

PERFORMANCE WORKBOOK

Loading systems and performance charts for the RPL, PPL and CPL aeroplane examinations.

WORKED EXAMPLE

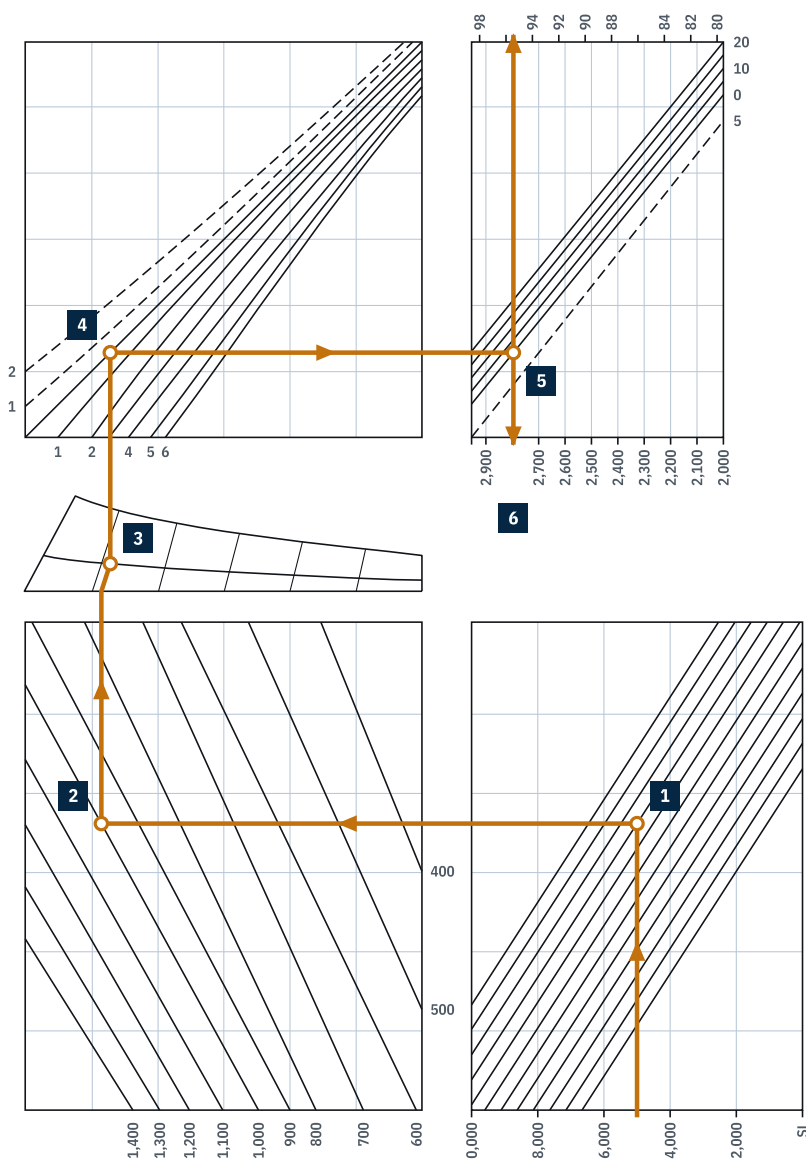
- 1** HEIGHT AND TEMPERATURE
5,000 ft, +5 °C
- 2** DISTANCE AVAILABLE
1,000 m
- 3** SURFACE
Short wet grass
- 4** SLOPE
Level
- 5** WIND
Nil
- 6** WEIGHT AND SPEED
2,796 kg, 95 kt

INSIDE

- P-type take-off and landing charts
- Linear take-off and landing charts
- Loading systems Alpha, Bravo, Charlie and Echo
- Echo take-off and landing weight charts
- Aerodrome markers and markings

ONLINE

Every chart here has a calculator in the PilotTrain practice exams that works it with you.



FOR STUDY ONLY

The tables and graphs in this workbook are samples. They are not to be used for flight operations or flight planning.

OPERATIONAL DOCUMENTS

Nothing in this workbook supersedes any operational document or procedure issued by the Civil Aviation Safety Authority, by aircraft or avionics manufacturers, by flight schools, or by the operators of aircraft.

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THIS EDITION

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ATTRIBUTION

Source: Civil Aviation Safety Authority.

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This workbook is for PilotTrain students working towards the recreational, private and commercial pilot licence examinations, and is published both online and in print. It follows the form of the examination workbook issued by the regulator. The tables and graphs inside are samples for study only: they are not to be used for flight operations or flight planning.

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AERODROME MARKERS AND MARKINGS

