another as appropriate to your phase of flight. For instance, when cruising at FL180 or higher, you might want to display only high-altitude VORs, Special Use Airspace and airports with paved runways of 6,000 feet or longer. The SN3500 allows you to save such a map configuration in one of four map memories and then recall it as needed.

All the airports, navaids and intersections on the moving map, except for the GPS flight plan waypoints, come from the internal database of the SN3500 and are color-coded cyan. Controlled and Special Use Airspace also comes from the SN3500's internal database and are color-coded according to its type (Class B and Class C in green, MOAs in purple, Restricted and Warning Areas in yellow, and Prohibited Areas in red.) The GPS flight plan waypoints and course line come from the database in the GPS and are color-coded magenta or white.

Note: The SN3500 requires a connection to a GPS receiver in order to display the moving map. GPS 1 is the master for EHSI 1 and GPS 2 is the master for EHSI 2. The map display, including the flight plan from the related GPS receiver, will also be shown when NAV1 or NAV2 is selected as the primary NAV source.

Internal Database

Non-flight plan data including airspace is referred to as the “internal database” and is stored in the SN3500’s internal memory. The internal database can be periodically updated from a Windowsbased PC. The expiration date of the internal database is shown during the power on sequence. Database updates are available directly from Sandel Avionics, and may be purchased at www.sandel.com by your dealer. As this database is for supplemental use only and not intended for primary navigation, there is no requirement to update it.

Map Controls and Displays

Information associated with control of the map is displayed as follows:

- The map status bar is shown just to the right of the MAP button and shows icons for the currently enabled map items.
- The map memory location currently being displayed is shown at the top of the map status bar as “1”, “2”, “3”, “4” or “S”.

Fig. 7.35.18 Map operation

Map operations are controlled with the following buttons:

- [MAP] - Press repeatedly to cycle through the map memory locations and no MAP.
- [☐] and [☐] - Press to zoom the map range in or out.
- Press and hold the [☐] button to auto-range the map to the current waypoint. Press and hold the [☐] to auto-range the map to the final waypoint.

Map Memories

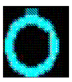
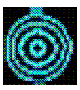
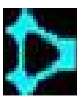
The [MAP] button cycles from MAP off through a maximum of four possible map memory locations, or memories, plus a scratchpad memory. The map memory that you are currently displaying is shown at the top of the map status bar and will show 1, 2, 3, 4 or S.

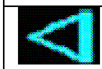
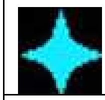
Any memory that is empty is skipped during the MAP rotation sequence. In the default setup of the SN3500, memories 1, 2 and 3 contain default settings, and memories S and 4 are empty.

Map memory S has been designated the scratchpad memory and the remaining memories 1-4 are designated as preset memories. All on-screen changes are made to S but can be copied to memories 1-4 as desired. The purpose of having a separate scratchpad is to allow you to quickly add or delete items from your map display to attend to a current flight situation, without changing presets previously made.

The map setup function, described below, shows how to make changes to the map memories. The following table lists the items that can be independently configures for each map memory.

There are a large number of selection items. However, the organization of the SN3500 is intended to make the map setup process as easy as possible. You should experiment with the map settings until you develop the style of operation best suited for your flying.

MAP DATABASE ITEMS			
Status bar icons	**Item**	**Setup MenuLabel**	**Color**
Airports 	Civil	CIVIL	Cyan
	Military	MIL	Cyan
	Private	PRIV	Cyan
	Runway Length[1]	MIN LEN	n/a
	Grass Surface	GRASS	n/a
	Other Surface	OTH SFC	n/a
NDBs 	Outer Marker	OM	Cyan
	Low Power	L PWR	Cyan
	High Power	H PWR	Cyan
VORs 	High Level	HI LV	Cyan
	Low Level	LO LV	Cyan
	Terminal	TERM	Cyan
	TACAN	TACAN	Cyan
Intersections	Enroute	ENRT	Cyan

MAP DATABASE ITEMS			
Status bar icons	**Item**	**Setup Menu Label**	**Color**
	SID	SIDS	Cyan
	STAR	STARS	Cyan
	Approach	APPR	Cyan
GPS Flight Plan	Flight Plan Course Line	GPS FPL	Active Leg: Magenta Other Legs: White
	Waypoint Symbols2	FPL SYM	
Airspace 	Class B	B	Green (dashed)
	Class C	C	Green (dotted)
	MOA	MOA	Purple (dotted)
	Restricted	RESTR	Yellow (dashed)
	Warning	WARN	Yellow (dotted)
	Prohibited3	n/a	Red (Solid)

Notes:

1. Suppresses display of runways below the specified minimum length

2. Flight plan waypoints can be displayed as facility icons (such as the VOR icon) or to show as the standard waypoint symbol. Most RS-232 GPS receivers are limited to displaying the waypoint symbol only.

3. Prohibited airspace is always displayed when in range and cannot be disabled.

Getting Started - Example

The default SN3500 map memories are set up as follows:

S: Empty

1: GPS flight plan

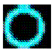
2: Airports, Airspace, and GPS flight plan

3: VORs and GPS flight plan

4: Empty

To get started, it is recommended to try some operations on the ground. Ensure that the GPS receiver is operating and enter a flight plan or direct-to in order to establish navigation.

