

AVIATION THEORY

Aircraft Operation Performance & Planning

for the Private & Commercial
Pilot Licences

Work Booklet



David Robson

This is to be used with Aircraft Operation, Performance & Planning (7th Edition)

This Work Booklet is also available on our website (Addenda page)
as a downloadable PDF for those of you who wish to print it out.

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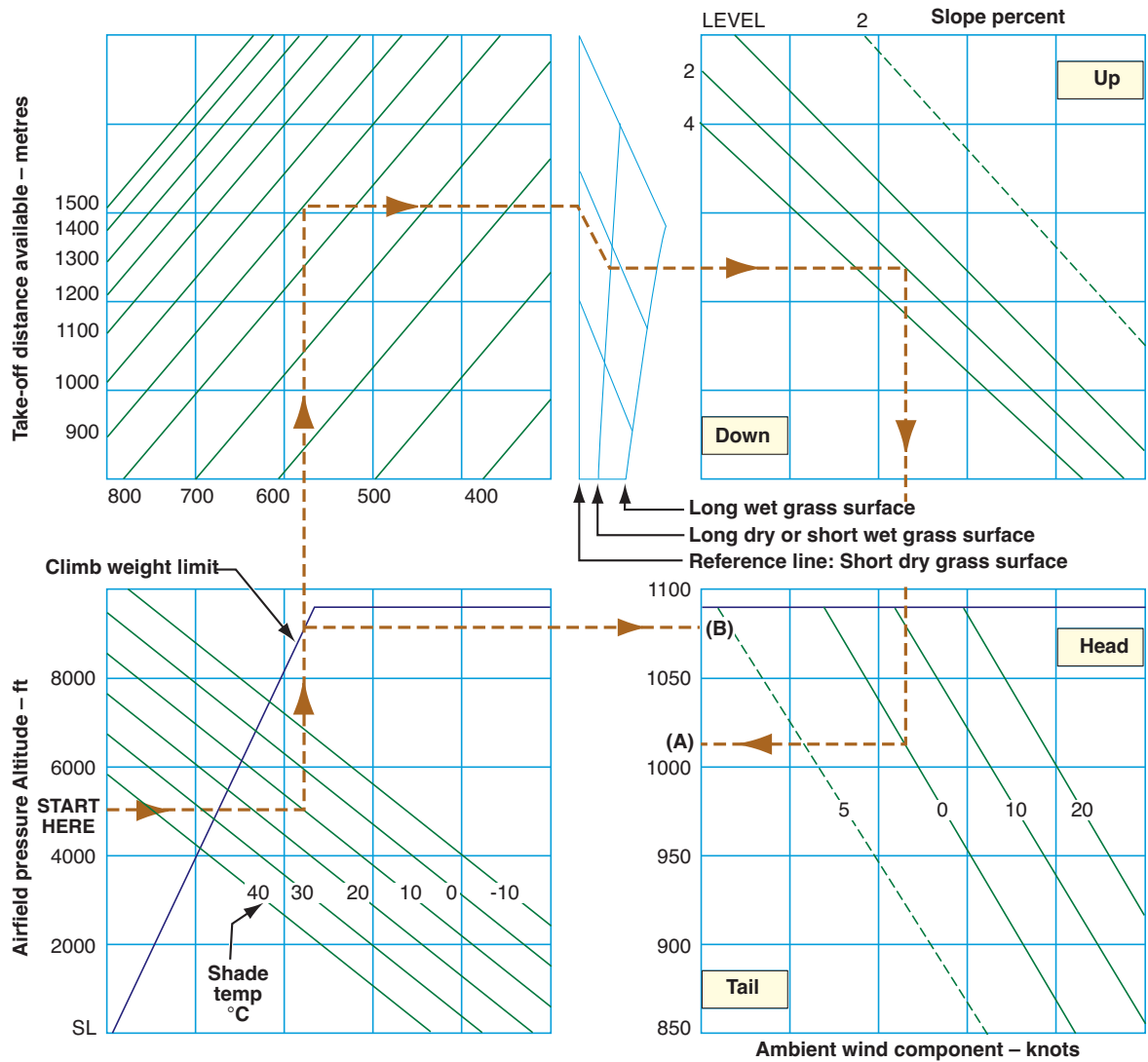
Introduction

This work booklet has been prepared for your use when answering the multiple-choice questions in Appendices 2 and 3 of *Aircraft Operation, Performance & Planning*. Although the tables and graphs are not necessarily those which you will use when sitting the CASA examinations, PPL or CPL, they cover all the areas you are likely to encounter. Note that the tables and graphs in this booklet are samples for study purposes only and are not to be used in conjunction with flight operations or flight planning.

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Cessna Type Take-Off Chart



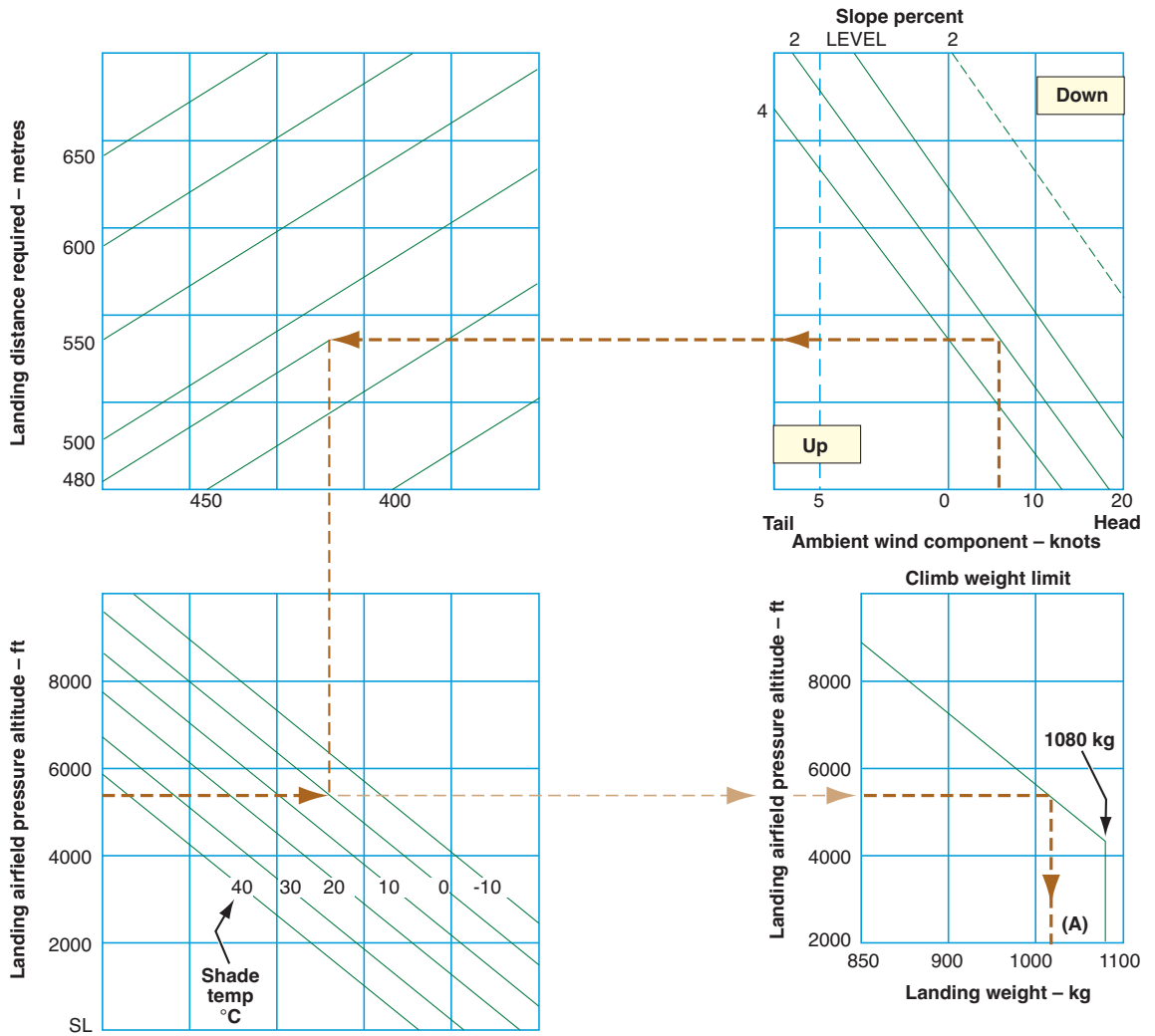
Power to be used	Full throttle
Flap settings	10 degrees
Take-off safety speed	60 KIAS
Take-off distance factor	1.15