FIGURE GROUP 1

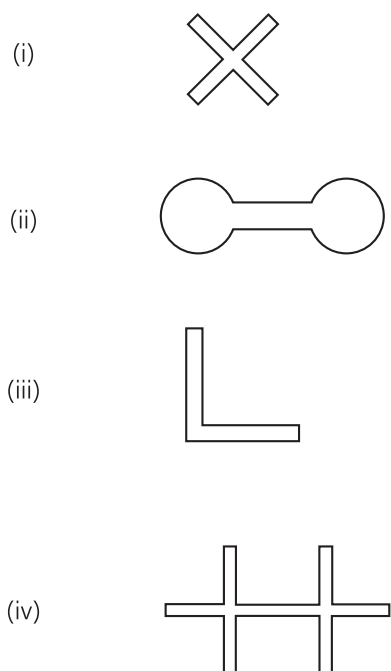
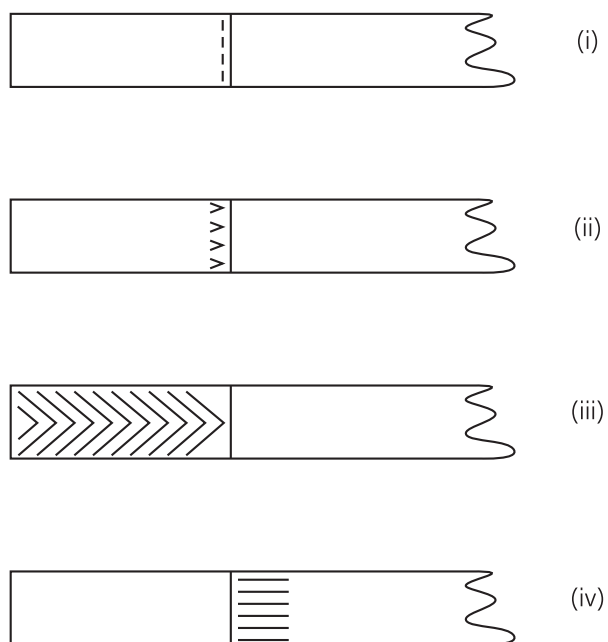
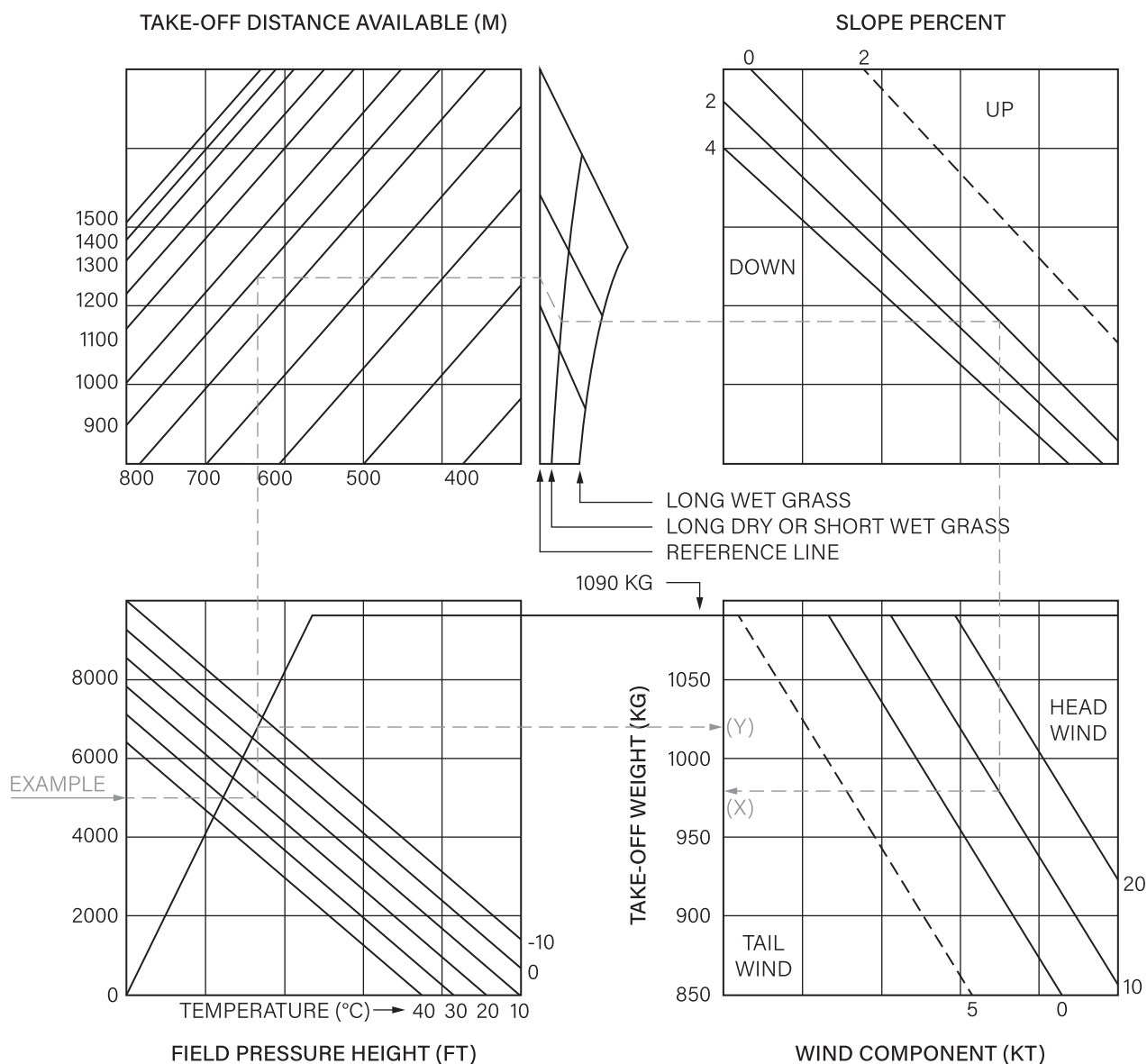


FIGURE GROUP 2

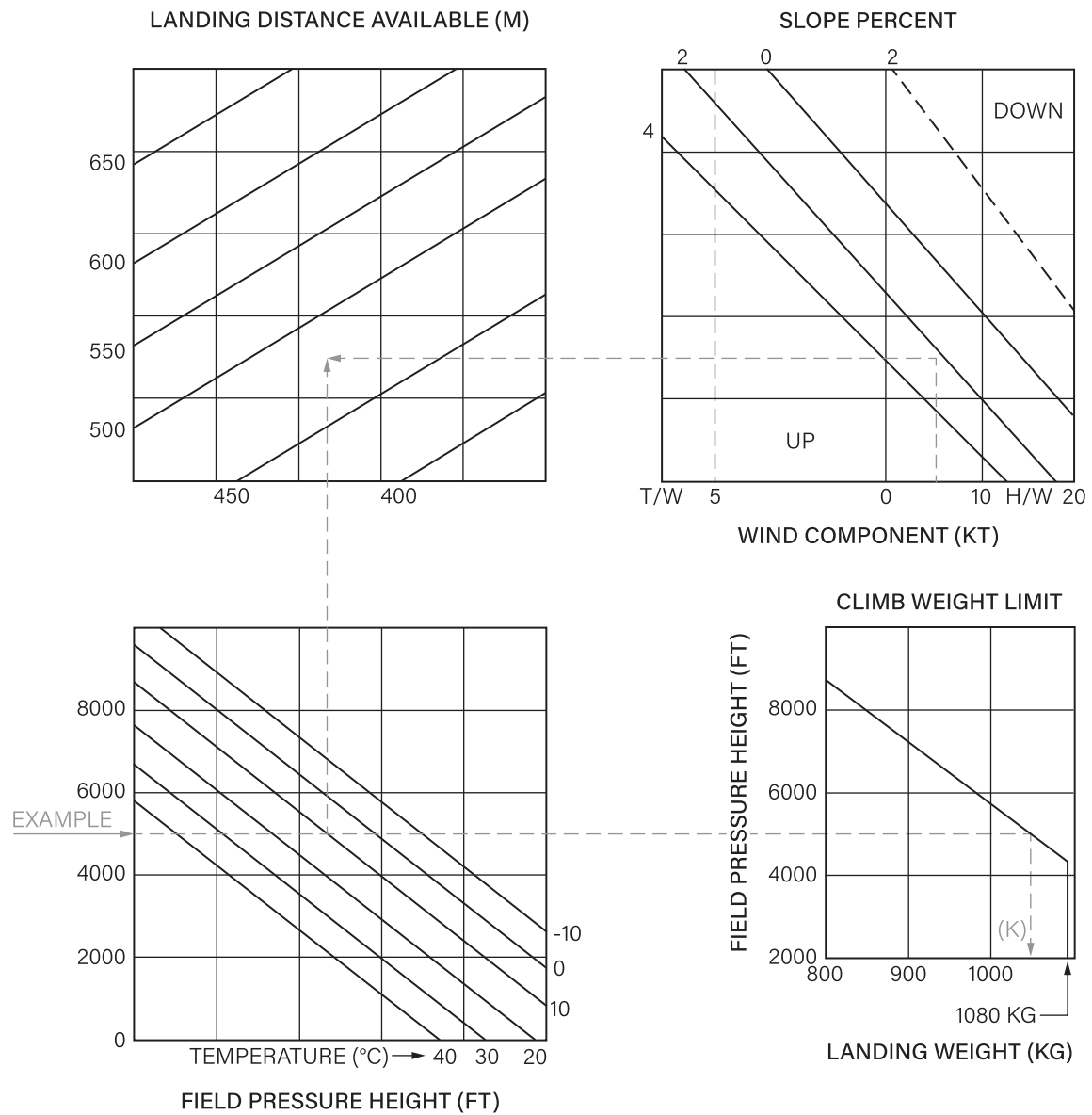



CONDITIONS

POWER SETTING	MAXIMUM
FLAP SETTING	10 DEGREES
TAKE-OFF SAFETY SPEED	60 KIAS
INCLUDED TAKE-OFF FACTOR	1.15
MAXIMUM CROSSWIND	15 KT

