RPL/PPL Volume 2

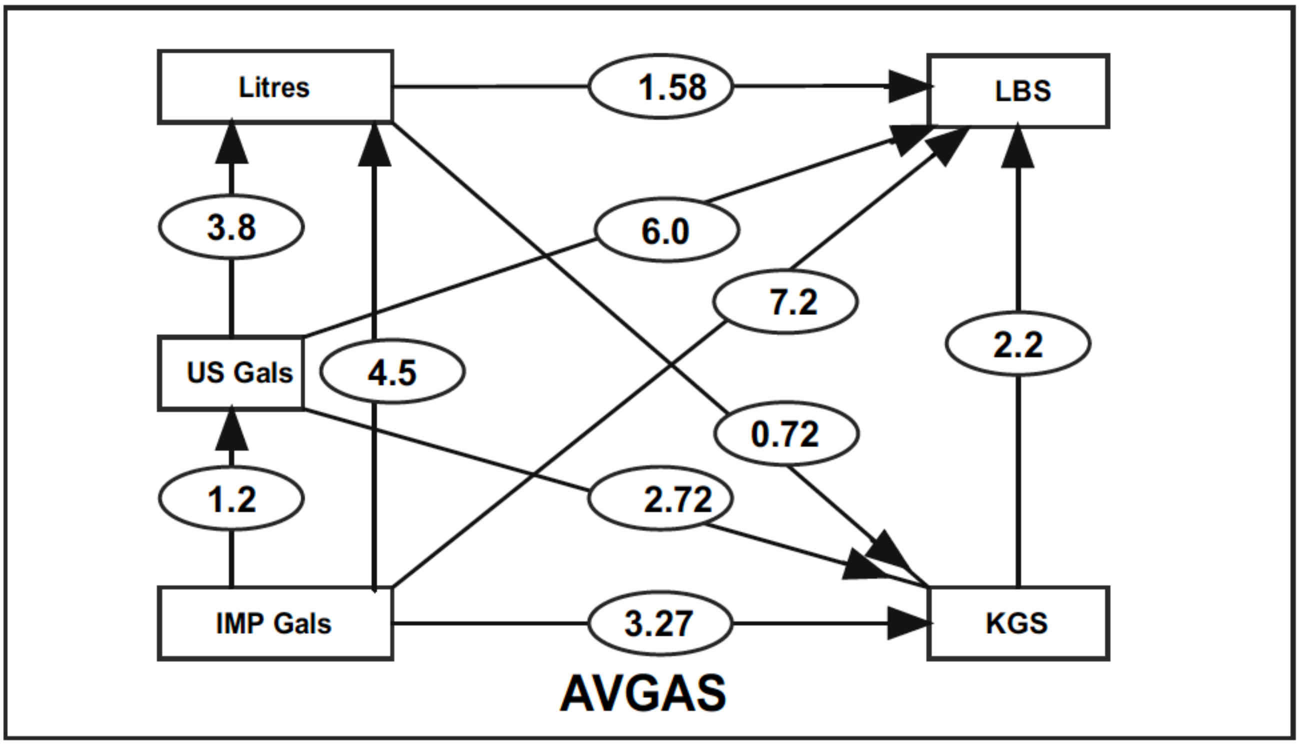
Private Pilot Licence (PPL)