Notes:

- (1) The gross weight at take-off shall not exceed the lesser of (A) AND (B)
- (2) Maximum take-off weight = 1090 kg

BAK-1403.EPS

Cessna Type Landing Chart



Flap settings	30 degrees
Approach speed	58 KIAS
Landing distance factor	1.15

Notes:

- (1) Climb weight limit: The gross weight at landing shall not exceed (A) the climb weight limit
- (2) This chart: Landing distance required does not vary significantly with weight

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Cessna 172 Climb Performance Table

Time, Fuel and Distance to Climb

MAXIMUM RATE OF CLIMB

Conditions:

Flaps Up
Full Throttle
Standard Temperature

Cessna Style
Performance
Model 172P

Notes:

1. Add 1.1 gallons of fuel for engine start, taxi and take-off allowance
2. Mixture leaned above 3,000 ft for maximum RPM.
3. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
4. Distances shown are based on zero wind.

Weight (lbs)	Pressure Altitude (ft.)	Temp (°C)	Climb Speed (KIAS)	Rate of Climb (fpm.)	FROM SEA LEVEL		
					Time (min.)	Fuel Used (Gal.)	Distance (nm.)
2400	Sea Level	15	76	700	0	0.0	0
	1,000	13	76	655	1	0.3	2
	2,000	11	75	610	3	0.6	4
	3,000	9	75	560	5	1.0	6
	4,000	7	74	515	7	1.4	9
	5,000	5	74	470	9	1.7	11
	6,000	3	73	425	11	2.2	14
	7,000	1	72	375	14	2.6	18
	8,000	-1	72	330	17	3.1	22
	9,000	-3	71	285	20	3.6	26
	10,000	-5	71	240	24	4.2	32
	11,000	-7	70	190	29	4.9	38
	12,000	-9	70	145	35	5.8	47

Cessna 172 Cruise Performance Table

CRUISE PERFORMANCE

Conditions:

2400 lbs

Recommended Lean Mixture

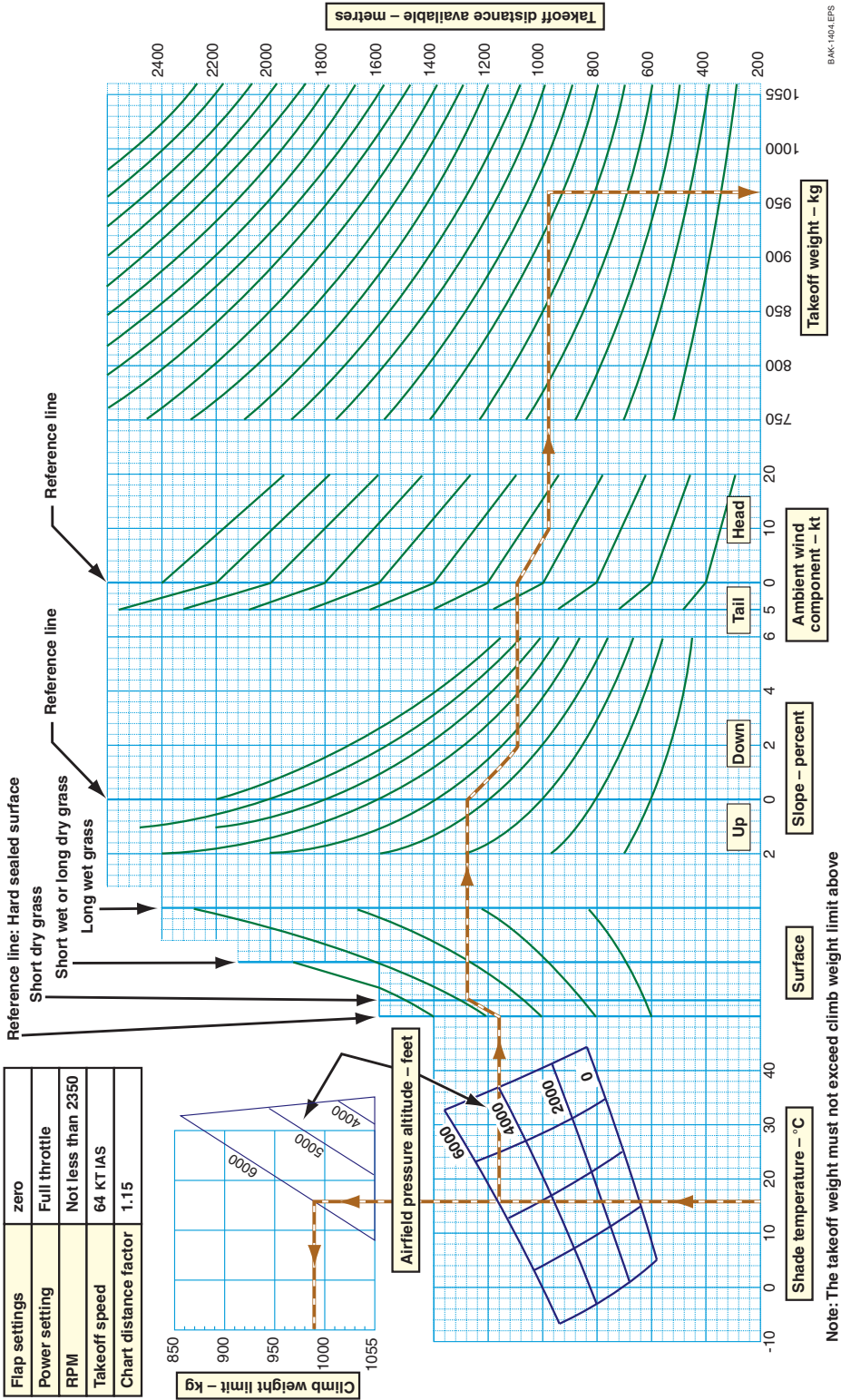
Cessna Style

Performance

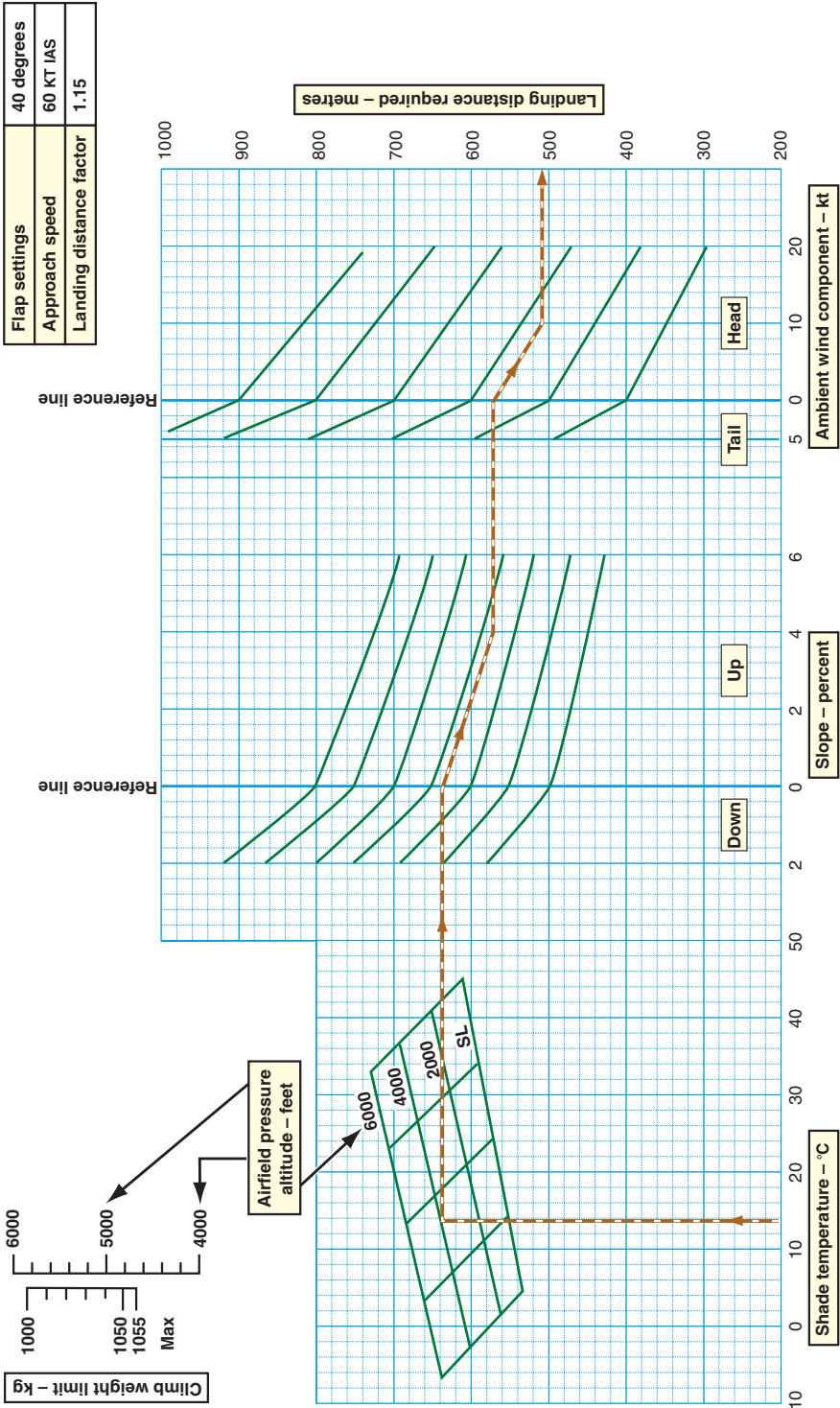
Model 172P

Pressure Altitude (ft.)	RPM	20°C Below Standard Temp			Standard Temp			20°C Above Standard Temp		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2,000	2500	---	---	---	76	114	8.5	72	114	8.1
	2400	72	110	8.1	69	109	7.7	65	108	7.3
	2300	65	104	7.3	62	103	6.9	59	102	6.6
	2200	58	99	6.6	55	97	6.3	53	96	6.1
	2100	52	92	6.0	50	91	5.8	48	89	5.7
4,000	2550	---	---	---	76	117	8.5	72	116	8.1
	2500	77	115	8.6	73	114	8.1	69	113	7.7
	2400	69	109	7.8	65	108	7.3	62	107	7.0
	2300	62	104	7.0	59	102	6.6	57	101	6.4
	2200	56	99	6.3	54	96	6.1	51	94	5.9
	2100	51	91	5.8	48	89	5.7	47	86	5.5
6,000	2600	---	---	---	77	119	8.6	72	118	8.1
	2500	73	114	8.2	69	113	7.8	66	112	7.4
	2400	66	108	7.4	63	107	7.0	60	106	6.7
	2300	60	103	6.7	57	101	6.4	55	99	6.2
	2200	54	96	6.1	52	95	5.9	50	92	5.8
	2100	49	90	5.7	47	88	5.5	46	86	5.5
8,000	2650	---	---	---	77	121	8.6	73	120	8.1
	2600	77	119	8.7	73	118	8.2	69	117	7.8
	2500	70	113	7.8	66	112	7.4	63	111	7.1
	2400	63	108	7.1	60	106	6.7	58	104	6.5
	2300	57	101	6.4	55	100	6.2	53	97	6.0
	2200	52	95	6.0	50	93	5.8	49	91	5.7
10,000	2600	74	118	8.3	70	117	7.8	66	115	7.4
	2500	67	112	7.5	64	111	7.1	61	109	6.8
	2400	61	106	6.8	58	105	6.5	56	102	6.3
	2300	55	100	6.3	53	98	6.0	51	96	5.9
	2200	50	93	5.8	49	91	5.7	47	89	5.6
12,000	2550	67	114	7.5	64	112	7.1	61	111	6.9
	2500	64	111	7.2	61	109	6.8	59	107	6.6
	2400	59	105	6.6	56	103	6.3	54	100	6.1
	2300	53	98	6.1	51	96	5.9	50	94	5.8

Turbo Lance Take-Off Performance Graph



Turbo Lance Landing Performance Graph

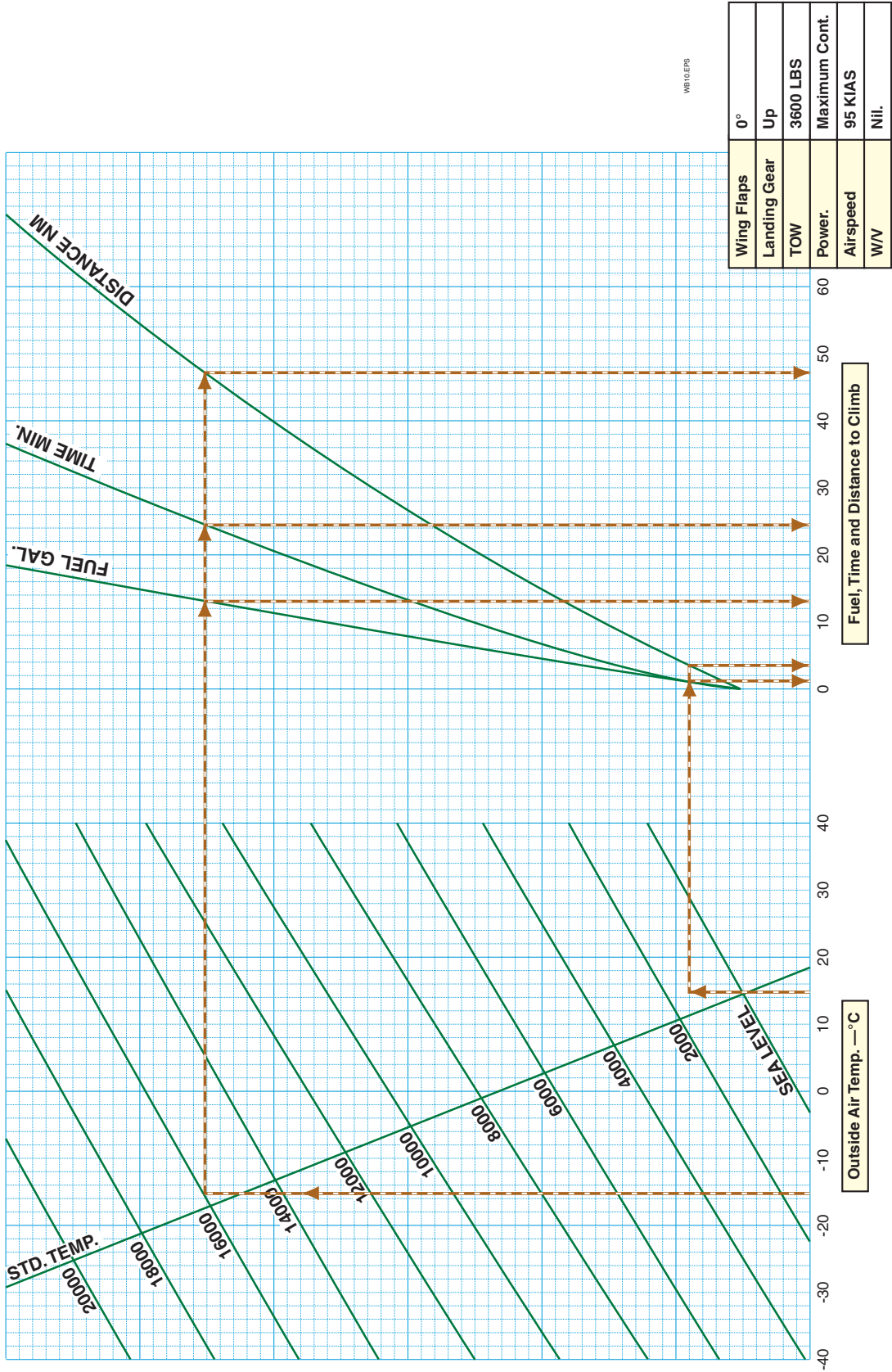


Notes: (1) The landing weight must not exceed climb weight limit above.