Press [MAP] until “1” shows at the top of the map status bar. You should see the GPS flight plan on the display. The active leg and waypoint will be shown in magenta and the other waypoints and course lines will be shown in white. Use the [☐] or [☐] buttons to adjust the map range.

Set the map range to 30nm, and press [MAP] so that “2” is displayed. The display should show the flight plan as before, but now overlaid with local airports with runways longer than 4,500 feet in length. Note that the airport icon  shows on the map status bar indicating that airports are being displayed and that on-screen airports are shown in cyan. The cyan color indicates that the source of the airport data is coming from the internal database. The flight plan information comes from the GPS database.

Lower the map range to 15nm. Notice that as the display zooms in, airport displays change from an icon to a runway (or multiple runways). Below 10nm, the runway numbers will also be displayed to assist in verifying orientation with respect to the airport. During flight, the display will rotate and update in real time.

Press [MAP] to change to map memory 3. Notice that the airports are removed and instead, LO and HI VORs are displayed in cyan. On the map status bar the airport icon is removed and replaced with the VOR icon.

Pressing [MAP] again will skip memory 4, because it is empty, and it will jump directly to no map. All the map information will be removed from the screen. To display the map again, repeat the cycle of pressing [MAP] to display map memories 1, 2 and 3.

Map Setup

After you are familiar with the displaying map information based on the default settings, customize the map display to suit your specific needs. In this example, start by pressing [MAP] until “1” shows at the top of the map status bar.

Press [M] to activate menu mode. Press [MAP] to display the MAP menu. A pop-up window will appear on the display next to the [MAP] button as shown below. All settings in map memory 1 are copied to S (the scratchpad memory), and you can now make nonpermanent changes using the knobs. Changes are actually made to the scratchpad memory S. To save changes into one of the map memory locations 1-4, use the COPY function described later in this chapter.

Fig. 7.35.18 Map setup menu

The following actions occur every time the Map Setup mode is accessed:

- The currently selected display memory is copied into S.
- S becomes the active memory.
- Map Setup mode is entered and changed can be made to the map display.

Map Setup mode allows you to change the scratchpad memory S by adding or deleting items from the map category by category. While in the map menu, rotate the left knob to highlight an item in the left column and rotate the right knob to select the available options in the right column. The middle column will display the current selection.

As an example, to display Class B airspace the following steps will be used:

- Press [M] to activate menu mode.
- Press [MAP] to display the MAP menu.
- Rotate the left knob until “MENU SEL” in the far left column is highlighted.
- Rotate the right knob until airspace is highlighted as shown below:

Fig. 7.35.19 Select "AIRSPC"

- Next, rotate the left knob until “B” is highlighted;
- Next, rotate the right knob to toggle Class B airspace to “ON”.

Fig. 7.35.20 Select "ON"

- Press [M] to exit the menu and return to normal operation. Class B airspace will now be shown on the map display and the airspace icon will appear in the Map Status Bar.

Map Memory Settings

Map settings can be retained for future use by storing them into one of the four memory presets. Individual memory presets can also be cleared, set to defaults, or copied to the scratch memory. These functions are all accessed through the map memory menu.

To access the map memory menu:

- Press [M] to activate menu mode.
- Press [MAP] to display the MAP menu..
- Rotate the left knob until “MENU SEL” in the far left column is highlighted.
- Rotate the right knob until “MEMORY” in the far right column is highlighted.

Storing Settings into Preset Memories 1-4

- Rotate the left knob until “S COPY TO” in the far left column is highlighted.

Fig. 7.35.21 Storing settings

- Map memory "S COPY TO"
- Rotate the right knob and select one of the four map memory locations.
- Press the right knob and the current scratchpad settings will be stored under the specified map memory number, the unit will exit the menu, and return to normal operation.

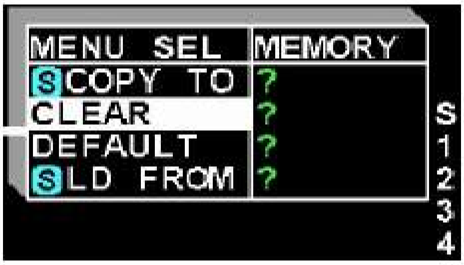
Removing a Map Memory from the Rotation Sequence

Individual map memory settings (including the scratchpad) can be cleared in order to reduce the number of map memories in the MAP button rotation sequence. This is done using the CLEAR function.

To access the “CLEAR” map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob to highlight “MENU SEL”.
- Rotate the right knob until “MEMORY” in the right column is highlighted.
- Rotate the left knob to highlight “CLEAR”

Fig. 7.35.22 Removing map memory



- Map memory "CLEAR"
- Rotate the right knob to select the desired map memory location to be cleared.
- Press the right knob to clear the map settings from that memory location. The center column will display the cleared memory location.
- Repeat as necessary to clear additional map memory locations.
- Press [M] to exit the menu and return to normal operation. The memory location(s) that were cleared will be skipped in the rotation sequence.