SUPPLEMENT

Pitts Special VH-SIE

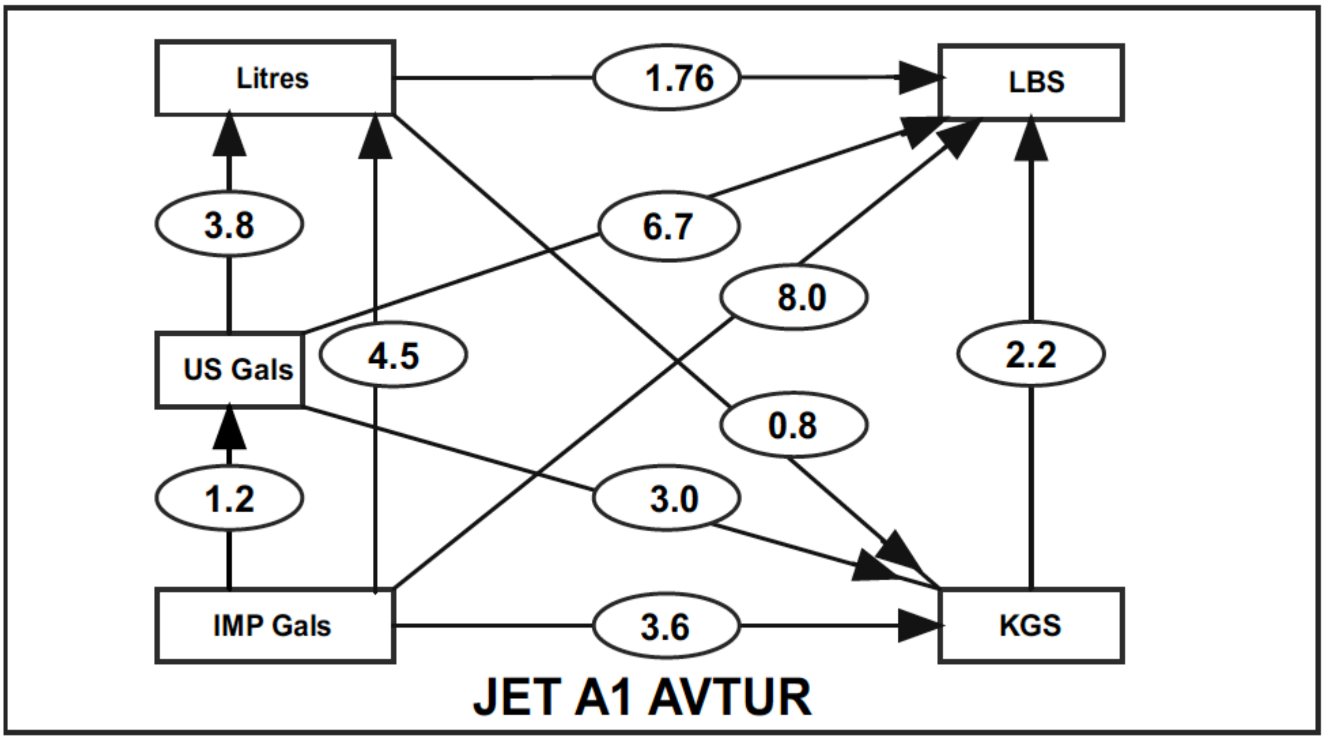
Bob Tait's Aviation Theory School

Piper Pacer VH_MBT

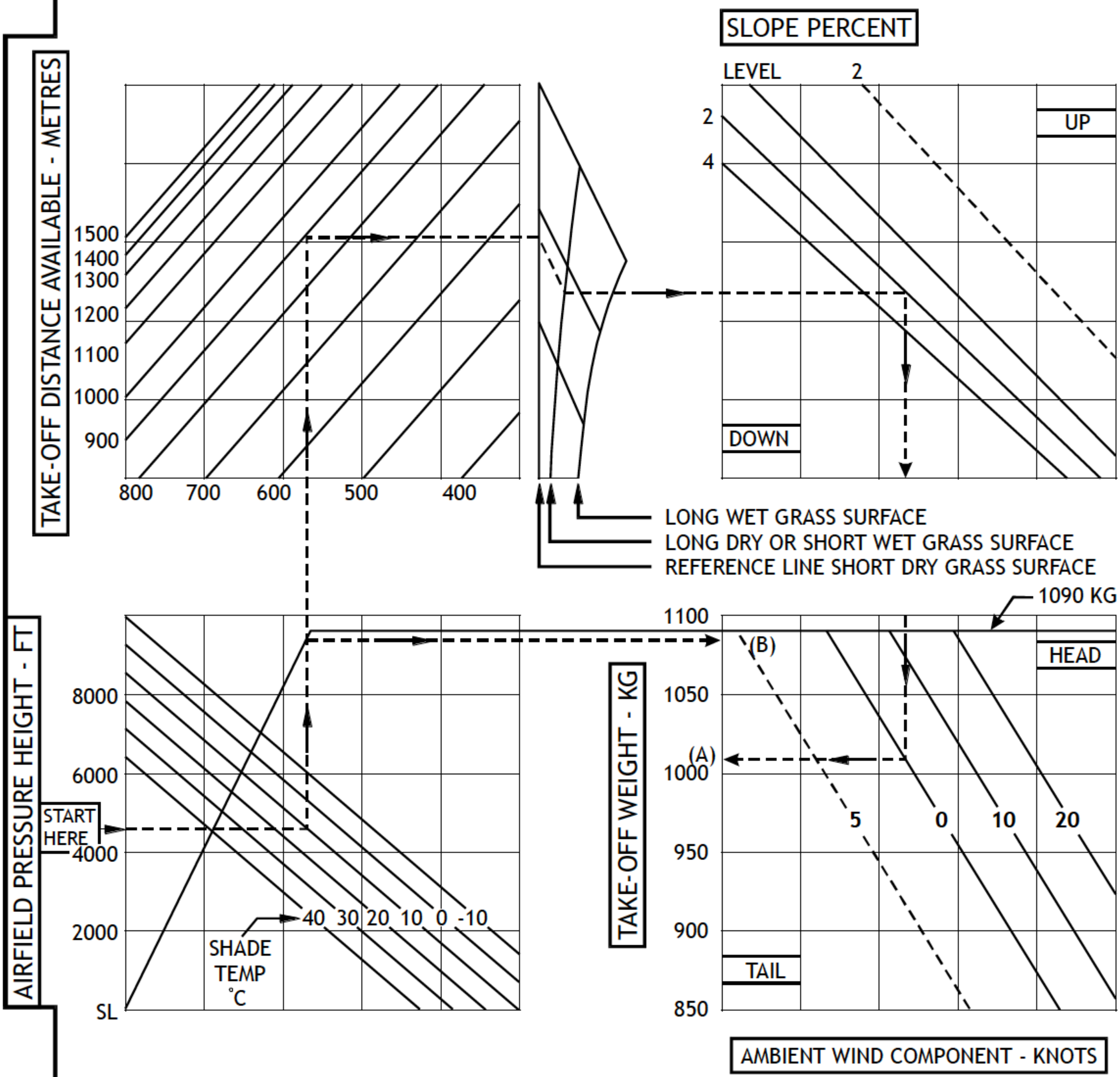


1. To convert:
   multiply by the factor in the "balloon" when moving in the direction of the arrow, or