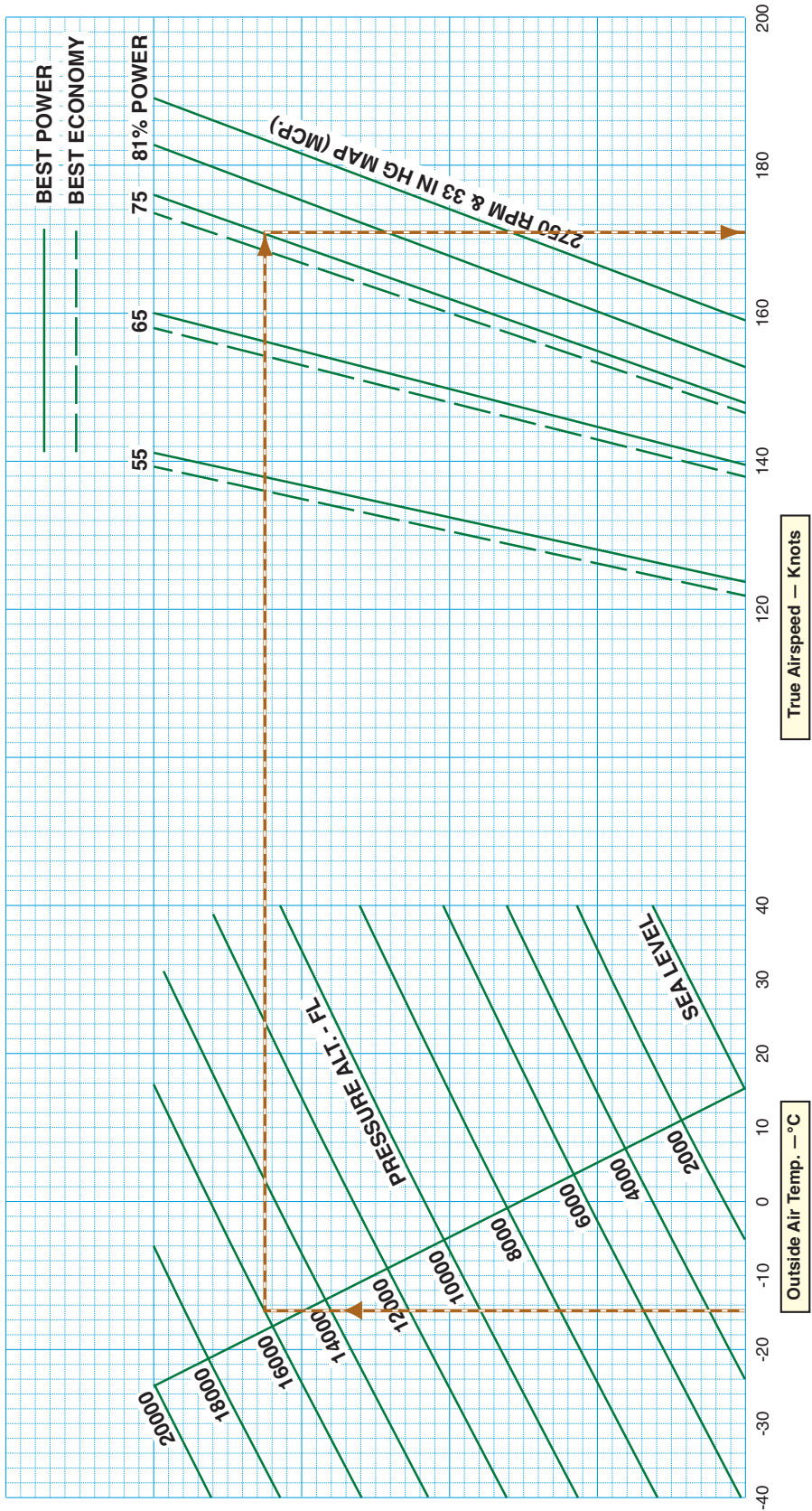
(2) This chart: Landing distance required does not vary significantly with weight.

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Turbo Lance Climb Performance Graph



Turbo Lance Cruise Performance Graph

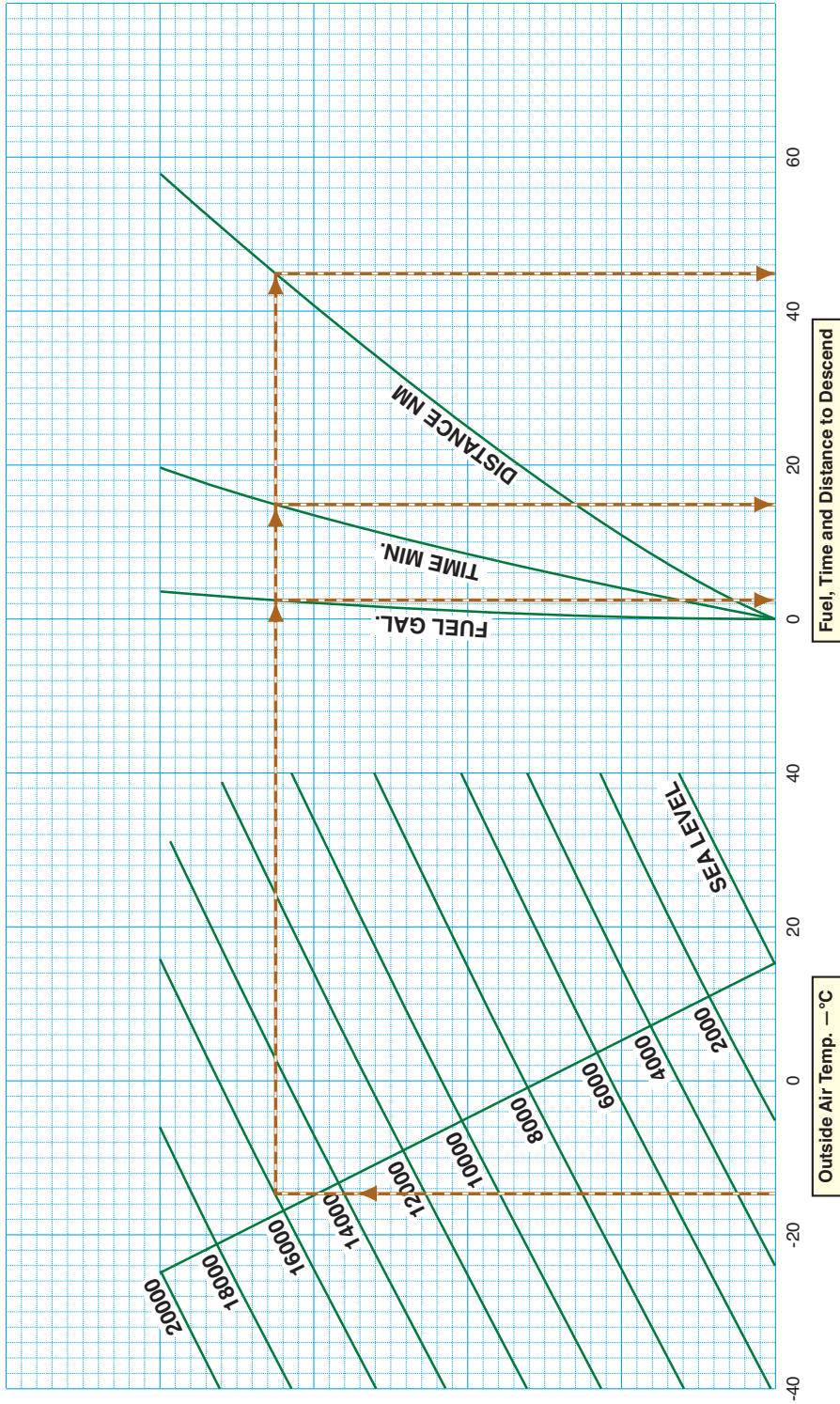


Best Economy	
% Power	Approx. Fuel Flow
75	17.4 GPH
65	15.7 GPH
55	13.8 GPH

Best Power	
% Power	Approx. Fuel Flow
81	24.0 GPH
75	21.9 GPH
65	19.8 GPH
55	16.8 GPH

Standard Configuration: Gear up, Flaps up, 1633 kg Gross Weight, Cowl Flaps Closed.
Best Power Configuration: Mixture leaned to 150°F rich of peak E.G.T (1650° max. allowable).
Best Economy Configuration: Mixture leaned to 50°F rich of peak E.G.T. (1650°F max. allowable).