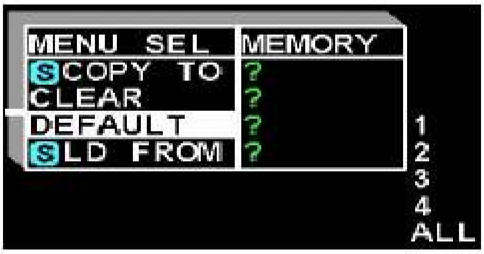
Restoring Default Settings

The default settings can be restored at any time. The default settings for individual map memory locations can be restored or all of them can be restored at once. Note that this will erase any previously stored settings. This is done using the “DEFAULT” function.

To access the “DEFAULT” map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob until “DEFAULT” is highlighted in the far left column. The map memory locations plus “ALL” will be displayed on the right.

Fig. 7.35.23 Restoring default settings



- Map memory "DEFAULT"
- Rotate the right knob until the desired map memory location is selected and then press the right knob to restore the default settings for that memory location. Selecting “ALL” will restore all of the map memory locations to default settings.
- Press [M] to exit the menu and return to normal operation.

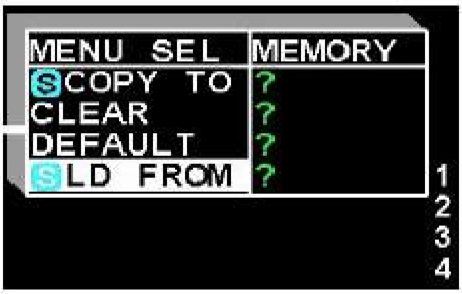
Copying Map Settings into the Scratchpad

It may be desired to copy settings that have been previously stored in a map memory location into the scratchpad. This is done using the “S LD FROM” function.

To access the “S LD FROM” map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob until “S LD FROM” is highlighted in the far left column. The map memory locations will be displayed on the right.

Fig. 7.35.24 Copying map settings

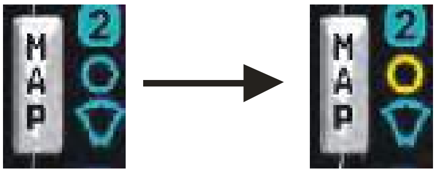


- Map memory "S LD FROM"
- Rotate the right knob until the desired map memory location is selected and press the knob to copy the settings in that memory location into the scratchpad memory.
- The scratchpad can now be further modified or press [M] to exit the menu and return to normal operation.

Automatic Decluttering

Occasionally, the SN3500 map display may become too cluttered to read, such as by turning on several categories of map items. The SN3500 will automatically remove items from the display if the total number of items is too great to display. When this occurs, it is indicated by an icon color change from cyan to yellow on the map status bar as shown following:

Fig 7.35.25



Normally the SN3500 will allow up to approximately 50 icons before this action occurs, but this number may be smaller if complex airspace is displayed simultaneously. When automatic decluttering occurs, it occurs first to objects closest to the aircraft. When the display is zoomed-in, these objects will reappear and the associated status bar icon will turn back to cyan.

Maximum Range of Internal Map Data

During normal operation, the SN3500 only displays items from its internal database that are within 200nm of the current aircraft position (400nm for long range VORs and NDBs), even when the selected map range is larger.

Clearing the Map Display

To quickly turn off the map display, press [CLR]. The map display will be removed. Pressing [CLR] again will return to the most recently displayed map memory location.

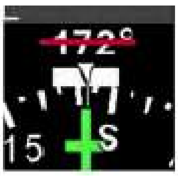
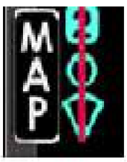
F. FLAGS AND ABNORMAL CONDITIONS

The SN3500 detects abnormal conditions such as flagged navigation receivers and failed directional gyro or Magnetic slaving transmitter. It also monitors its own internal temperature and provides warnings for over temperature or loss of cooling conditions.

In some cases, the flagged displayed will be accompanied with a failed equipment list message. This message can be accessed by holding down the menu button until the message display shows. The list will show both current and prior messages (if applicable). To show just the current messages, exit the message page by pressing the menu button and reenter by holding down the menu button.

Fig. 7.35.26 Messages

FLAG OR CONDITION	DISPLAY	DESCRIPTION
NAV flag		Large red “X” through the CDI scale, and the deviation bar is not displayed. Numeric information display shows “---“
	Note: CDI pointer will be visible under the red “X” for two minutes after power-up to allow testing for certain GPS receivers.	
GS (glideslope) flag		Large red “X” through glideslope scale (VDI), glideslope pointer is not displayed.
GS flag, backcourse		Large yellow "X" through glideslope scale (VDI) to show that you are on backcourse approach.

