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DOCUMENT TITLE

AUS OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 1
ECHO MKIV PILOT OPERATING MANUAL

The data in this book has been compiled for examination and training purposes only

Version 1.0
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INTRODUCTION

This manual contains information extracted from the "Australian Flight Manual" and the associated "Pilot's Operating Handbook". The "Australian Flight Manual" states –

> "It is the responsibility of the pilot in command to be familiar with the contents of this manual and to comply with all the directions complained herein relating to the operation of the aeroplane

Figures in the performance tables, which have been obtained from flight test data and by calculation, are presented to a degree of accuracy that facilitates interpolation. Round off fuel figures to values that on the "safe side" - not necessarily the nearest - of the values extracted from the tables. The rounding off is best done after all calculations have been made.

The dimensional units used in this manual comply with the Department's metrication policy and the ICAO Annex 5 Blue table. Units relating to the engines are those currently used in Pilot's Operating Handbooks. ALL FUEL QUANTITIES ARE GIVEN IN US GALLONS.

Conversion factors –

1 inch	=	25.4 mm		
1 foot	=	0.305 metre		
1 lb	=	0.454 Kg		
1 Imp gal	=	1.201 US gal	=	4.546 litres

SECTION 1 GENERAL AEROPLANE SPECIFICATIONS

1.1 The ECHO Mk IV aeroplane is a twin engine aeroplane with maximum take-off weight of 2950 Kg providing cabin accommodation for one pilot and five passengers, fully instrumented for IFR operations and with sufficient oxygen for all flights at any level. Four separate cargo or baggage compartments are available, the capacities and locations of which are given in SECTION 5.

1.2 The aeroplane is fitted with retractable landing gear and two "ZULU Mk XV" turbo-supercharged engines coupled to constant speed, fully feathering propellers.

1.3 Two main and two auxiliary fuel tanks are fitted, the location and capacity of which are –

	Usable fuel (US gal)	Unusable fuel (US gal)	Total fuel (US gal)
MAIN TANKS:			
Left	50	2	52
Right	50	2	52
AUXILIARY TANKS:			
Left	40	3	43
Right	40	3	43
TOTAL (US gal)	180	10	190

The grade of fuel to be used is 100/130 aviation gasoline with SPECIFIC GRAVITY 0.71. The weight of unusable fuel is included in the basic empty weight

1.4 The oil tank capacity for each engine is 3 US gal. The weight of all oil is included in the basic empty weight of the aeroplane.

SECTION 2 OPERATING INSTRUCTIONS

2.1 The aeroplane shall be operated within the limits given in this manual. Unless otherwise specified, all flight shall be planned in accordance with the following data –

- Start-up and taxi fuel.....3 gal
- An allowance for take-off and landing fuel is included in the Cruise-climb and Cruise-decent charts
- Climb will be made along track. Cruise-climb performance is given in chart No.;3, page 9.
- Cruise: (Top of climb to top of descent) Cruise to be conducted as specified in the examination paper.

  Cruise data are given in Cruise Performance and Engine performance charts – Charts Nos. 5 & 6, pages 10 & 11.
- Descent: Unless otherwise instructed, assume all descents are made along track in accordance with Cruise-descent chart – Chart No. 4, page 9.
- Total flight fuel is the fuel for take-off, climb, cruise and descent. It does not include taxi fuel.

Reserves: (for all flights) Variable reserve fuel equal to 15% of total flight fuel (i.e. total fuel required for climb, cruise and descent) shall be carried.
Fixed reserve fuel for 15 you this gal shall be going.

2.2 Fuel Management:

Refuelling:

AUXILIARY TANKS are to be used only if fuel required for the flight cannot be accommodated in the MAIN TANKS in which case the MAIN TANKS must be full.

In the event of an aeroplane landing with usable fuel remaining in the AUXILIARY TANKS, fuel need not be transferred to MAIN TANKS and if desired, the next flight may depart with MAIN TANKS partly filled.

Flight Procedures

MAIN TANKS are to be used for taxi, take off, climb, descent and landings

At top of climb, change to AUXILIARY TANKS and use all the fuel from these tanks before changing back to the MAIN TANKS. If a landing is to be made before all usable AUXILIARY FUEL has been consumed, change to MAIN TANKS at top of descent.

Normally, LEFT TANKSare fed to the LEFT ENGINE and RIGHT TANKS to the RIGHT ENGINES. Cross-feed is used only in the case of a symmetric flight or fuel system malfunction.