NOTES

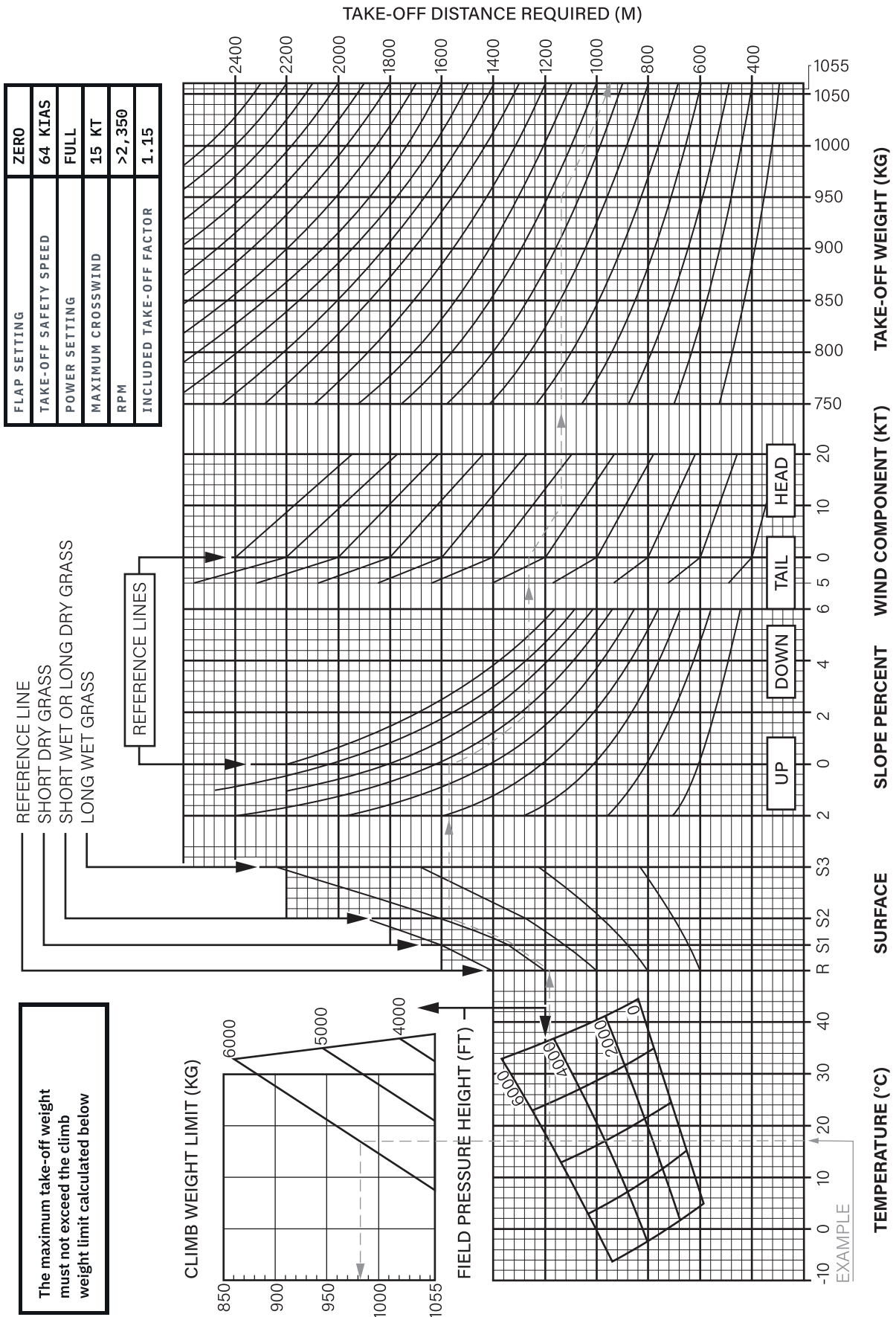
- The maximum weight at take-off must not exceed the lesser of X and Y.
- The maximum take-off weight is 1090 KG.

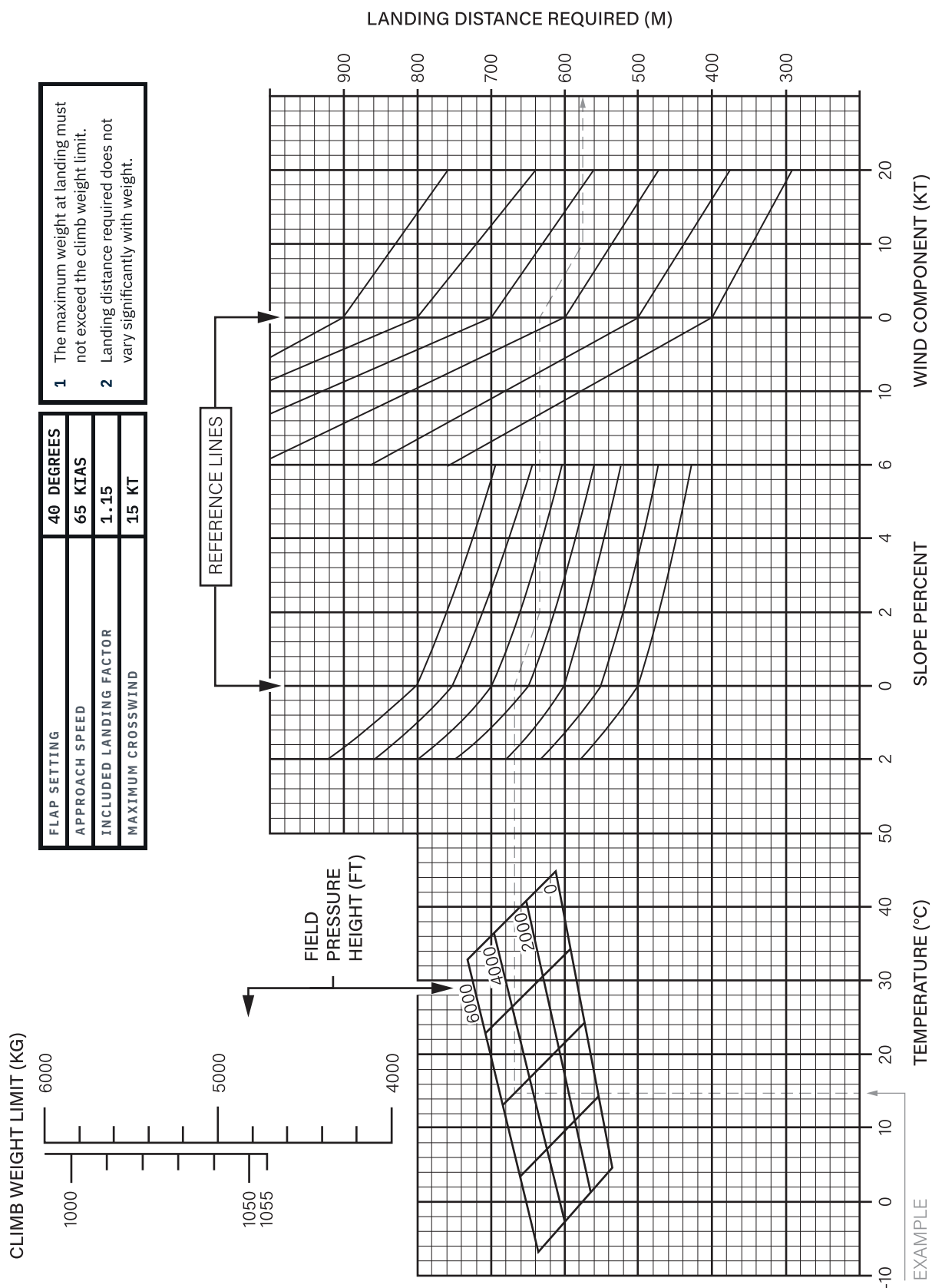

CONDITIONS

FLAP SETTING	30 DEGREES
APPROACH SPEED	58 KIAS
INCLUDED LANDING FACTOR	1.15
MAXIMUM CROSSWIND	15 KT

NOTES

- 1 The maximum weight at landing must not exceed K.
- 2 Landing distance required does not vary significantly with weight.