Turbo Lance Descent Performance Graph



Wing Flaps	0°	Manifold Pressure	18 in
Landing Gear	Up	EGT	Leaned to 1350°F
Cowl Flaps	Closed	Profile	150 KIAS
Power	2400 RPM	Wind	Nil.

WB12.EPS

Working Page

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Loading System Alpha Data

Loading System Alpha Configuration: 6/7 Seats

Instructions for Use of Loading System

1. Obtain Basic Empty Weight and Index Units from current Section of 6.2 of Flight Manual.
2. Mark Basic Empty Weight Index Units on top scale. Enter Basic Empty Weight at top of right-hand column.
3. Enter Weights of load items required for flight in appropriate squares of right-hand column. Maximum weights for load items are indicated on Index Unit scales.
4. Total weights in right-hand column to obtain Zero Fuel Weight and Take-Off Weight. **
5. Draw horizontal lines on C.G. Envelope graph corresponding to Zero Fuel Weight and Take-Off weight.
6. Draw a line vertically down from point marked on Basic Empty Weight Index Units scale to first load item scale.
*Move to the left or right on this load item index scale as per arrow direction, and mark point as appropriate to the load indicated in the right-hand column (e.g. 154kg load @ 77kg div. = 2 div.)
7. Draw a line vertically down from the point marked on the first load item index scale to the second load item index scale and continue as per* above. Continue down the scales to "Rear Baggage". Draw a line vertically from the "Rear Baggage" point down to intersect the Zero Fuel Weight line and Take-Off Weight line previously marked on the C. G. envelope graph.
8. The two intersection points as per 7. Above must not exceed the boundaries of the C. G. envelope graph. If they do, reorganise the load in the aircraft and start with steps 3. to 7.

****Do not exceed the maximum take-off weight as shown on C.G. envelope diagram of this loading system.**

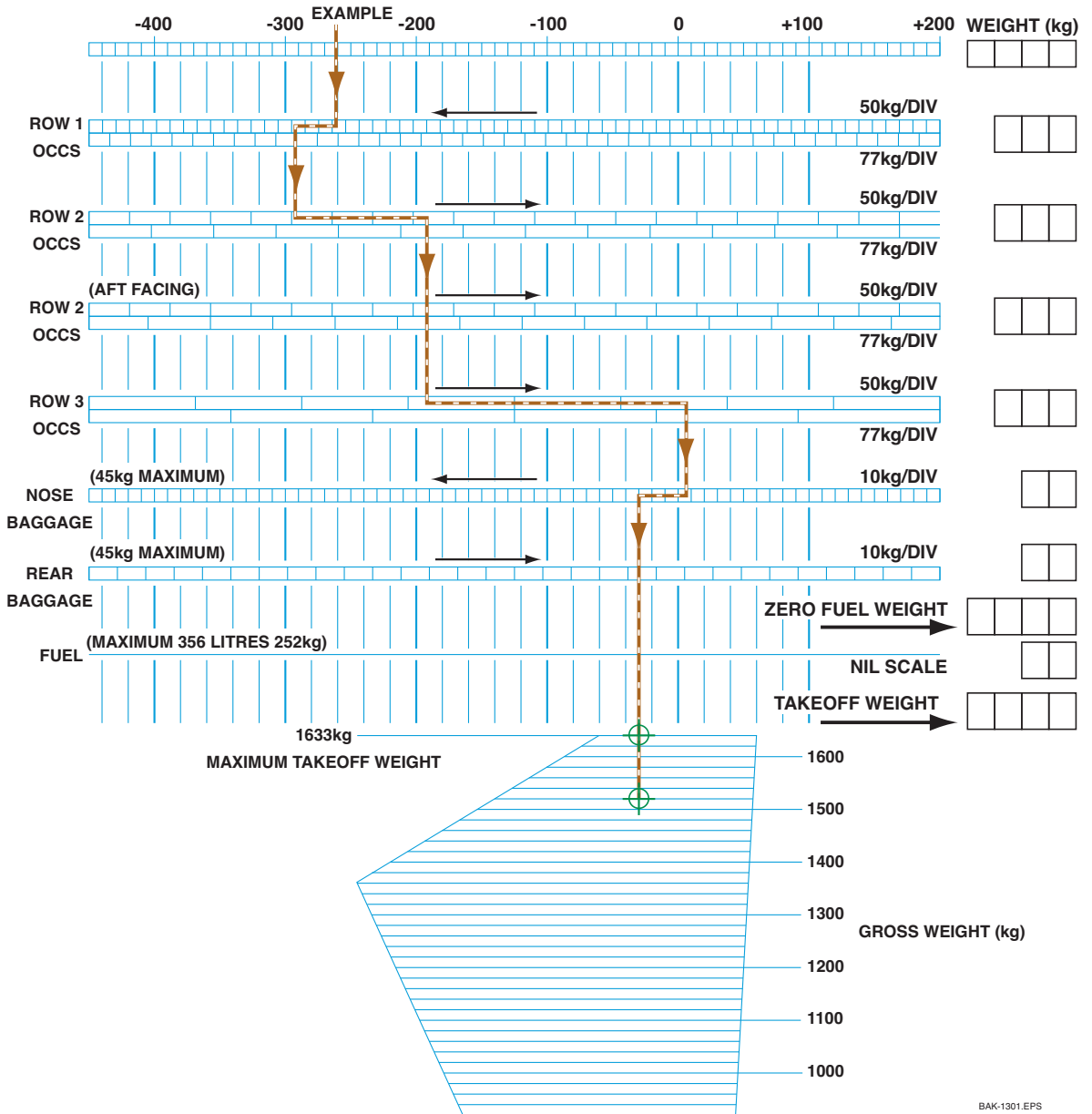
Example:

Basic Empty Weight	1050kg
Empty index units	-260
Row 1	150kg (2 persons)
Row 2 (forward facing)	160kg (2 persons)
Row 3	120kg (2 persons)
Nose baggage	40kg → Zero Fuel Wt = 1520kg
Rear baggage	Nil
Fuel	113kg → Take-Off Wt = 1633kg

Note: Basic Empty Weight includes unusable fuel and full oil.

Loading System Alpha Graph

LOADING SYSTEM ALPHA



Loading System Bravo Data

Loading System Bravo Configuration: 4 Seats

Instructions for Use of Loading System

To check the loading of the aircraft before take-off, calculate the total weight and total moments as shown in the example below.

Plot the total weight and moment on the "Centre of Gravity Envelope" chart, and if the intersection point is within the envelope, the loading is acceptable.