SECTION 3 OPERATING LIMITATIONS

3.1 Airspeeds (IAS):

Never Exceed ..... 230 Kt

Normal Operating Limit (Maximum Structural Cruising) ..... 199 Kt

Maximum -..... Wing Flap 15° 156 Kt

- Wing Flap 15° to 45° ..... 139 Kt
- Landing Gear Extended ..... 139 Kt

Minimum Single Engien Control..... 75 Kt

Manoeuvring ..... 160 Kt

3.2 Power Plants:

The following table gives the engine manufacturer's limitations for ZULU Mk XV engines

	Take-off Power for Maximum of 3 min	Max Continuous Power
Maximum RPM	3200	3200
Manifold pressure	37.4"Hg	34.5"Hg
Mixture	Rich	Rich
Brake horsepower	375	340

3.3 Crosswind Component:

The maximum permissible crosswind component for take-off and landing is 20 knots.

3.4 Tailwind Component:

The maximum permissible tailwind component for take-off and landing is 5 knots.

SECTION 4 PERFORMANCE DATA:

4.1 Take-off and Landing Performance:

TAKE-OFF and LANDING WEIGHT CHARTS – Chart No. 7 & 8 are included at pages 12 & 13.

These charts are to be used to determine –

(a) the take-off or landing distance required for giving values of gross weight, pressure height, temperature, type of surface, runway gradient and wind component.

(b) the maximum permissible gross weight for take-off or landing for given values of pressure height, take-off or landing distance available (TODA or LDA), temperature, runway gradient, type of surface and wind component.

Note:- *(i) Extrapolation outside the boundaries of the performance charts is not permitted. When temperature and/or pressure is below the lowest range shown on the charts, the aeroplane performance shall be assumed to be no better than the appropriate to this lowest range. The performance information is not valid when temperature and/or pressure height exceeds the maximum values for which the information is shown.*

(ii) Gross weight for take-off is the gross weight of the aeroplane when brakes are released fortake-off.

(iii) For sealed and gravel take-off surfaces, the gross weight for take-off shall be determined as for a short dry grass surface.

4.2 Maximum Climb Performance:

The MAXIMUM CLIMB PERFORMANCE for TWO ENGINES or ONE ENGINE is given on chart 1 & 2, page 8.

These charts give the MAXIMUM rate of climb of the aeroplane for various conditions of weight and pressure height when using maximum continuous power.

Values for intermediate conditions of weight and pressure height may be obtained by interpolation.

4.3 Cruise-Climb Performance:

The CRUISE–CLIMB PERFORMANCE chart – Chart No. 3, page 9 gives the overall climb performance for TWO ENGINE operation maintaining 75% maximum continuous power, 120 Kt IAS and rich mixture. This chart, which is to be used for flight planning, gives values of time, fuel consumption and air distance to climb to selected pressure heights.

4.4 Cruise Performance (Two engines):

The CRUISE PERFORMANCE (TWO ENGINES) Chart - Chart No.5, page 10 shows the expected TAS for different percentages of maximum continuous power at various weights and pressure heights

4.5 Engine Performance:

He ENGINE PERFORMANCE Chart - Chart No. 6, page 11 is the ZULU Mk XV engine performance table and gives the manifold pressure, RPM and mixture settings required to produce given percentages of maximum continuous power and the resultant fuel flow rates, PER ENGINE, in US GPH.

The recommended settings for cruise at tabulated pressure heights are enclosed within heavy lines.

4.6 Cruise Performance (Single engine):

See para 6-5, page 10.

4.7 Cruise-Descent Performance:

The CRUISE-DESCENT Chart – Chart No. 4, Page 9, gives the overall descent performance for the aeroplane at all weights. For flight planning purposes it is to be assumed that the descent to the destination aerodrome is made along track.

SECTION 5 WEIGHT AND BALANCE DATA:

5.1 Empty Aeroplane (fitted with 6 seats):

Aeroplane basic empty weight and moment are given in the examination paper.

5.2 Weight Limitations:

Aeroplane basic empty weight and moment are given in the examination paper.

Maximum take-off weight ..... 2950 Kg

Maximum landing weight ..... 2725 Kg

Maximum zero fuel weight ..... 2630 Kg

Note:- All weight above Maximum Zero Fuel Weight must be made up of fuel.