Loading system alpha is a simple flow style chart. Use the following instructions to complete the flow chart and plot the blade correctly.

METHOD

- 1** Obtain the Basic Empty Weight and Index Units of the aircraft from the flight manual/question.
- 2** Enter the Basic Empty Weight on the top scale and identify the Index Units location. Mark this point and draw a line vertically down to the next blade.
- 3** Enter weights of the loaded 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. Do not exceed the maximum take-off weight as shown on the centre of gravity envelope.
- 5** Draw horizontal lines on CG 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 directions, and mark point as appropriate to the load indicated in the right-hand column. (e.g. 154 KG load at 77 KG per division = 2 divisions.)
- 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 CG envelope graph.
- 8** The two intersection points as per 7, above must not exceed the boundaries of the centre of gravity envelope graph. If they do, re-organise the load in the aircraft and start again with steps 3 to 7.

EXAMPLE

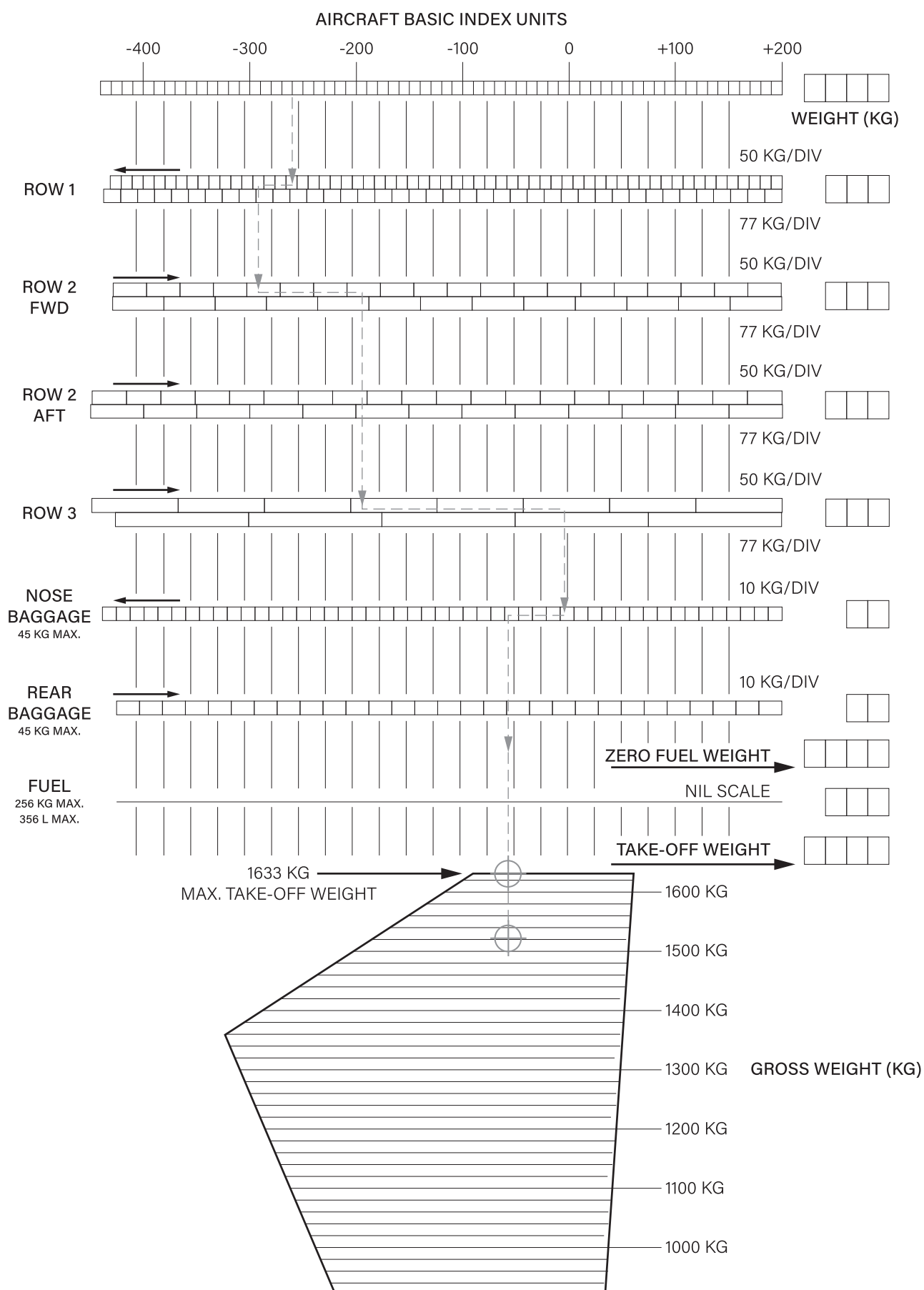
Basic empty weight	1,050 KG
Empty index units	-260 IU
Row 1	150 KG
Row 2 (FWD)	160 KG
Row 2 (AFT)	NIL
Row 3	120 KG
Nose baggage	40 KG
Rear baggage	NIL
Zero fuel weight	1,520 KG
Fuel	113 KG
Take-off weight	1,633 KG

NOTE

Basic Empty Weight includes unusable fuel and full oil.

LIMIT

Do not exceed the maximum take-off weight as shown on the centre of gravity envelope diagram!



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, and if the intersection point is within the envelope, the loading is acceptable for safe flight.

AIRCRAFT LIMITATIONS

MAXIMUM TAKE-OFF WEIGHT	KG	LBS
Normal category	1,000	2,200
Utility category	841	1,850

COMPARTMENT LIMITATIONS	KG	LBS
Cargo compartment	154	339
Baggage compartment	54	120

NOTES

- 1 The aircraft is fitted with standard tanks (37 USG at 6 lbs/gallon);
- 2 The aircraft is not fitted with optional fuel tanks.
- 3 Empty weight includes unusable fuel and undrainable oil; and
- 4 Obtain Moment/1000 inch pounds from the loading graph.