Aircraft Limitations

Maximum take-off weight

Normal category: 1000 kg/2200 lbs

Utility category: 841 kg/1850 lbs

Maximum baggage compartment baggage: 53 kg/120 lbs

- Notes:
1. The aircraft is fitted with standard tanks (37 US Gallons at 6 lbs/gallon)
 2. Empty weight includes unusable fuel and undrainable oil
 3. Obtain Moment/1000 inch pounds from the loading graph

Example:

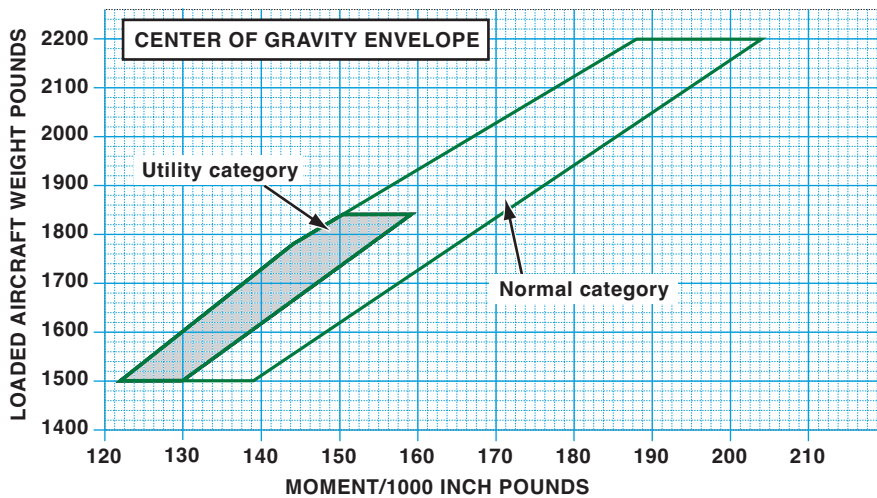
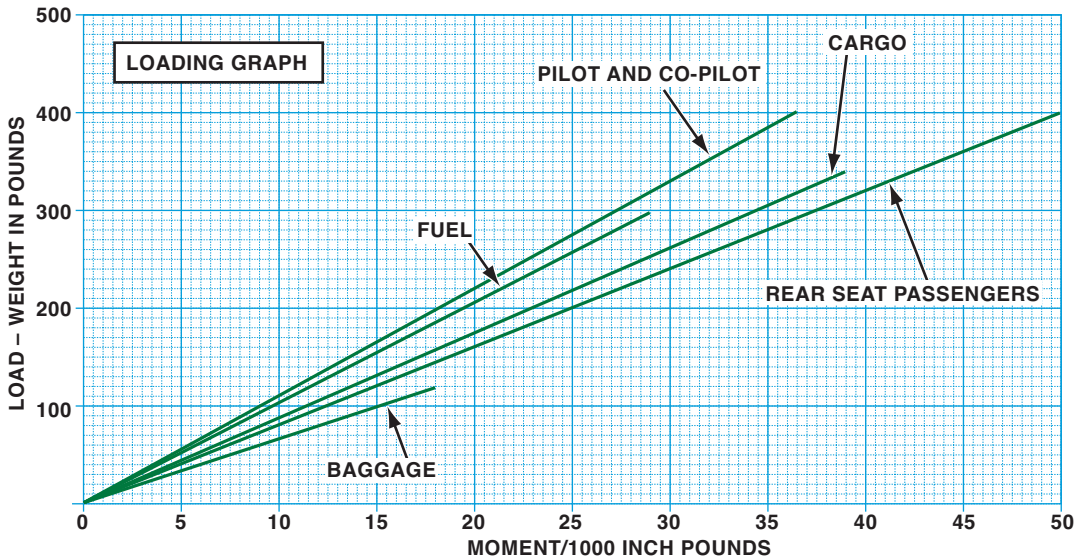
	Weight (lbs)	Arm (in)	Moment/ 1000 in lb
Empty Weight	1260	80	100.80
Oil	15	32	.48
Fuel (141 litres)	222	91	20.02
Pilot & Co-pilot	320	91	29.12
Rear Seat Passengers	350	126	44.10
Baggage	25	151	3.78
Takeoff Weight	2192		198.30

Check CG is within the envelope

Loading System Bravo Graph

LOADING SYSTEM BRAVO

Add weight of items to be carried to aeroplane licensed empty weight.
Add moment/1000 of items to be carried to total aeroplane moment/1000.
Use Center of Gravity Envelope to determine acceptability.



Loading System Charlie Data

Loading System Charlie

Index Units

FUEL	ARM: 2950		BAGGAGE	ARM: 4210
20	14	413	10	421
40	28	826	20	842
60	43	1268	30	1,263
80	57	1682	40	1,684
100	71	2095	50	2,105
120	85	2507	60	2,526
140	99	2920	70	2,947
160	114	3363	80	3,368
180	129	3806	90	3,789
200	142	4189	100	4,210
216	153	4513	110	4,631
			122	5,136

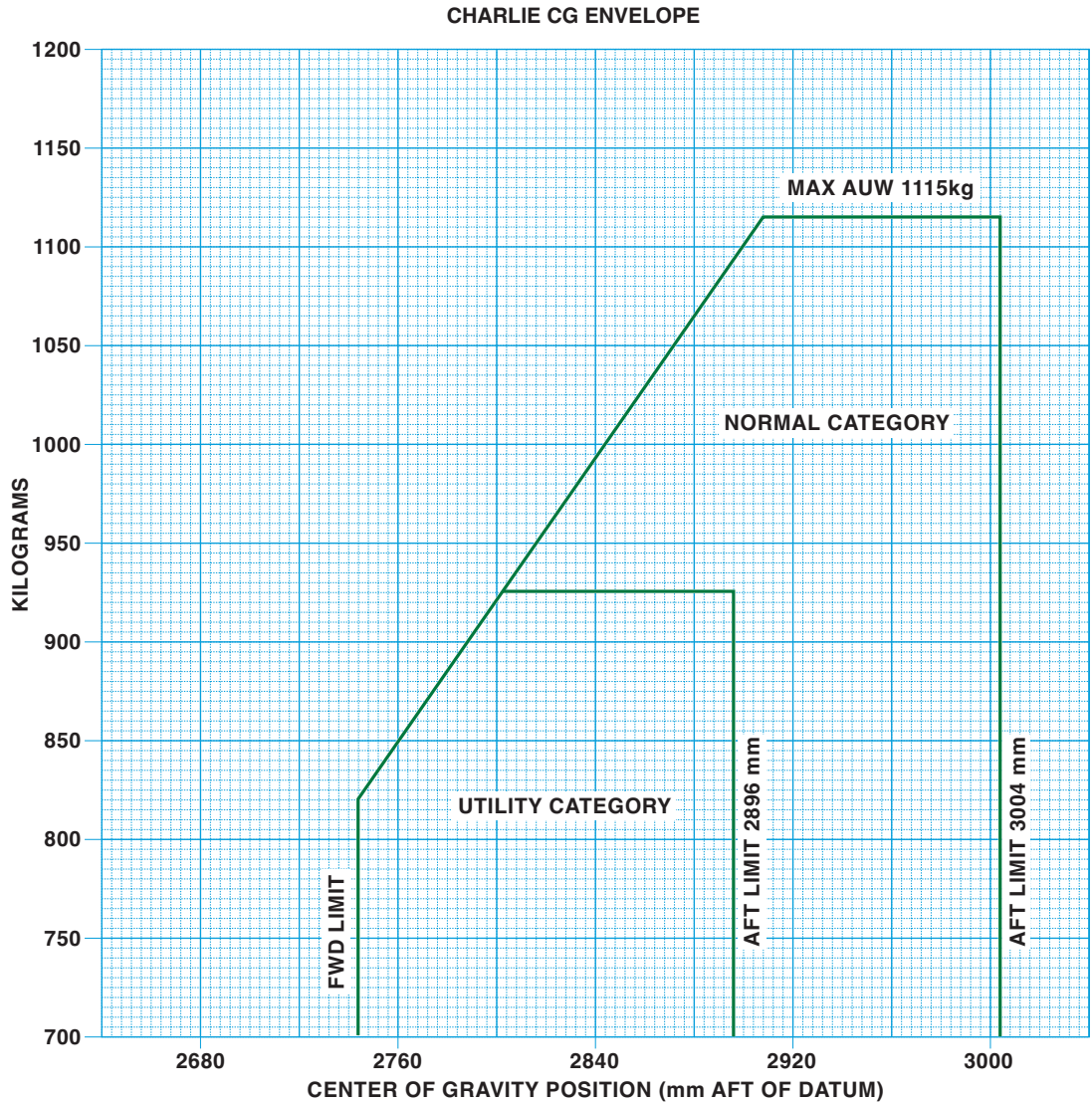
OCCUPANTS

KG	Row 1 ARM: 2750	Row 2 ARM: 3600
40	1,100	1,440
45	1,237	1,620
50	1,375	1,800
55	1,512	1,980
60	1,650	2,160
65	1,786	2,340
70	1,925	2,520
75	2,062	2,700
80	2,200	2,880
85	2,338	3,060
90	2,475	3,240