5.3 Balance Data:

The Mean Aerodynamic Chord (MAC) data is as follows:

Length of chord ..... 1900 mm

Location of leading edge ..... 2190 mm aft of datum

Centre of gravity range:

2400 mm to 2680 mm at 2360 Kg or less

2560 mm to 2680 mm at 2950 Kg

Linear variation between the points given

5.4 Weight and Balance Charts:

The LOADING GRAPH – Chart No. 9, page 14 may be used when determining the balance of the aeroplane. Locate the weight (in Kg) of a particular load item on the vertical scale and move horizontally to the line representing that item. From that point drop vertically to read off the Moment index.

The CENTRE OF GRAVITY ENVELOPE diagram – Chart No. 10, page 15 is used to indicate whether or not the aeroplane is correctly loaded. Locate the Cross Weight of the loaded aeroplane (in Kg) on the vertical line representing the Total Moment Index of the loaded aeroplane. If the point of intersection, which represents the centre of gravity, falls in the shaded area, the aeroplane is correctly loaded

Note: The centre of gravity must lie in the shaded area at all stages of flight.

The Index numbers used on both charts represents the moment (in Kg mm) divided by 10,000.

5.4 Loading Data:

The location of seats and cargo or baggage compartments with corresponding loading arms (expressed as millimetres aft of datum) and the maximum permissible loads are shown in the following table –

Location	Maximum Permissible Load	Loading Arm (mm aft of datum)
Seating:		
Row 1 (Seats 1 & 2)	Pilot & 1 pass.	2290
Row 2 (Seats 3 & 4)	2 pass.	3300
Row 3 (Seats 5 & 6)	2 pass.	4300
Cargo & Baggage Compartments:		
Forward compartment	55 Kg	500
Left wing compartment	55 Kg	3550
Right wing compartment	55 Kg	3550
rear compartment	155 Kg	5000
Floor loading intensity (all compartments)	450 Kg/m²	
Fuel:		
Left main tank	50 gal	1780
Right main tank	50 gal	1780
left auxiliary tank	40 gal	2800
Right auxiliary tank	40 gal	2800

Note : All passenger seats weigh 5 Kg each and may be removed to permit the carriage of additional cargo or baggage in the cabin

The maximum permissible load in the area otherwise occupied by a passenger seat is 82 Kg.

If a passenger seat is removed, adjustment of the empty weight and empty moment will be necessary.

SECTION 6 PERFORMANCE TABLES & GRAPHS:

6.1 Maximum Climb Performance Tables:

Chart No. 1 gives Maximum Climb Performance 9TWO ENGINES) and Chart No. 2 the Maximum climb Performance (ONE ENGINE) when using Maximum Continuous Power at various pressure heights at standard temperatures.

To obtain the climb performance at a particular level, enter the table with the pressure height and gross weight of the aeroplane and extract the rate of climb and TAS.

If the temperature deviation from ISA is more than 5°C, density height should be used instead of pressure height.

CHART No. 1 MAXIMUM CLIMB PERFORMANCE (TWO ENGINES)

Pressure Height feet	GROSS WEIGHT					
	2950 Kg		2500 Kg		2000 Kg	
	TAS Kt	R.o.C fpm	TAS Kt	R.o.C fpm	TAS Kt	R.o.C fpm
ZERO	101	1600	92	2250	82	2950
5,000	109	1500	99	2100	88	2800
10,000	118	1400	107	1950	95	2650
15,000	128	1300	116	1800	104	2500
20,000	139	800	126	1250	112	1800

CHART No. 2 MAXIMUM CLIMB PERFORMANCE (ONE ENGINES)

Pressure Height feet	GROSS WEIGHT					
	2950 Kg		2500 Kg		2000 Kg	
	TAS Kt	R.o.C fpm	TAS Kt	R.o.C fpm	TAS Kt	R.o.C fpm
ZERO	105	280	97	525	92	780
5,000	112	200	103	450	98	700
10,000	120	100	111	360	106	625
15,000	129	20	119	270	115	530

6.2 Cruise-Climb Performance Graph:

Chart No. 3 (page 9) shows the performance of the aeroplane when climbing with 75% maximum continuous power at varying weights and atmospheric conditions.