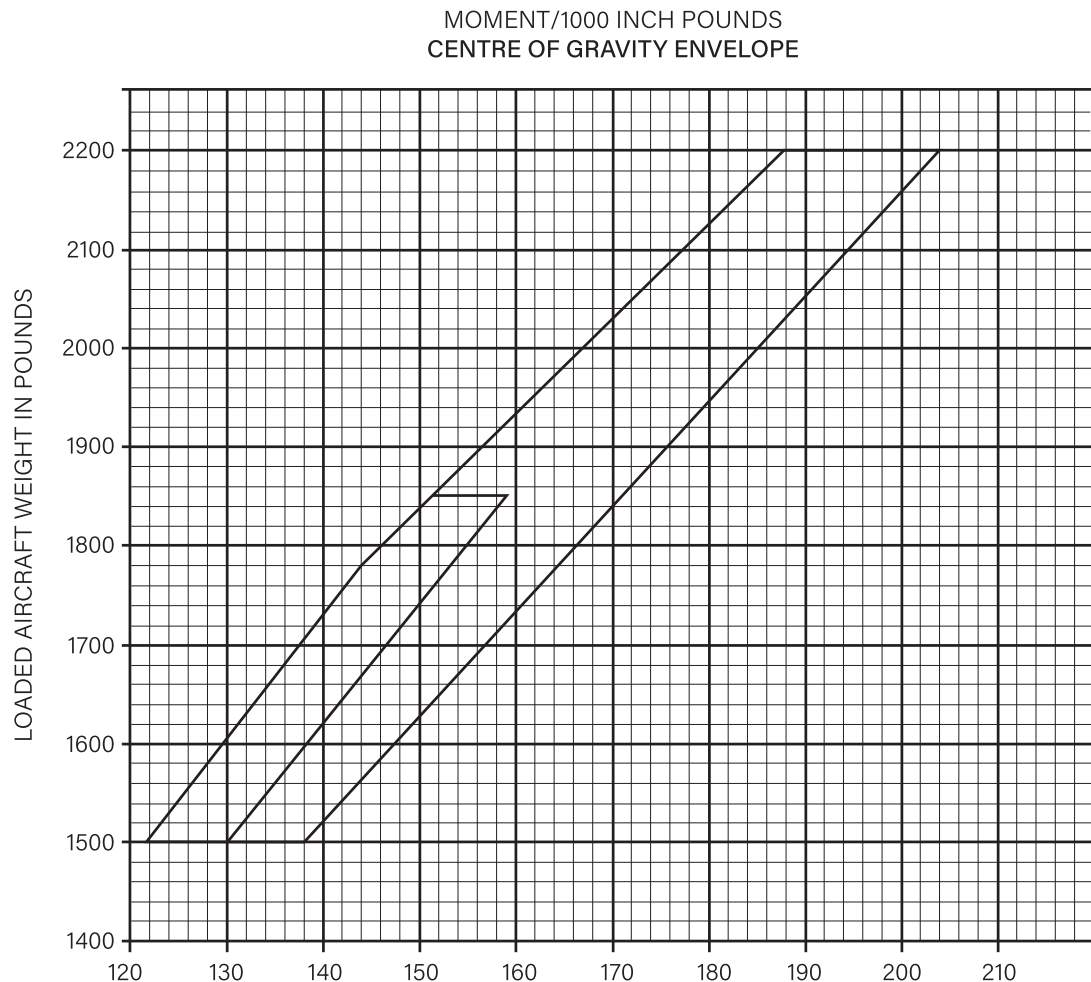
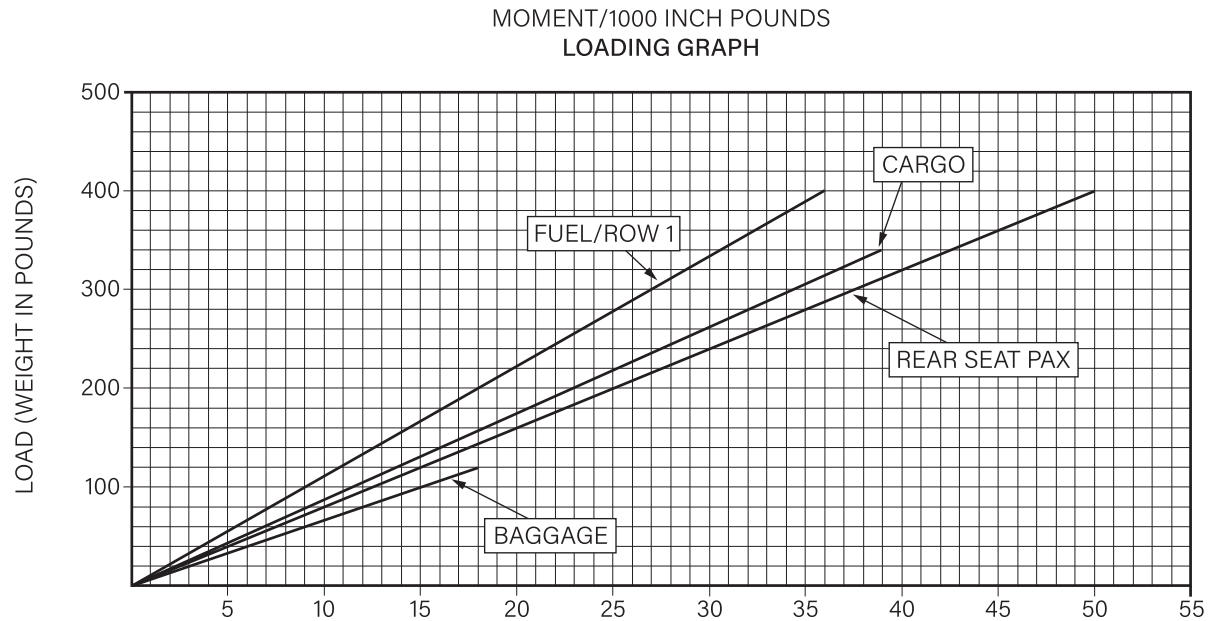
EXAMPLE

	WEIGHT (LBS)	ARM (IN)	MOMENT/1,000 IN LB
Basic empty weight	1,260	80	100.80
Oil	15	32	0.48
Row 1	320	91	29.12
Cargo	80	115	9.20
Row 2	250	126	31.50
Baggage	25	151	3.78
Zero fuel weight	1,950		174.88
Fuel	221	91	20.11
Take-off weight	2,171		194.99

CHECK

Check centre of gravity is within the envelope at both ZFW and TOW.





- 1** Add weight of items to be carried to aeroplane empty weight.
- 2** Add moment/1000 of items to be carried to total aeroplane moment/1000.
- 3** Use centre of gravity envelope to determine acceptability.

To check the loading of the aircraft before take-off, carry out a summation of weight and index units. Check the centre of gravity of the aircraft at Zero Fuel Weight and Take-Off Weight by use of the following formula:

$$\text{CG (mm aft of datum)} = \text{Index Units} \times 100 \div \text{Weight}$$

AIRCRAFT LIMITATIONS

Maximum take-off weight (normal category)	1,115 KG
Maximum take-off weight (utility category)	925 KG
Maximum load in baggage compartment	122 KG

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

QUICK REFERENCE TABLES

FUEL @0.72 ARM = 2,950 mm		
LITRES	KG	INDEX UNITS
20	14.40	424.80
40	28.80	849.60
60	43.20	1,274.40
80	57.60	1,699.20
100	72.00	2,124.00
120	86.40	2,548.80
140	100.80	2,973.60
160	115.20	3,398.40
180	129.60	3,823.20
200	144.00	4,248.00
216	155.52	4,587.84

BAGGAGE ARM = 4,210 mm	
KG	INDEX UNITS
10	421
20	842
30	1,263
40	1,684
50	2,105
60	2,526
70	2,947
80	3,368
90	3,789
100	4,210
110	4,631
122	5,136