OIL ARM: 1230

US Quarts	Litres	KG	Index Units
6	5.7	5.0	62
7	6.6	6.0	74
8	7.6	7.0	86

Loading System Charlie Graph



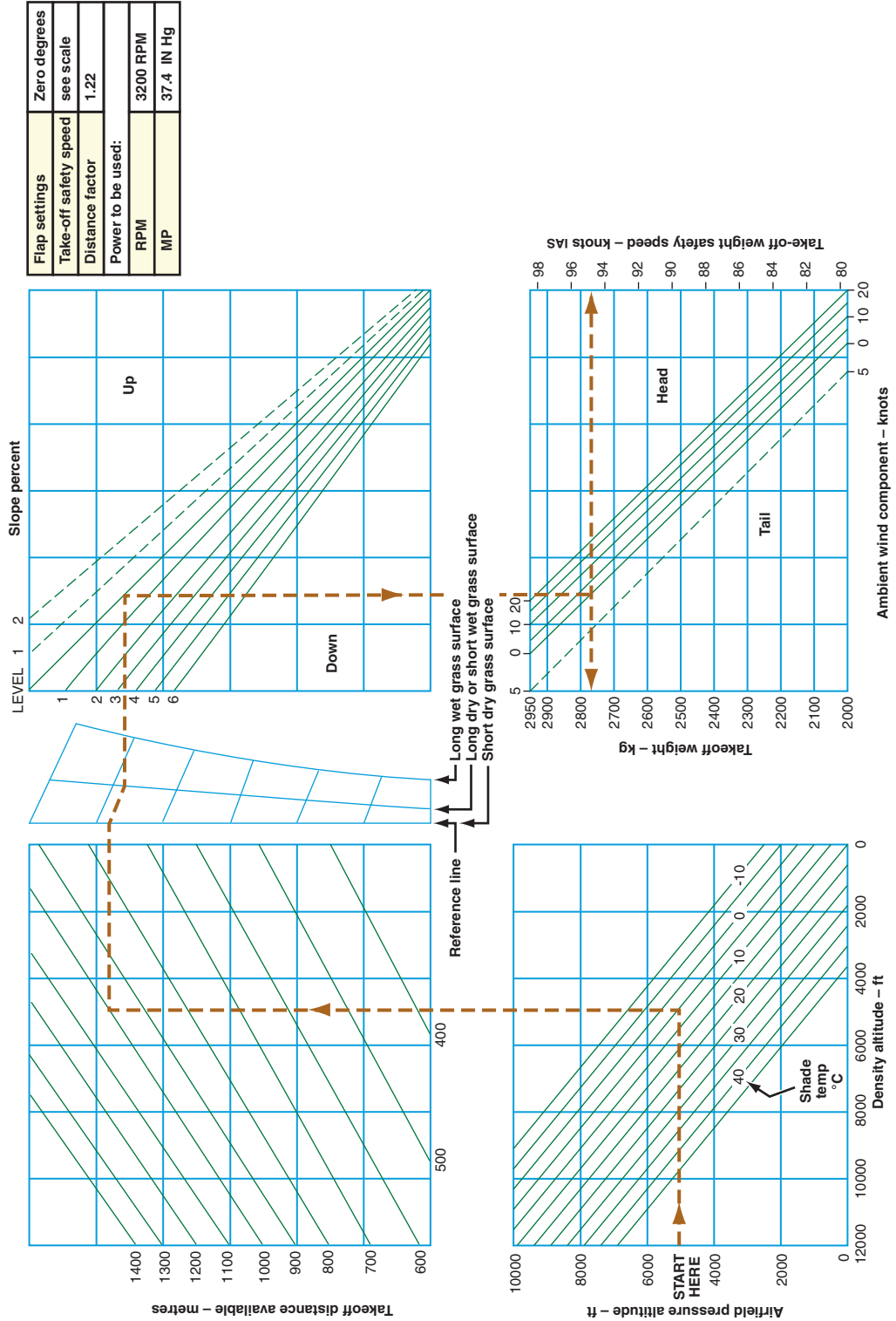
Aircraft Limitations

Maximum take-off weight	
Normal category:	1115 kgs
Utility category:	925 kgs
Maximum baggage compartment baggage:	122 kgs
Aircraft empty weight	687 kg; IU 19,522

- Notes:
1. Aircraft empty weight includes unusable fuel and undrainable oil
 2. All arms are in mm aft of datum
 3. 1 index unit = 100 kg mm

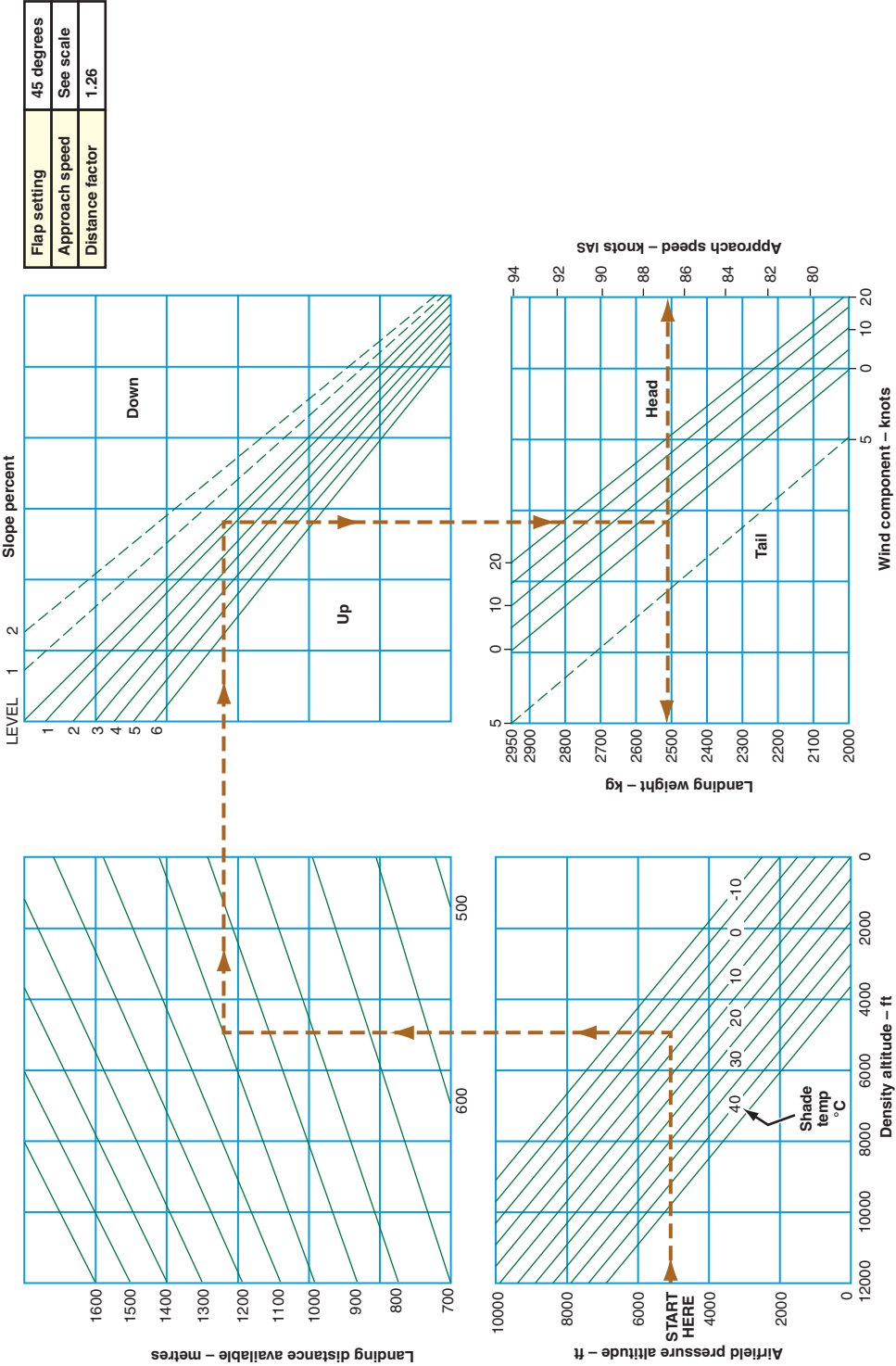
Echo Take-Off Chart

ECHO TAKEOFF CHART



Echo Landing Chart

ECHO LANDING CHART



Echo Landing Data

Loading System Echo Configuration: 6 Seats

Weight Limitations: Maximum Takeoff Weight 2950kg
 Maximum Landing Weight 2725kg
 Maximum Zero Fuel Weight 2630kg