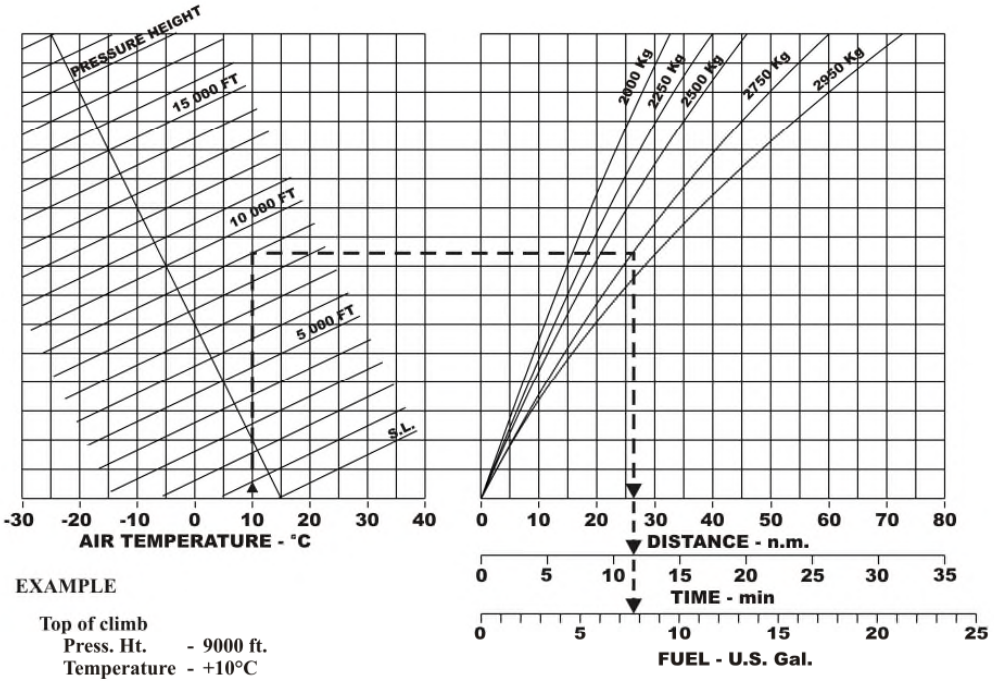
Entry arguments are –

- Gross weight at start of climb.
- Temperature and pressure height or start of climb.
- Temperature and pressure height at top of climb.

6.3 Cruise-Descent Performance Graph:

Chart No. 4 (page 9) shows the performance of the aeroplane during a normal enroute descent.

Chart No. 3 CRUISE-CLIMB PERFORMANCE



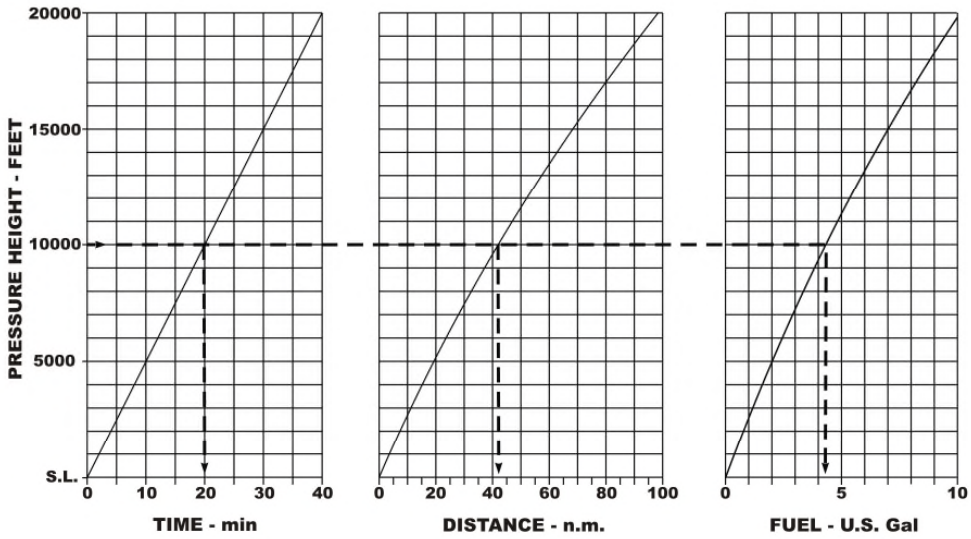
EXAMPLE

Top of climb
Press. Ht. - 9000 ft.
Temperature - +10°C

Start of climb
Press. Ht. - sea level
Temperature - +15°C
Gross Weight - 2750 kg

Distance to climb from SL - 26 nm
Time to climb from SL - 12 min
Fuel used - 7.7 US Gal

Chart No. 4 CRUISE-DESCENT PERFORMANCE



EXAMPLE
Descend from 10,000 ft pressure ht to sea level
Time - 20 min Distance - 42 nm Fuel - 4.2 US Gal

6.4 CHART No. 5 CRUISE PERFORMANCE (TWO ENGINES)

This chart tabulates the TAS to be expected when flying at various gross weights using different percentages of maximum continuous power at various pressure heights and temperatures.