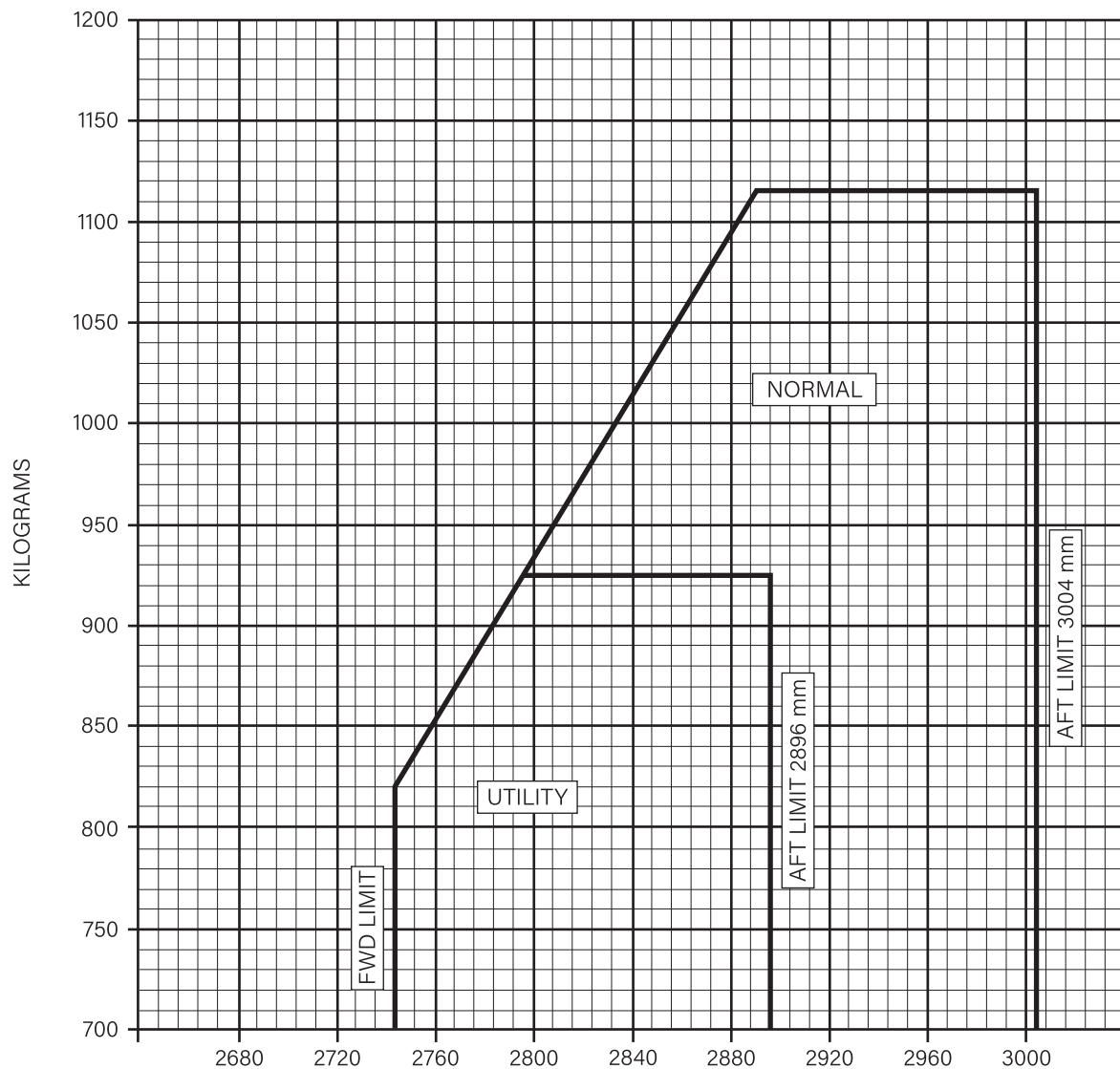
AIRCRAFT OCCUPANTS		
KG	ROW 1 ARM = 2,750 mm	ROW 2 ARM = 3,600 mm
40	1,100	1,440
45	1,238	1,620
50	1,375	1,800
55	1,513	1,980
60	1,650	2,160
65	1,788	2,340
70	1,925	2,520
75	2,063	2,700
80	2,200	2,880
85	2,338	3,060
90	2,475	3,240

OIL ARM = 1,230 mm			
US QUARTS	LITRES	KG	INDEX UNITS
6	5.7	5.0	62
7	6.6	6.0	74
8	7.6	7.0	86

CHECK

The CG must be within the envelope given at all times.





CENTRE OF GRAVITY POSITION (mm AFT OF DATUM)
ALLOWABLE CENTRE OF GRAVITY ENVELOPE

To check the loading of the aircraft, total the weights and the moment index units as shown in the example, then plot each total on the centre of gravity envelope.

METHOD

- 1 Take the basic empty weight and its index units from the question.
- 2 Find the moment index of each item on the moment index chart: enter at the item's weight on the vertical scale, move across to the line for its station, and read down to the moment index.
- 3 Add the weights to obtain the gross weight, and the index units to obtain the total moment index.
- 4 On the centre of gravity envelope, enter at the gross weight and move across to the total moment index. If the point falls in the shaded area, the aircraft is correctly loaded.

NOTES

- 1 All passenger seats weigh 5 KG each and may be removed to carry additional cargo or baggage in the cabin.
- 2 The maximum load in the area otherwise occupied by a passenger seat is 82 KG.
- 3 If a passenger seat is removed, adjust the empty weight and the empty moment index.
- 4 1 index unit = 10,000 KG mm. The moment index of an item is its weight multiplied by its arm, divided by 10,000.
- 5 Fuel is at a specific gravity of 0.72.

AIRCRAFT LIMITATIONS

Maximum take-off weight	2,950 KG
Maximum landing weight	2,725 KG
Maximum zero fuel weight	2,630 KG

BALANCE DATA

Mean aerodynamic chord (MAC)	1,900 mm long
Leading edge of the MAC	2,190 mm aft of datum
Centre of gravity range at 2,360 KG or less	2,400 mm to 2,680 mm
Centre of gravity range at 2,950 KG	2,560 mm to 2,680 mm
Between 2,360 KG and 2,950 KG	Linear variation

$$\text{CG (mm aft of datum)} = \text{Total moment index} \times 10,000 \div \text{Gross weight}$$

$$\text{CG (\% MAC)} = (\text{CG} - 2,190) \div 1,900 \times 100$$

CHECK

The centre of gravity must lie in the shaded area at all stages of flight.
Check it at zero fuel weight, at take-off weight and at landing weight.