Directional gyro failure		Compass rose color changes from white to amber. The inner course and vertical deviation indicators are removed. Heading data is obtained from Magnetic slaving transmitter alone if connected to SN3500. Because Magnetic slaving transmitter signals are averaged over time, heading response will lag the aircraft significantly.
Fluxgate failure (Magnetic slaving transmitter failure)		Compass rose color changes from white to amber and the compass heading is redlined. The inner course and vertical deviation indicators are removed. The display can be used to determine relative headings for turns, but the magnetic compass should be used to determine absolute heading.
Loss of gyro & Fluxgate (Magnetic slaving transmitter)		Loss of compass rose. The inner course and vertical deviation indicators are removed.
Fast slave mode		Compass heading is redlined during fast slave correction. Heading has not stabilized.
Map flag		Redlined map icons indicates that the map cannot be displayed because of loss of LNAV.

G. MESSAGES

The Sandel SN3500 displays different messages to alert the pilot. The messages are initiated by the Pilot, the Built in Self Test (BIST), the Power On Self Test (POST), or by the system. Most of the pilot initiated messages are shown for two seconds and are removed automatically. Error messages, which are considered critical, are placed on-screen permanently until acknowledged. The acknowledgment is done using the ACK soft-key which will appear and flash when such a message appears. It also monitors its own internal temperature and provides warnings for over-temperature or loss of cooling conditions.

Fig. 7.35.27 Message and "ACK" button

Message	Description
400HZ FAILED	Loss of main inverter. Note 1
400HZ HIGH	Problem with main inverter. Note 1
400HZ LOW	Main power to unit out of specification.
AIRCRAFT POWER	Displayed when course knob is turned but course knob setting is over-written by Direct Track from the Long Range NAV Receiver. Auto-slew operation can be disabled by entering the NAV menu and setting auto-slew to OFF. If auto-slew is turned off, you will need to turn the course pointer manually at every waypoint when flying a flight plan.
AUTO-SLEW ACTIVE	Loss of auxiliary inverter. Notes 1, 3
AUX 400HZ FAILED	Loss of auxiliary inverter. Notes 1, 3

Message	Description
AUX 400HZ HIGH	Problem with auxiliary inverter. Notes 1, 3
AUX 400HZ LOW	Problem with auxiliary inverter. Notes 1, 3
COOLING FAN FAIL	The internal temperature is continuously monitored. An over temperature condition will only occur if the cooling airflow is obstructed. As the temperature rises a warning will be issued prior to shutdown. If shutdown occurs the SN3500 will shut off the projection lamp and continue operating, and resume normal operation as the internal temperature falls.
COPY MEM	This message appears when [MEM] button is pushed and held. After this COPY MEM is performed, both memories will show the display settings in effect when the COPY MEM was executed.
EXT SW SET TO GPS	This message appears when pressing the “NAV” button on the SN3500 when it is slaved to an external GPS/NAV switch/annunciator panel. Instead of the SN3500 NAV switch use the external GPS/NAV switch.
EXT SW SET TO NAV	This message appears when NAV button pressed while in slave mode and selection is NAV.
FCS FDBCK ERR	Auto pilot functions. (Not installed).
FGATE EXCIT LOST	Magnetic slaving transmitter excitation has failed. Check the gyro circuit breaker. Note 2
FGATE XYZ LOST	Magnetic slaving transmitter XYZ signal voltage too low or not received.
GYRO INVALID	Gyro valid flag asserted. Check the gyro circuit breaker. Note 2
GYRO XYZ LOST	Gyro XYZ (synchro) signal voltage too low or not received.
GYRO/FG CFG BAD	The Heading hardware configuration is incorrect.
MAP CRC INVALID	Indicates that the upload of the map database to the unit was not completed successfully or the file was corrupted. Repeat the upload procedure. Contact Sandel technical support if the messages persist. All other functions of the SN3500 continue to operate normally when the map has failed.
MAP INCOMPATIBL E	Indicates a mismatch between the operating software version and the map database. Check the Sandel website to ensure that you have the latest versions of operating software and database and repeat the upload procedure. All other functions of the SN3500 continue to operate normally when the map has failed.
NAV TUNED TO ILS	This message appears when pressing the “NAV” switch on the SN3500 to select a GPS and this action is overridden because an ILS is tuned on NAV1 or NAV2 and ILS lockout was enabled during installation.
NAV1 TUNED ILS	Appears when VHF NAV1 is tuned to an ILS frequency overriding and changing the SN3500 current NAV selection and ILS lockout was

ILS	enabled during installation.
NAV2 TUNED ILS	Appears when VHF NAV2 is tuned to an ILS frequency overriding and changing the SN3500 current NAV selection and ILS lockout was enabled during installation.
NOT IMPLEMENTED	<BRG> key pushed with no source of bearing available.
NOT INSTALLED	<TFC> or <WX> key pushed or TFC or WX menu access attempted when supporting equipment is not installed.
OVERTEMP SHTDWN	The internal temperature is continuously monitored. An over temperature condition will only occur if the cooling airflow is obstructed. As the temperature rises a warning will be issued prior to shutdown. If shutdown occurs the SN3500 will shut off the projection lamp and continue operating, and resume normal operation as the internal temperature falls.
PARAM CRC FAULT	PARAM CRC is not the expected value. The SN3500 installation settings have become invalid. Parameter memory is probably corrupt. This message must not appear on power-up if flight operations are predicated on the use of the SN3500 Navigational Display.
PGM CRC INVALID	Program CRC is not the expected value. This message must not appear on powerup if flight operations are predicated on the use of the SN3500 Navigational Display.
PWR SUPPLY FAIL	Internal power supply out of specification.
RELAY SENSE ERR	This message appears with the selected relay feedback does not match.