   divide by that factor if converting in the opposite direction.

2. Fuel SG (0.8 AVTUR and 0.72 AVGAS) is based on ISA temperature at MSL.
   Therefore, fuel weights will be approximate for other than 15DEG Celsius.



TAKEOFF CHART TYPE 1



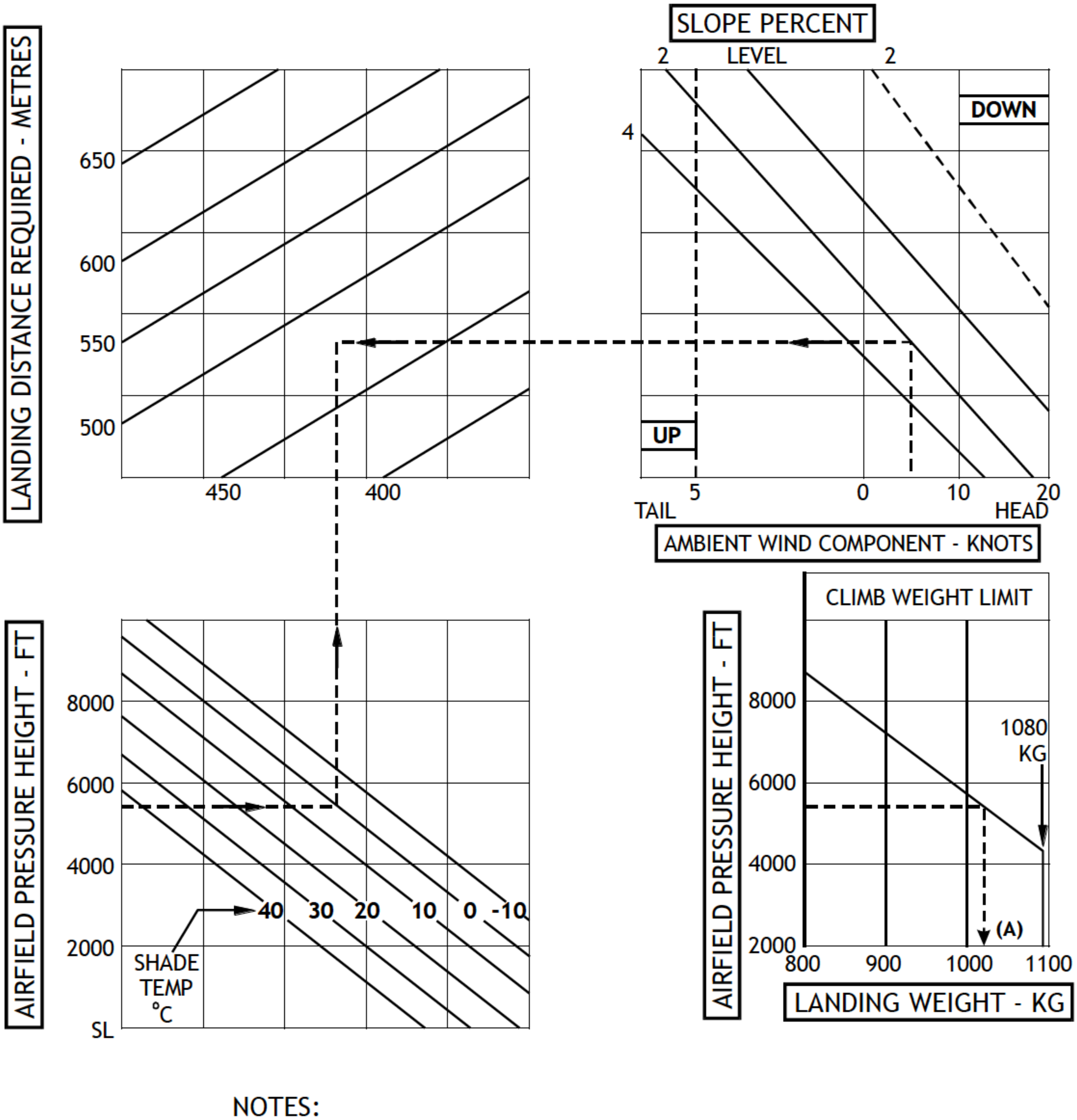
NOTES:

(1) THE GROSS WEIGHT AT TAKE-OFF SHALL NOT EXCEED THE LESSOR OF (A) AND (B).

(2) THE MAXIMUM TAKE-OFF WEIGHT = 1090 KG

POWER TO BE USED	FULL THROTTLE
FLAP SETTING	10 DEGREES
TAKE-OFF SAFETY SPEED	60 KIAS
TAKE-OFF DISTANCE FACTOR	1.15
MAX PERMITTED CROSS WIND	15 KTS

LANDING CHART TYPE 1



NOTES:

(1) THE GROSS WEIGHT AT LANDING SHALL NOT EXCEED (A).

(2) LANDING DISTANCE REQUIRED DOES NOT VARY SIGNIFICANTLY WITH WEIGHT

FLAP SETTING	30 DEGREES
APPROACH SPEED	58 KIAS
LANDING DISTANCE FACTOR	1.15
MAX PERMITTED CROSS WIND	15 KTS

THE LINEAR TAKE-OFF CHART

Another type of take-off chart is shown on the opposite page and in the supplement. This type of chart features a linear presentation instead of the 'run around' charts we used in RPL/PPL VOLUME 1. This is a much poorer type of presentation and much more prone to error. Shown on the opposite page is the working for the following example [Fig 1.12].

Find the maximum take-off weight permitted under the following conditions.

TODA	850 m
Surface short dry grass	
Slope	2% down
Wind	10 knot headwind
Pressure height	6000 ft
Temperature	+16°C

Step 1 Enter the shade temperature scale at +16°C

Step 2 Move vertically up to hit the 6000 ft pressure height line.

[Continue through to the climb weight limit box above and hit the 6000 ft line. Move horizontally to the left and note the climb weight limit for 6%. It is 990 kg.]

Step 3 Make a note of the climb weight limit and continue. Move right from the 6000 ft pressure height line to hit the reference line for surface. If the surface is sealed, go straight through. In this case it is short dry grass, so move parallel to the guide lines until you hit the short dry grass line. From this point, continue horizontally to the slope reference line.

Step 4 From the slope reference line, move back up parallel to the guide lines for an up slope, go straight through for level and move down parallel to the guide lines for a down slope. In this case, move down to 2%, then continue horizontally to the wind reference line.