LOADING DATA

LOCATION	MAXIMUM LOAD	ARM (MM AFT OF DATUM)
Row 1 (seats 1 and 2)	Pilot + 1 passenger	2,290
Row 2 (seats 3 and 4)	2 passengers	3,300
Row 3 (seats 5 and 6)	2 passengers	4,300
Forward compartment	55 KG	500
Left wing compartment	55 KG	3,550
Right wing compartment	55 KG	3,550
Rear compartment	155 KG	5,000
Left main tank	50 US gal	1,780
Right main tank	50 US gal	1,780
Left auxiliary tank	40 US gal	2,800
Right auxiliary tank	40 US gal	2,800

Floor loading intensity, all compartments: 450 KG/m²

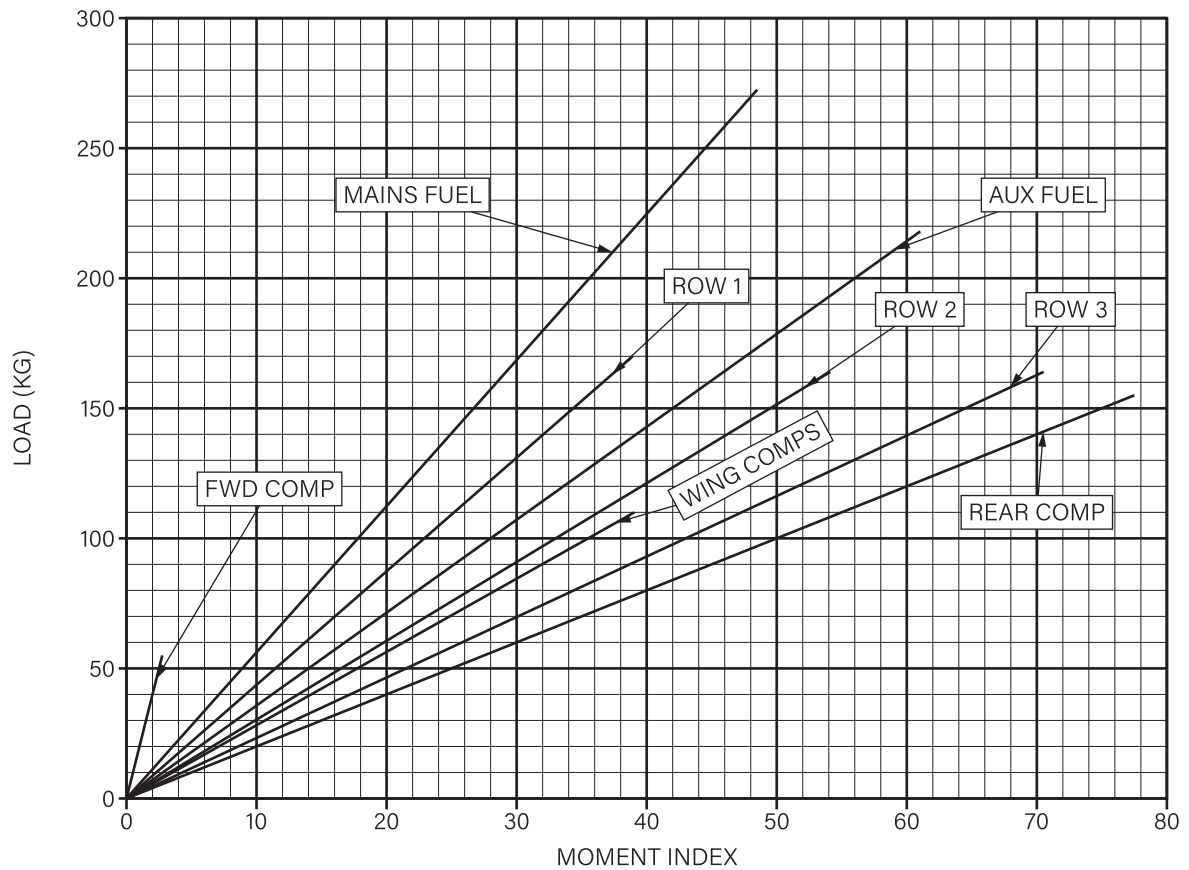
EXAMPLE

	WEIGHT (KG)	ARM (MM)	MOMENT INDEX
Basic empty weight	1,970		478.00
Row 1 (2 occupants)	150	2,290	34.35
Row 2 (2 passengers)	140	3,300	46.20
Row 3 (2 passengers)	130	4,300	55.90
Rear compartment	100	5,000	50.00
Zero fuel weight	2,490		664.45
Fuel in main tanks	200	1,780	35.60
Take-off weight	2,690		700.05
Fuel burn-off (main tanks)	80	1,780	14.24
Landing weight	2,610		685.81

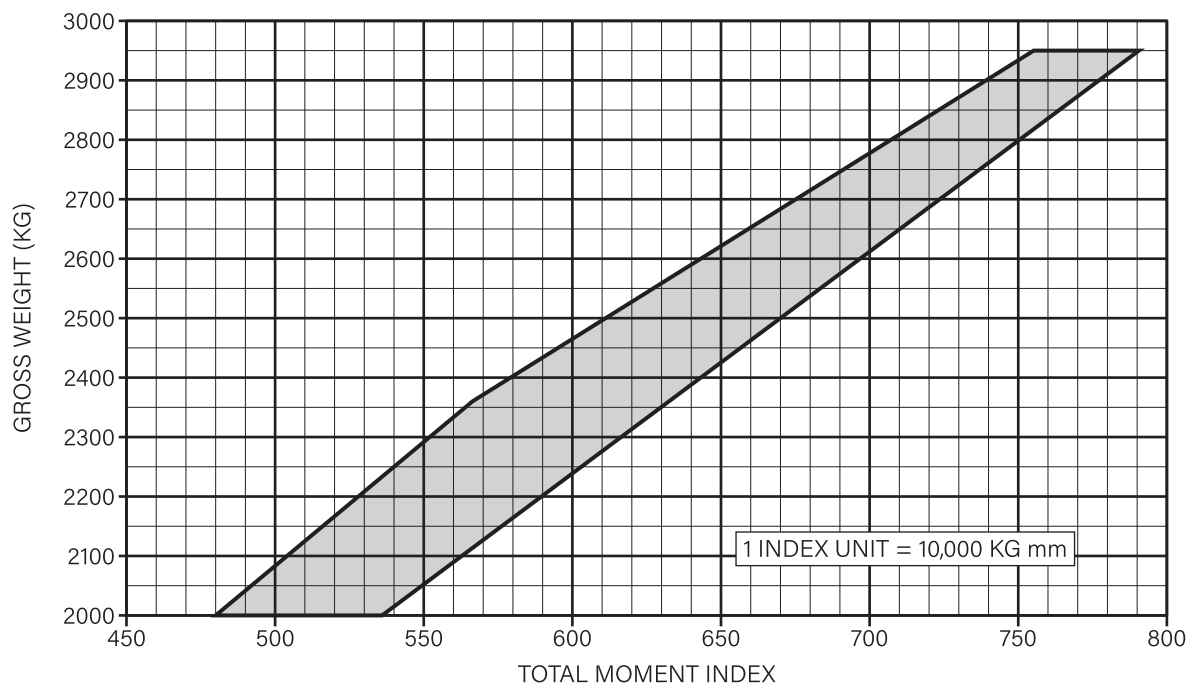
CHECK

Check the centre of gravity is within the shaded area at zero fuel weight, take-off weight and landing weight.