Press Ht	Temp	GROSS WEIGHT														
		2950 Kg					2500 Kg					2000 Kg				
		75 %	65 %	55 %	45 %	35 %	75 %	65 %	55 %	45 %	35 %	75 %	65 %	55 %	45 %	35 %
SL	ISA -20°	177	164	156	142	116	180	168	159	145	118	184	171	161	149	120
5,000		185	172	160	145	116	188	172	163	147	119	192	178	166	151	121
10,000		193	179	165	147	117	196	182	168	150	119	201	185	171	153	122
15,000		201	185	169	149	116	204	189	173	152	117	209	193	177	155	120
20,000		209	193	174	150	-	213	197	178	154	-	217	201	182	157	-
SL	ISA	181	168	158	144	116	184	171	161	146	118	188	174	164	149	121
5,000		189	175	162	146	117	192	178	165	148	119	198	181	169	152	122
10,000		197	182	166	148	117	200	185	170	151	119	205	189	174	154	122
15,000		205	189	171	150	114	208	192	176	154	116	213	196	184	156	118
20,000		213	198	177	151	-	217	201	180	154	-	221	208	189	157	-
SL	ISA +20°	185	171	160	145	116	187	174	163	147	119	191	177	166	151	121
5,000		192	178	166	147	117	195	181	166	150	119	200	185	171	153	122
10,000		200	185	170	149	116	204	188	173	152	118	208	192	175	155	121
15,000		209	193	173	151	-	212	196	178	154	-	217	200	182	157	-
20,000		216	201	179	149		221	205	183	152		225	209	186	155	

6.5 CRUISE PERFORMANCE (SINGLE ENGINES)

For single engine cruise, the aeroplane can be expected to cruise at 5000 feet with a TAS of 110 Kt and a fuel flow of 25 GPH..

6.6 Engine Performance Chart:

This table represents the manifold pressure and RPM required to give a particular percentage of maximum continuous power at various pressure heights in the standard atmosphere with either rich or lean mixture. The fuel flow per engine for rich or lean mixture is shown in the right hand columns.

The manifold pressure required to obtain the desired power is found by reading down the column appropriate to the RPM and mixture to be used to the pressure height and the required percentage of maximum continuous power.

CHART No. 6 ZULU Mk XV ENGINE PERFORMANCE CHART

PRESSURE HEIGHT	POWER %	3200	3000	2800 RPM		2600 RPM		2400RPM		2200 RPM		POWER %	FUEL FLOW	
		Rich	Rich	Rich	Lean	Rich	Lean	Rich	Lean	Rich	Lean		Rich	Lean
Feet		"Hg	"Hg	"Hg	"Hg	"Hg	"Hg	"Hg	"Hg	"Hg	"Hg		GPH	GPH
Zero	100	34.5	-	-	-	-	-	-	-	-	-	100	31.7	-
	75	26.5	26.9	27.8	28.7	-	-	-	-	-	-	75	19.7	16.3
	65	23.1	23.5	24.4	24.9	25.9	26.4	28.4	28.9	-	-	65	16.9	14.0
	55	19.9	20.3	21.2	21.5	22.7	23.0	25.2	25.5	-	-	55	14.1	11.8
	45	-	17.4	18.3	18.4	19.8	19.9	22.3	22.4	27.0	27.1	45	11.8	10.2
	35	-	-	-	-	16.4	16.5	18.9	19.0	23.6	23.7	35	9.3	8.6
5,000	100	34.5	-	-	-	-	-	-	-	-	-	100	31.7	-
	75	26.0	26.4	27.3	28.2	-	-	-	-	-	-	75	19.7	16.3
	65	22.6	23.0	23.9	24.4	25.4	25.9	27.9	28.4	-	-	65	16.9	14.0
	55	19.4	19.8	20.7	21.0	22.2	22.5	24.7	25.0	-	-	55	14.1	11.8
	45	-	-	17.8	17.9	19.3	19.4	21.8	21.9	26.5	26.6	45	11.8	10.2
	35	-	-	-	-	15.9	16.0	18.4	18.5	23.1	23.2	35	9.3	8.6
10,000	100	34.5	-	-	-	-	-	-	-	-	-	100	31.7	-
	75	25.5	25.9	26.8	27.7	-	-	-	-	-	-	75	19.7	16.3
	65	22.1	22.5	23.4	23.9	24.9	25.4	27.4	27.9	-	-	65	16.9	14.0
	55	18.9	19.3	20.2	20.5	21.7	22.0	24.2	24.5	-	-	55	14.1	11.8
	45	-	-	-	-	18.8	18.9	21.3	21.4	26.0	26.1	45	11.8	10.2
	35	-	-	-	-	15.4	15.5	17.9	18.0	22.6	22.7	35	9.3	8.6
15,000	100	34.5	-	-	-	-	-	-	-	-	-	100	31.7	-
	75	25.0	25.4	26.3	27.2	27.8	28.7	-	-	-	-	75	19.7	16.3
	65	21.6	22.1	22.9	23.4	24.4	24.9	26.9	27.4	-	-	65	16.9	14.0
	55	18.4	18.8	19.2	20.0	21.2	21.5	23.7	24.0	-	-	55	14.1	11.8
	45	-	-	-	-	18.3	18.4	20.9	21.0	25.5	25.6	45	11.8	10.2
	35	-	-	-	-	-	-	17.4	17.5	22.1	22.2	35	9.3	8.6
20,000	86.7	29.0	-	-	-	-	-	-	-	-	-	86.7	23.3	-
	75	24.6	25.0	-	-	-	-	-	-	-	-	75	19.7	-
	65	21.2	21.7	22.5	23.0	-	-	-	-	-	-	65	16.9	14.0
	55	18.0	18.4	19.3	19.6	20.8	21.1	23.3	23.6	-	-	55	14.1	11.8
	45	-	-	-	-	17.9	18.0	20.5	20.6	-	-	45	11.8	10.2