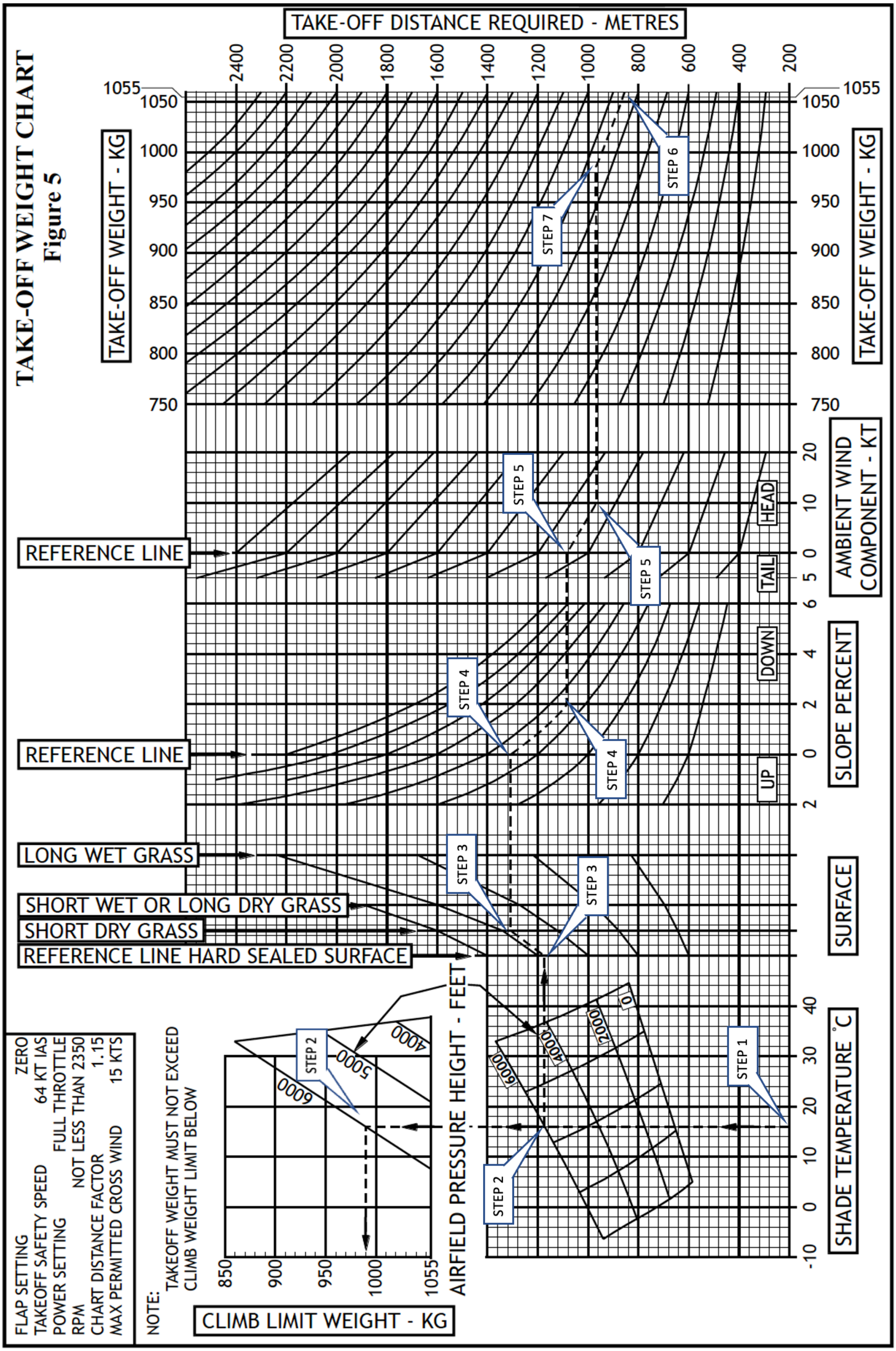
Step 5 From the wind reference line, move back up parallel to the guide lines for a tailwind, go straight through for no wind and move down parallel to the guide lines for a headwind. In this case, move down to the 10 kt headwind line and then continue the line horizontally through the weight box. Leave this line waiting.

Step 6 Now enter the TODA scale on the right hand side of the chart at 850 m and move back up parallel to the guide lines to intersect the line you left waiting in step 5.

Step 7 From this intersection, move vertically down to the take-off weight scale to read the maximum take-off weight of 960 kg.

Because this is less than the figure obtained from the climb weight limit box, it becomes the limiting weight for take-off.

ANSWER **MAXIMUM TAKE-OFF WEIGHT = 960 KG**



TAKE-OFF WEIGHT CHART
Figure 5
TAKE-OFF DISTANCE REQUIRED - METRES
TAKE-OFF WEIGHT - KG
AMBIENT WIND COMPONENT - KT
HEAD
TAIL
SLOPE PERCENT
DOWN
UP
SURFACE
SHADE TEMPERATURE °C
AIRFIELD PRESSURE HEIGHT - FEET
CLIMB LIMIT WEIGHT - KG
REFERENCE LINE
REFERENCE LINE
LONG WET GRASS
SHORT WET OR LONG DRY GRASS
SHORT DRY GRASS
REFERENCE LINE HARD SEALED SURFACE
STEP 1
STEP 2
STEP 3
STEP 4
STEP 5
STEP 6
STEP 7
FLAP SETTING ZERO
TAKEOFF SAFETY SPEED 64 KT IAS
POWER SETTING FULL THROTTLE
RPM NOT LESS THAN 2350
CHART DISTANCE FACTOR 1.15
MAX PERMITTED CROSS WIND 15 KTS
NOTE: TAKEOFF WEIGHT MUST NOT EXCEED CLIMB WEIGHT LIMIT BELOW

THE LINEAR LANDING CHART

The presentation of the linear landing chart is much the same as that of the linear take-off chart. The main difference is that aircraft weight has no effect on the landing distance required. This is often the case with small aircraft, where the increased rolling friction and braking effectiveness after touch-down cancels out the penalty of extra weight.