7.36 Flight Data Recorder (FDR) during normal operation

Fig. 7.36 Flight Data Recorder Schematic Diagram

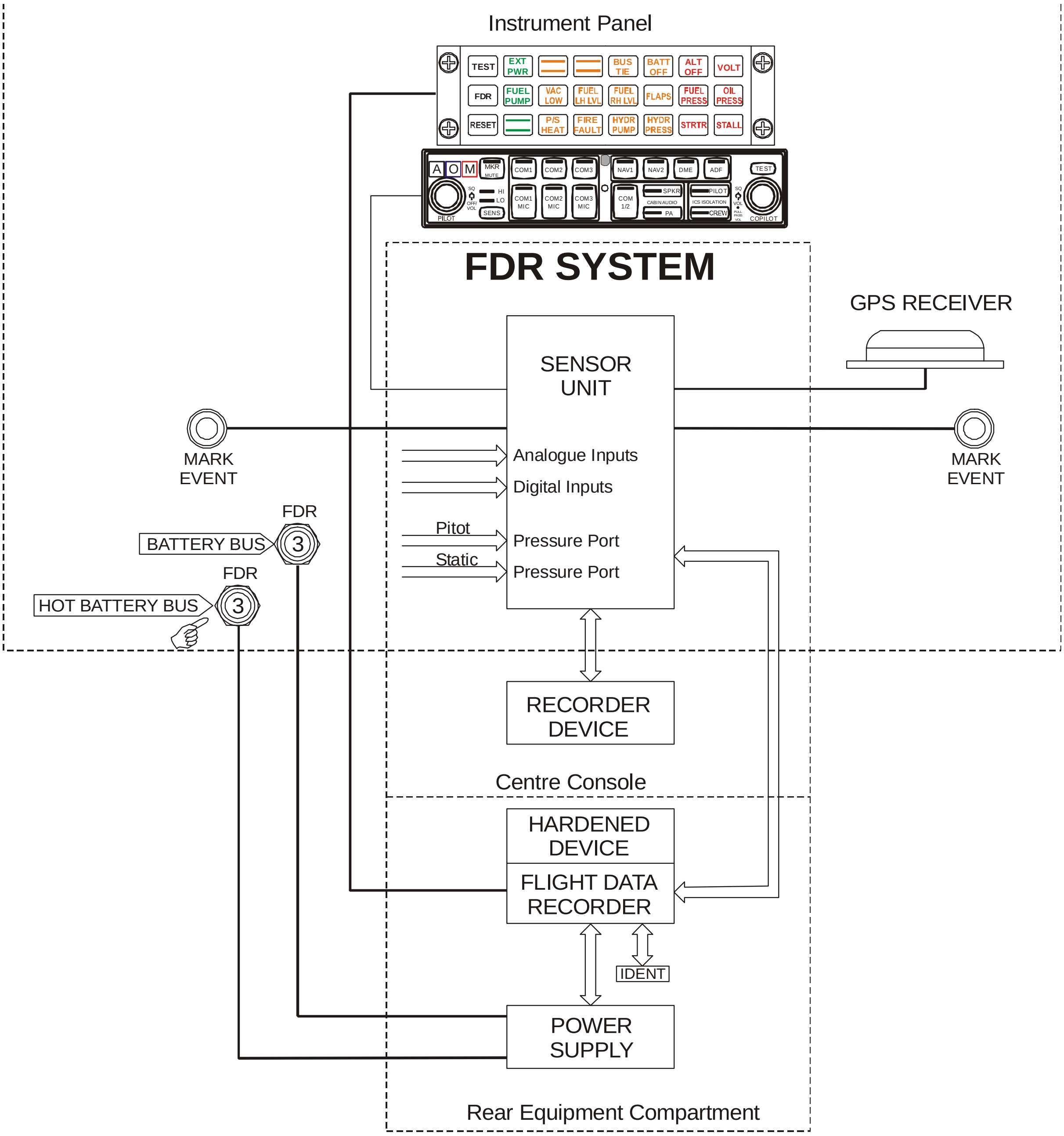


Fig. 7.36 shows the schematic diagram for the flight data recorder system.

Components

The data recording system has the following main components:

A flight data recorder located in the rear equipment compartment.

An interface unit located on the instrument panel floor between the firewall and the instrument panel.

A power supply unit located in the rear equipment compartment.

A recorder unit located on the centre console between the seats.

Two mark-event push buttons on the instrument panel.

A GPS antenna/receiver located on top of the instrument panel glare shield to provide navigation data.

Data Recorded

The system records the following data:

The engine parameters from the engine instrument module.