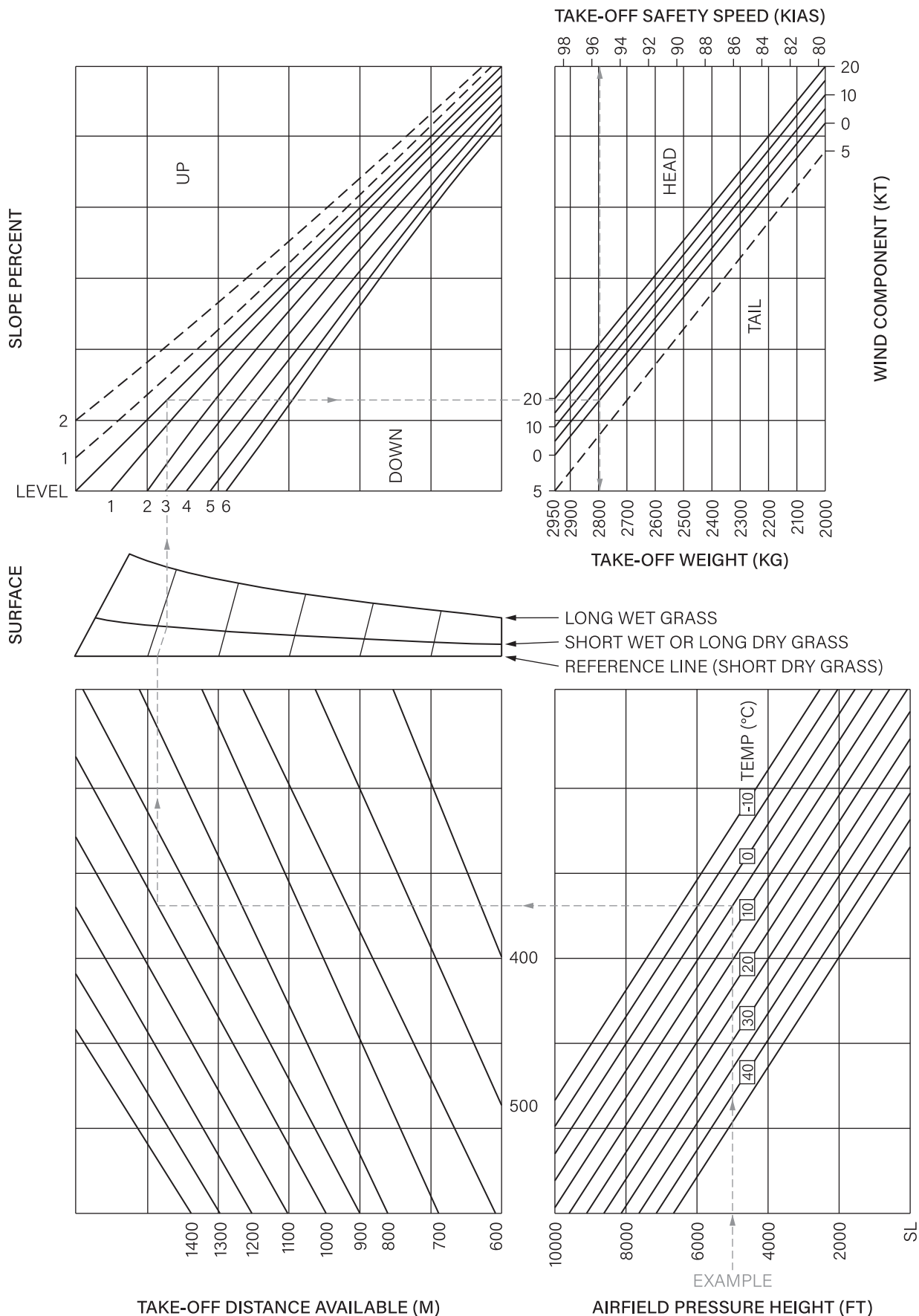
MOMENT INDEX CHART



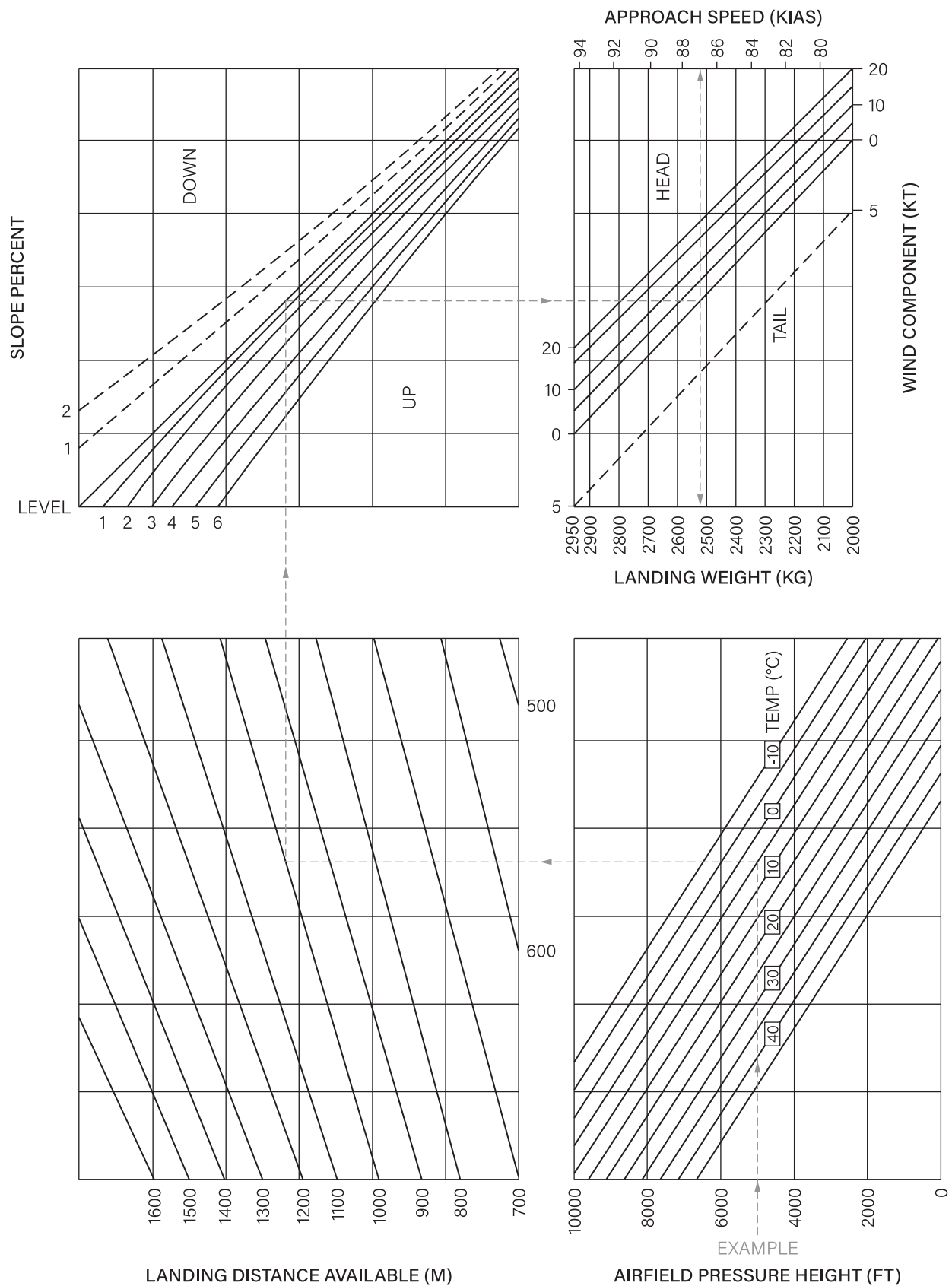
CENTRE OF GRAVITY ENVELOPE



FLAP SETTING	ZERO DEGREES	ENGINE SPEED	3200 RPM
TAKE-OFF SAFETY SPEED	SEE SCALE	MANIFOLD PRESSURE	37.4 IN HG
INCLUDED TAKE-OFF FACTOR	1.22	MAXIMUM CROSSWIND	20 KT



FLAP SETTING	45 DEGREES	INCLUDED LANDING FACTOR	1.26
APPROACH SPEED	SEE SCALE	MAXIMUM CROSSWIND	20 KT







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