The following example is shown worked in Fig 1.13.

Given the following conditions

Runway	15/33
Wind	150°M at 10 kt
Slope	4% down to the NW
Airfield pressure height	4000 ft
Shade temperature	14°C

Find the landing distance required.

Step 1 Enter the chart at 14°C.

Step 2 Move vertically up to the 4000 ft pressure height line.

Check for a climb weight limit on the scale above. Read the maximum weight permitted on the left hand scale against the pressure height on the right hand scale. At 4000 ft there is no climb weight limit.

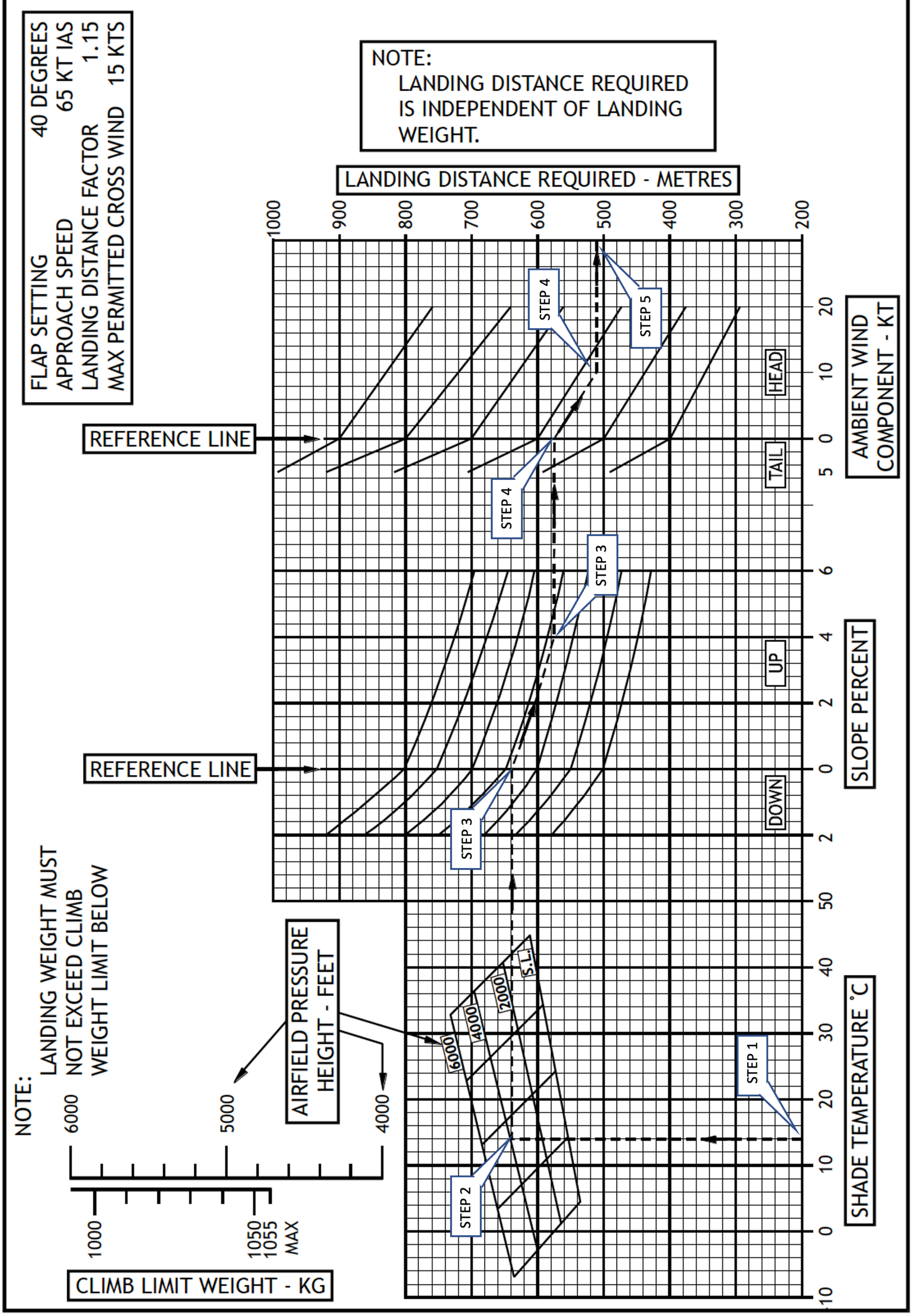
Step 3 Move horizontally to the right to hit the reference line in the slope box. If there is a down slope, move back and up, parallel to the oblique guide lines to the appropriate value. If there is an up slope, move forward and down, parallel to the oblique guide lines to the appropriate value. In this case, the slope is given as 4% down to the north west. Since the wind is coming from the south east, you will be landing up-hill, so move forwards to the 4% up slope line.