Note: - The figures enclosed within the heavy lines in this chart are the settings recommended for cruise operation.

- Leaning is not permitted above 75% maximum continuous power.

CHART No. 7 TAKE-OFF WEIGHT CHART

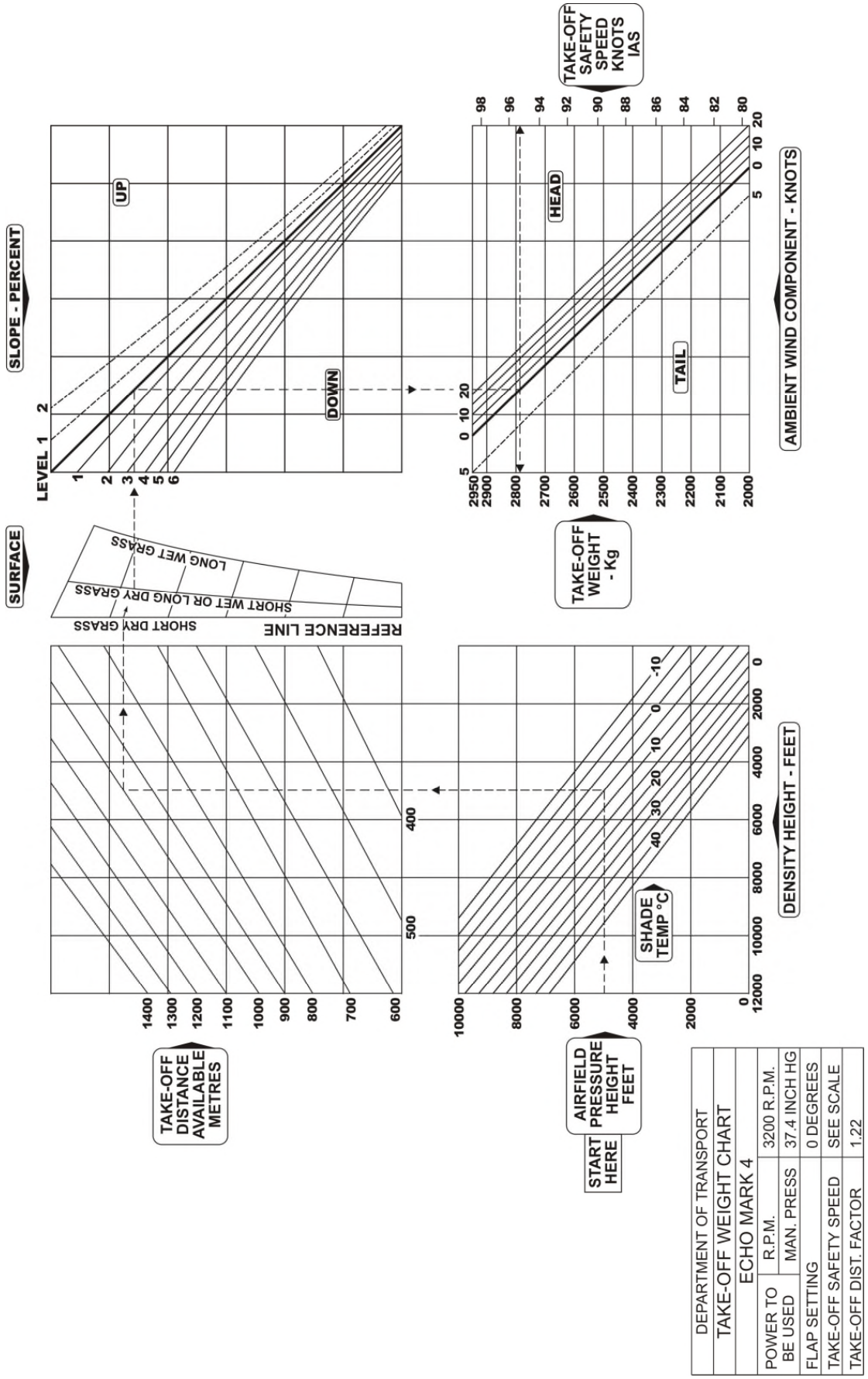


CHART No. 8 LANDING WEIGHT