Trajectory.

Pressure altitude.

Indicated airspeed.

Latitude, longitude, track.

Lateral and vertical accelerations.

Airframe parameters; positions of:

Landing gear,

Flaps,

Elevator trim,

Rudder trim,

Aileron trim.

Date and hours.

Date and hour of engine running.

Date and hour of takeoff and landing.

Radio and intercom communications.

Alerts and warnings.

The battery bus provides power for the FDR during normal operation. A 3-amp circuit-breaker protects the circuit. The hot bus (permanently connected to the battery) provides power if the battery bus fails or the battery master switch is set to OFF. A 3-amp circuit-breaker on the left circuit-breaker panel protects the circuit.

The FDR main memory is hardened against physical damage and radiation.

The sensor unit is the main interface between the FDR and the aircraft systems. It receives analogue and digital signals from several sources. All signals are converted into a digital format that is compatible with the FDR.

A dedicated GPS antenna/receiver provides position and time data that is processed to give the velocity and acceleration data for the aircraft trajectory. This data is completely independent of the aircraft navigation system.

Pushing either mark event button places a ‘Flag’ in the data being recorded at that time. The flag allows the person reading the data during de-briefing, to move directly to the flagged position.

A white alert caption on the annunciator panel and a red light on the recorder unit, show when the FDR detects faults.

Operation

The FDR starts recording as soon as power is applied to the aircraft. The power supply from the hot bus allows the unit to continue recording after power is removed from the battery bus. The FDR switches itself off when the aircraft sensor inputs are not alive.

The FDR can record 50 hours of data. When the memory is full, the new data over-writes the oldest data so that the last 50 hours is always available.

The pilot can insert a memory card in the recorder unit in the centre console. The FDR records the same data on this card as in the main memory. The card can be removed after flight for analysis. The card is not essential for recorder operation.

If the FDR records a fault, the white FDR light on the annunciator panel comes on. The red light on the recorder unit also comes on. Push the button on the recorder unit to cancel the warnings. This action is not essential and does not affect recording.

Data that has been previously recorded can be retrieved from the main memory with a specially initialized card.

During flight, press the mark event button before, during or after any part of the flight that you wish to examine during de-briefing or which may be useful to engineers for trouble-shooting.

FDR Data Sources

Recorded Parameter	Source
AILERON TRIM position	Aileron trim actuator
ALT OFF warning	Alternator RCCB open
BAT OFF caution	Battery relay open
BUS TIE caution	Bus tie relay open
ELEVATOR TRIM position	Elevator trim motor
FIRE warning	Pneumatic fire sensor alarm switch
FIRE FAULT caution	Pneumatic fire sensor integrity switch
FLAPS asymmetry	Flap asymmetry switch
FLAPS UP	Flap selector UP microswitch
FLAP position	Flap motor linear potentiometer
FLAPS DOWN	Flap selector DOWN microswitch
FUEL PUMP status	Fuel pump switch
FUEL PRESSURE	Fuel low-pressure switch
P/S HEAT caution	P/S current sensor control box
FUEL LH LEVEL	Audio board
FUEL RH LEVEL	Audio board
HYDR PUMP caution	Temperature switch on pump
HYDR PRESS caution	Hyd emergency low-pressure switch
LANDING GEAR	
LH GEAR SAFE	LH down-lock position switch
LH GEAR UNLOCKED	LH up and down-lock position switches
NOSE GEAR SAFE	Nose down-lock position switch
NOSE GEAR UNLOCKED	Nose up-lock position switch
RH GEAR SAFE	RH down-lock position switch
RH GEAR UNLOCKED	RH up and down-lock position switches
OIL PRESS warning	Low oil pressure switch
PRESSURE ALTITUDE	Sensor unit static pressure input
INDICATED AIRSPEED	Sensor unit pitot and static pressure inputs
RUDDER TRIM position	Rudder trim actuator
STALL warning	Lift detector
STRTR warning	Starter solenoid
VAC LOW caution	Low vacuum pressure switch
VOLTAGE warning	Audio board
All audio	Audio control panel
All indications on engine instrument module	Engine instrument module
All navigation data	Dedicated GPS

7.37 KANNAD 406AF ELT

Fig. 7.37 shows the ELT cockpit remote switch.

Description

The ELT system has these main components:

The ELT unit with integral battery pack is located in the equipment compartment aft of the baggage compartment.

Mounting bracket and related components.

Fixed antenna located on the top of the rear fuselage just forward of the vertical stabilizer.

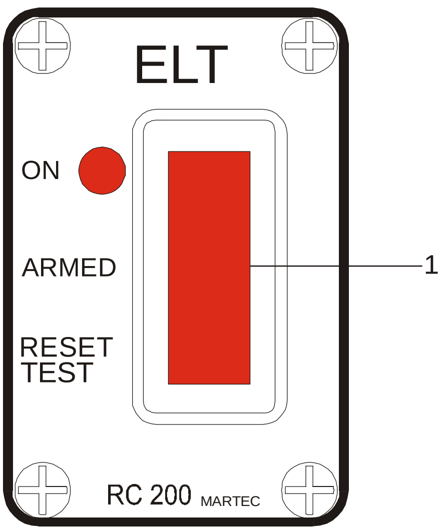
Cockpit remote control panel (1) located in the left instrument panel.