Step 4 From this point, move horizontally to the right to hit the reference line in the ambient wind box. If there is a tailwind, move back and up, parallel to the oblique guide lines to the appropriate value. If there is a headwind, move forward and down, parallel to the oblique guide lines to the appropriate value.
In this case, there is a 10 kt headwind so move forward and down to the 10 kt headwind line.

Step 5 From this point, move horizontally to the right to read the landing distance required on the perimeter scale

The landing distance required is just under 510 m.

Landing Chart type 2 - Linear Landing chart



EXAMPLE FOR THE USE OF LOADING SYSTEM ALPHA.

Step 1 Enter the basic empty weight of 1050 kg in the weight column on the right, and enter the top of the chart at the basic index units of -260.

Step 2 Move vertically down until you hit the 'Row 1' line, then move horizontally in the direction of the arrow, in this case left, by an amount equal to the weight in that row. Weight divisions are given as 50 or 77 kilos, use whichever is convenient. In this case, move left for a distance equal to 3 of the 50 kg divisions ie 150 kg. Add 150 kg to the right hand column.

Step 3 Move vertically down again to the forward facing row 2 line. The example gives the weight in row 2 as 160 kg, so move horizontally in the direction of the arrow for a distance equal to 160 kg on the scale. Add 160 kg to the right hand column.

Step 4 Move vertically down to row 3 and then horizontally in the direction of the arrow for 120 kg on that weight scale. Add 120 kg to the right hand column.

Step 5 Move vertically down to the nose locker line and left for 40 kg on the scale. Add 40 kg to the right hand column.

Step 6 There is no rear baggage and the fuel in this particular aircraft is on the datum, so it has no arm. It therefore generates no moment. Add the weight of the fuel [113 kg] to the right hand column. Drop the line from this position down into the shaded envelope at the bottom of the chart.

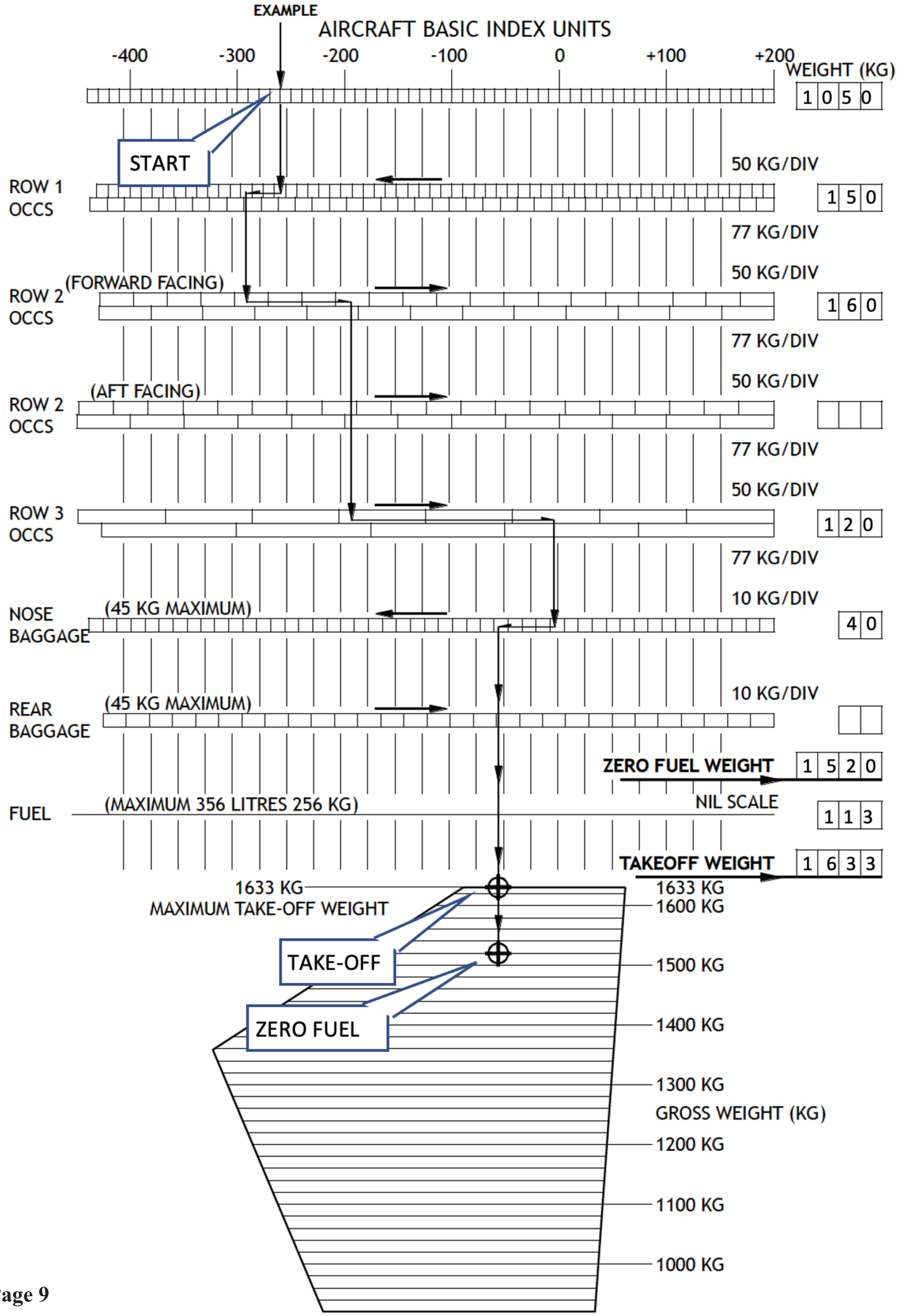
Step 7 Add the weights in the right hand column to get a zero fuel weight total of 1520 kg and a take-off total of 1633 kg.