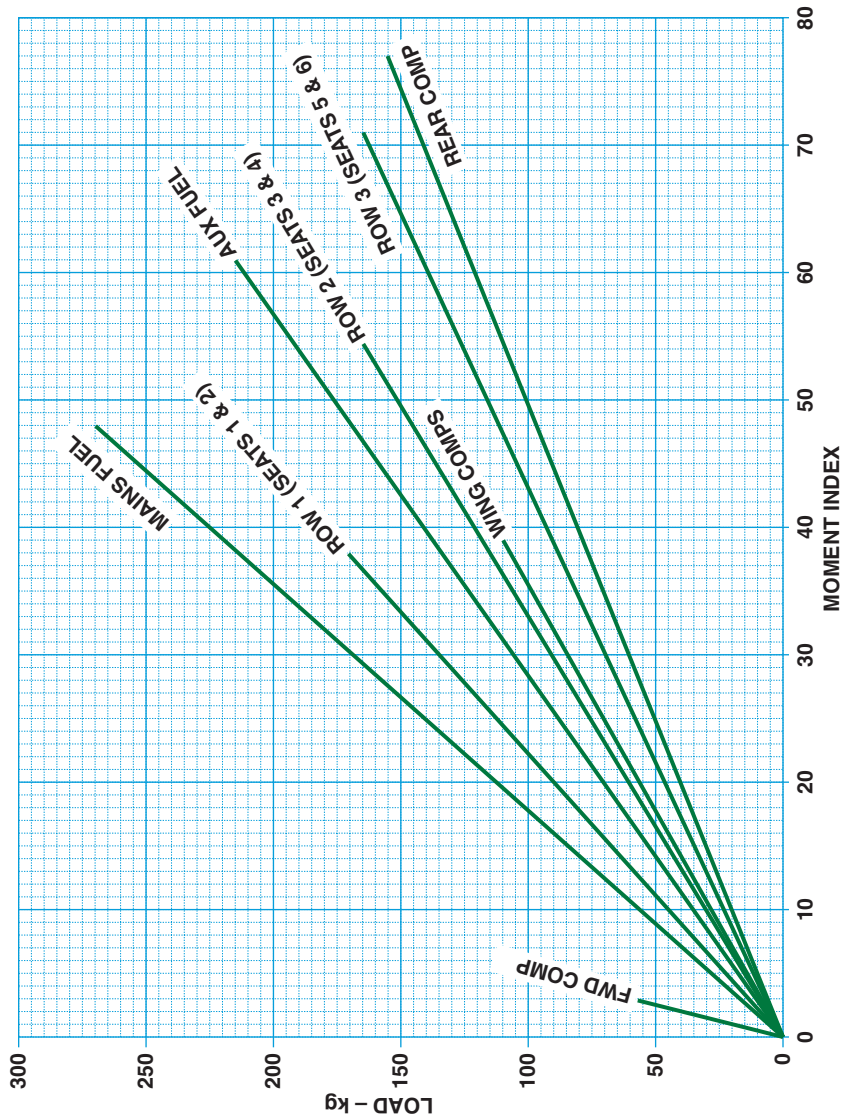
Balance Data: The Mean Aerodynamic Chord (MAC) data is as follows:
 Length of chord 1900mm
 Location of leading edge 2190mm aft of datum
 Centre of Gravity range is as follows:
 2400mm to 2680 mm at 2360kg or less
 2560mm to 2680mm at 2950kg
 Linear variation between the points given

Loading Data:

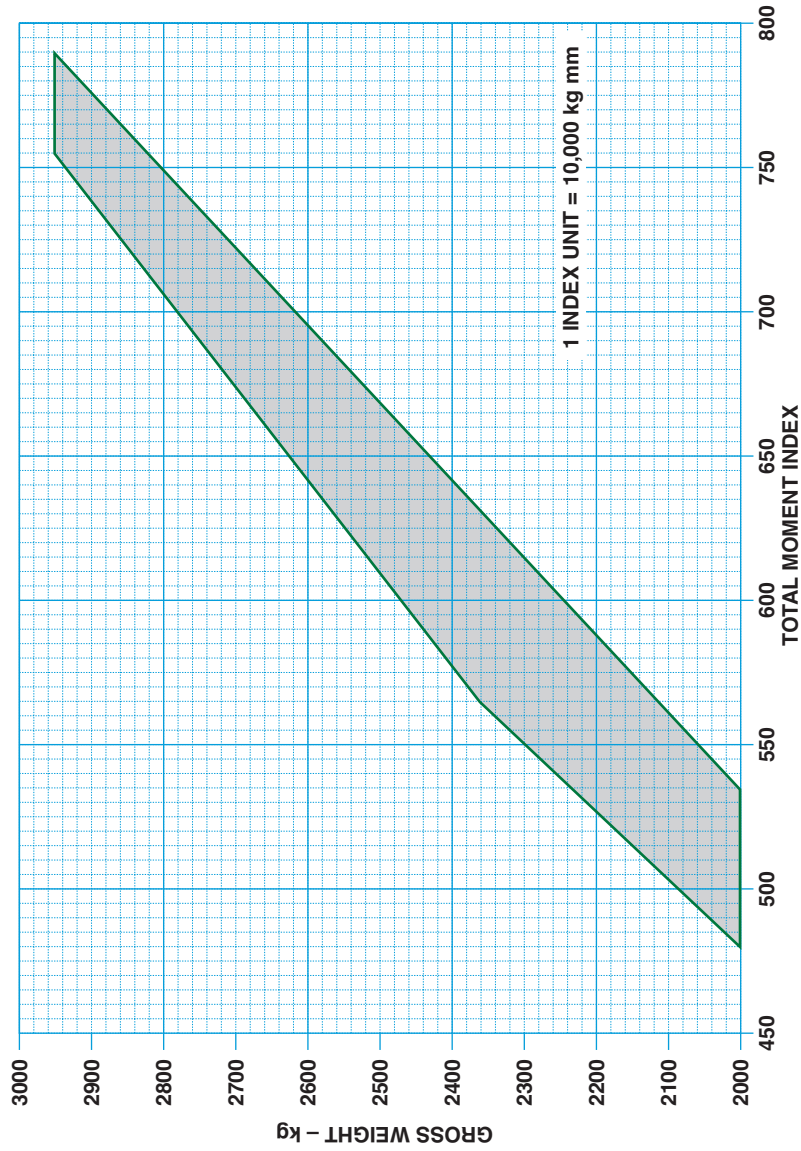
Location	Maximum Permissible Load	Arm (mm Aft of Datum)
Seating: Row 1 (Seats 1 & 2) Row 2 (Seats 3 & 4) Row 3 (Seats 5 & 6)	Pilot + 1 passenger 2 passengers 2 passengers	2290 3300 4300
Cargo & Baggage Compts: Forward compt. Left wing compt. Right wing compt. Rear compt. Floor loading intensity	55 kg 55 kg 55 kg 155 kg 450 kg/m ² (All Compts)	500 3550 3550 5000
Fuel: Left main tank Right main tank Left auxiliary tank Rightauxiliary tank	50 USG 50 USG 40 USG 40 USG	1780 1780 2800 2800

Note: All Passenger seats weigh 5kg 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 82kg.
 If a passenger seat is removed, adjust the empty weight and empty moment.

Echo Moment Index Graph



Echo CG Envelope Graph



Load Sheet

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Working Page

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