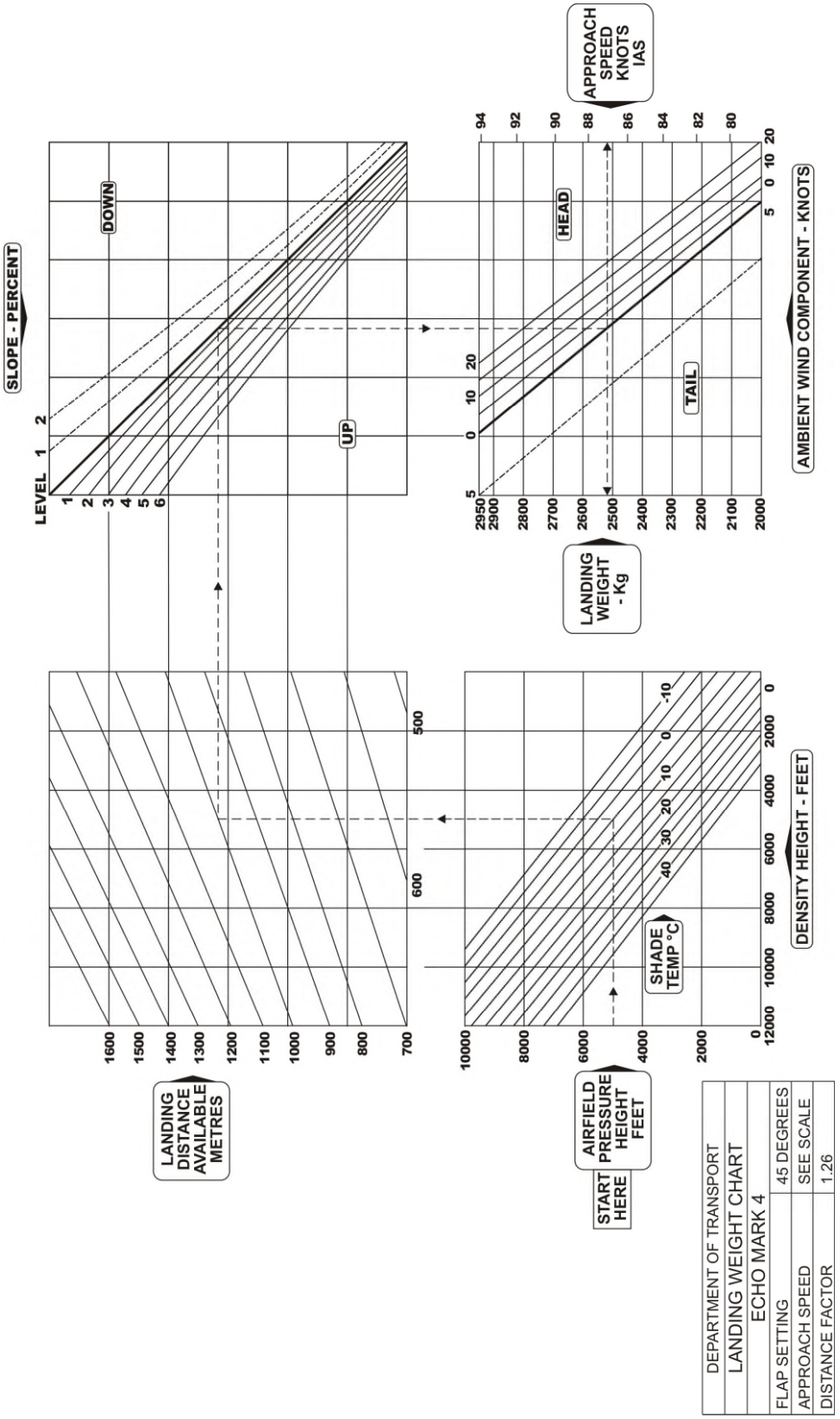


CHART No. 9

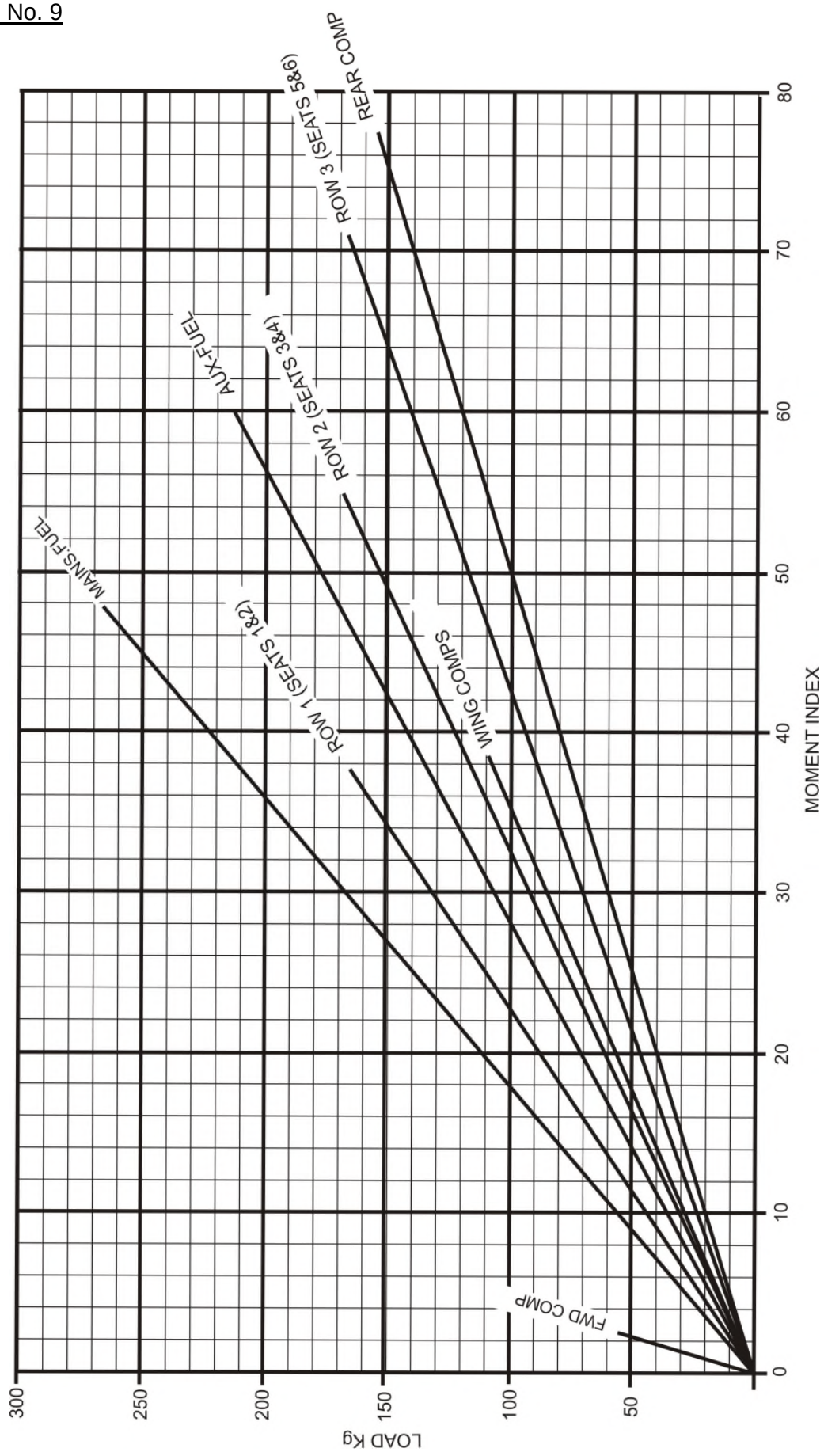


CHART No. 10 CENTRE OF GRAVITY ENVELOPE