A buzzer located on the instrument panel shelf aft of the firewall.

The ELT transmits on 121.5, 243.0 and 406.025 MHz. The ELT has two transmitters. One transmitter operates on 121.5 and 223 MHz. The other transmitter operates on 406.025 MHz. The ability of 406 ELTs to transmit accurate position data from the aircraft navigation system is not used in this installation.

The cockpit remote switch assembly (1) is a rocker switch. The switch has three -positions: ON when the top is pushed and ARMED in the central position. In addition, pushing the bottom of the switch against a spring will reset or test the ELT.

Fig. 7.37 ELT Cockpit Remote Switch



An LED in the switch flashes when the ELT transmits (approximately 3 times per second). It also stays ON for approximately 1 second after entering the armed state. If the system is serviceable, the LED then goes off. If a problem is detected, the LED provides a fault indication by flashing a coded signal immediately after the test is complete.

A loud buzzer is installed in the ELT. The buzzer operates at predetermined intervals when the ELT operates. The buzzer is to alert personnel that the ELT is operating and avoid inadvertent ELT operation causing activation of emergency agencies. The ELT battery pack powers the buzzer. When the ELT operates, the buzzer can be heard from outside the aircraft when the engine is not running.

Usual Operation

In the usual situation, the ELT switch is set to ARM and the remote control panel is set to ARMED.

If the ELT senses a severe impact (such as a crash) the G-switch operates and the ELT transmits on 121.5 and 243.0 MHz. The ELT can transmit for over 48 hours on these frequencies. These transmissions allow the rescue coordination system to calculate a crash location to within approximately 15 – 20 km.

After 50 seconds and at 50 second intervals, the ELT also transmits a coded message on 406.025 MHz for 520 milliseconds. The coded message contains this data:

Serial number of the transmitter or aircraft I.D. (Pre-programmed).

Country code.

I.D. code.

The message is received by satellite. The satellite system calculates a crash position accurate to approximately 1 – 2 km.

For the first 24 hours of ELT operation, the buzzer also operates.

Emergency Manual Operation

The pilot can set the cockpit remote switch or the ELT switch to ON to operate the ELT in an emergency (for example after a forced landing that did not activate the ELT).

Reset the ELT After Accidental Operation

The cockpit remote switch has a reset function. If the ELT operates accidentally, set the cockpit remote switch to RESET/TEST, then back to ARMED. If the cockpit remote switch continues to flash after resetting, count the number of flashes and get maintenance assistance.

Checks

Monitor the red LED on the remote control panel during normal operation to make sure that the transmitter has not been unintentionally activated. Maintenance staff will do routine checks of the ELT operation.

SECTION 8
HANDLING, SERVICING AND MAINTENANCE

Table of Contents

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SECTION 8 HANDLING, SERVICING AND MAINTENANCE

8.1 Introduction

This section contains factory recommended procedures for proper ground handling, routine care and servicing of your GROB G120A.

It is recommended that all aircraft undergo a regular inspection each 50, 100 or 200 hours of operation. The scope of the respective inspection interval is given in chapter 05-20 of the G120A Maintenance Manual. In addition, a first inspection is necessary after 25 operating hours. Annual inspections must be performed according to the national requirements. All inspections must be performed by a designated representative of the Aviation Authority of the country in which the aircraft is licensed.

The Aviation Authority of the country in which the aircraft is licensed may require other inspections by the issuance of airworthiness directives applicable to the airplane, engine, propeller and other components. It is the responsibility of the owner/operator to ensure compliance with all applicable airworthiness directives and, when the inspections are repetitive, to take appropriate steps to prevent inadvertent noncompliance.

Scheduling of all maintenance is the responsibility of the aircraft operator. A general knowledge of the aircraft is necessary to perform day-to-day service procedures and to determine when unusual service or shop maintenance is needed.

Service information in this section of the manual is limited to service procedures which the operator will normally perform or supervise. For U.S. registered aircraft reference should be made to FAR Part 43 for information regarding preventive maintenance which may be performed by a U.S. licensed pilot.

It is wise to follow a planned schedule of lubrication and preventive maintenance based on climatic and flying conditions encountered in your locality.

Should an extraordinary or difficult problem arise concerning repair or upkeep of your G 120A, consult the GROB representative in your country or the Customer Support department at the following address.

Grob Aerospace GmbH.

Lettenbachstr. 9

86874 Tussenhausen-Mattsies, Germany.

All correspondence regarding your airplane should include the model and the serial number. These numbers can be found on the identification plate of the airplane.

8.2 Publications

The following publications are available:

1. Flight Manual GROB G 120A with optional equipment installed in accordance with Change Note OÄM 1121-075 (Sales Designation G 120A-F).
   Doc. No. 120A-F.PO.002-E.
2. Maintenance Manual GROB G 120A with optional equipment installed in accordance with Change Note OÄM 1121-075 (Sales Designation G 120A-F).
   (Doc. No. 120A-C.MM.002-E).
3. Wiring Manual GROB B 120A with optional equipment installed in accordance with Change Note OÄM 1121-075 (Sales Designation G 120A-F).
4. Illustrated Parts Catalogue GROB G 120A with optional equipment installed in accordance with Change Note OÄM 1121-075 (Sales Designation G 120A-F).
5. Service Bulletins.
6. Service Information.

NOTE

Service and maintenance information of the GROB G 120A is based on the civil aviation authority requirements of the Federal Republic of Germany. Therefore, airplanes which are registered in other countries must comply according to the authority requirements of that country.

8.3 Ground Handling

Dimensions of the GROB G 120A can be seen from the 3-view (page 1- 3).

CAUTION

Make sure that tires and landing gear struts are correctly inflated to ensure ground clearance of the propeller.

Towing

The parking brake lever is located on the LH side. To set the parking brake, position the parking brake lever to the "SET" position and pump the toe brake pedals until firm resistance is felt. Moving the parking brake lever to "RELEASE" releases brake pressure.

NOTE

If the airplane is parked unsupervised, chock the wheels instead of setting the park brake, since a change in weather could result in the brakes being released or being subjected to excessive high pressure.

When taxiing, the G 120A can easily be steered by means of the steerable nosewheel. To achieve a tight turn, the toe brake pedals can be used to brake the corresponding wheel of the landing gear.

To prevent propeller ground contact, take caution when taxiing over uneven ground. Apart from this, loose stones, gravel or any loose material can cause damage to the propeller blades at high speeds.

Mooring

To moor the airplane head into the wind. Four tie down points are provided on the airplane: one under each wing, one at the nosewheel fitting and one on the fuselage (through the tail skid). To moor the airplane proceed as follows:

- Install control locks;
- Chock wheels fore and aft, secure plastic or chain tie-down ropes of adequate strength to the aircraft at the tie-down points on the nosewheel fitting and the wing adapters. In addition the tail skid may be used as a tie-down point;
- Release parking brake.

Jacking

For wheel or tire change the G 120A must be jacked up at the prescribed locations. For a detailed description see G 120A maintenance manual.

8.4 Servicing

Engine Air Filter

A air filter is incorporated downstream of the air intake scoop in the bottom cowling half for easy replacement. This filter should be cleaned or replaced regularly in accordance with the AMM. When the airplane is operated in dusty locations, check, clean or replace the air filter more often.

Brakes

Both landing gear wheels of the GROB G 120A are equipped with disk brakes. The brake system is filled with brake fluid as per MIL-H 5606. Check brake fluid level regularly in accordance with the AMM. The brakes do not require adjustment. Changing the disk brake linings is described in the maintenance manual.

Tires

The tire pressure for the main wheels is 3,0 bar (43.5 PSI) and for the nose wheel 2,5 bar (36 PSI).

Oil

Before long flights the oil should always be replenished up to the top level. For oil quantities refer to chapter 1. Engine oils must comply with the engine manufacturer’s. requirements. (See also section 1).

Fuel

The G 120A fuel is stored in two wing tanks (for quantity refer to chapter 2). Drain a sample of fuel from each drain-point before each first flight of the day and after fuelling, paying particular attention to contamination in the fuel. Drain until the fuel emerges clean. Should contaminated fuel still emerge from the drain valve after one minute, have the fuel system inspected.

CAUTION

After draining make sure that there is no danger of fire from fuel spillage when starting the engine. Aviation grade fuel: Avgas 100 LL.

Canopy

To clean the canopy plexiglass proceed in the same way as for exterior cleaning of the G 120A, but pay particular attention to using ample water applied with clean sponges and leathers, otherwise even the smallest dust particles will tend to scratch the glazing.

CAUTION

Never polish plexiglass dry! Dull or scratched canopy sections can be returned to their transparent state by treating with specially formulated plexiglass cleaning agents.

CAUTION

Always keep the canopy clean and remember that a dirty canopy impairs the view and thus flight safety.

Exterior Cleaning

As with any composite airplane having mainly laminar flow conditions, keeping these surfaces clean is of major importance to aircraft performance. For this reason all exterior surfaces of the aircraft, in particular the wing leading edges must always be clean. Cleaning is best accomplished with an ample supply of water, mixed with a light solvent, if required. In order to remove especially heavy dirt from the wing leading edges due to insect splatter and the like, it is good practice to undertake cleaning immediately after the flight, since deposits of this kind are more diffi cult to remove when dry. Roughly once a year the surface should be treated with a paint cleaner or a non-silicone car polish and repolished to high gloss.

CAUTION

Never use cleaning agents containing silicone!

Engine

Use a cold solvent to clean the engine and make sure that no solvent can enter the magnetos, alternator, starter, suction pump and air intakes.

CAUTION

Do not operate the engine until excess solvent has evaporated or otherwise been removed.

Painted Exterior Surfaces

Changing the paint coat is only permissible after approval by the manufacturer!

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