Enter the vertical weight scale on the right hand side of the shaded envelope at 1520 kg and move horizontally to intercept the vertical line which resulted from step 6 above. This locates point B. Because it falls within the shaded envelope, you can be sure the aircraft is safely within limits with no fuel on board.

Now enter the same scale at the take-off weight of 1633 kg. Move horizontally to intersect the line which resulted from step 6 above. This locates point A. It is on the maximum take-off weight limit for the aeroplane, but it falls within the shaded envelope. The aircraft is safely within limits after the fuel has been added.

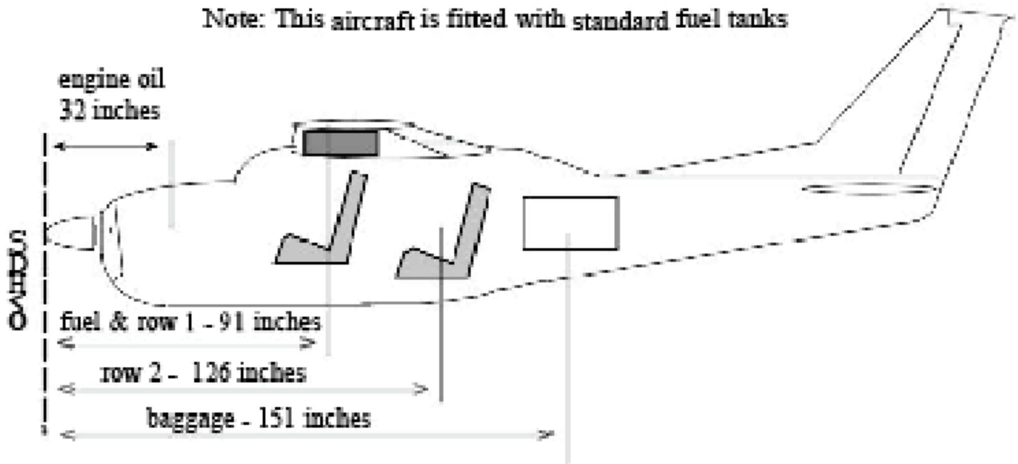
Because both A and B are within the envelope, you can be sure the aircraft will remain in balance throughout the flight.

LOADING SYSTEM ALPHA
Figure 7



LOADING SYSTEM BRAVO

This system has been designed for a four place aeroplane like the one illustrated below.



In this case, the empty aircraft weight does not include engine oil, so it must be included as a weight item in any balance calculation. The weight of oil would have to be given in the examination question, but it would normally be about 15 lbs.

To use this system, it is necessary to set up a table [called a load sheet], listing the weight, arm and moment about the datum for each weight item. You can get the moment index by multiplying each item of weight by its arm [given in the example], and dividing the result by 1000, or you can obtain a moment index from the loading graph.

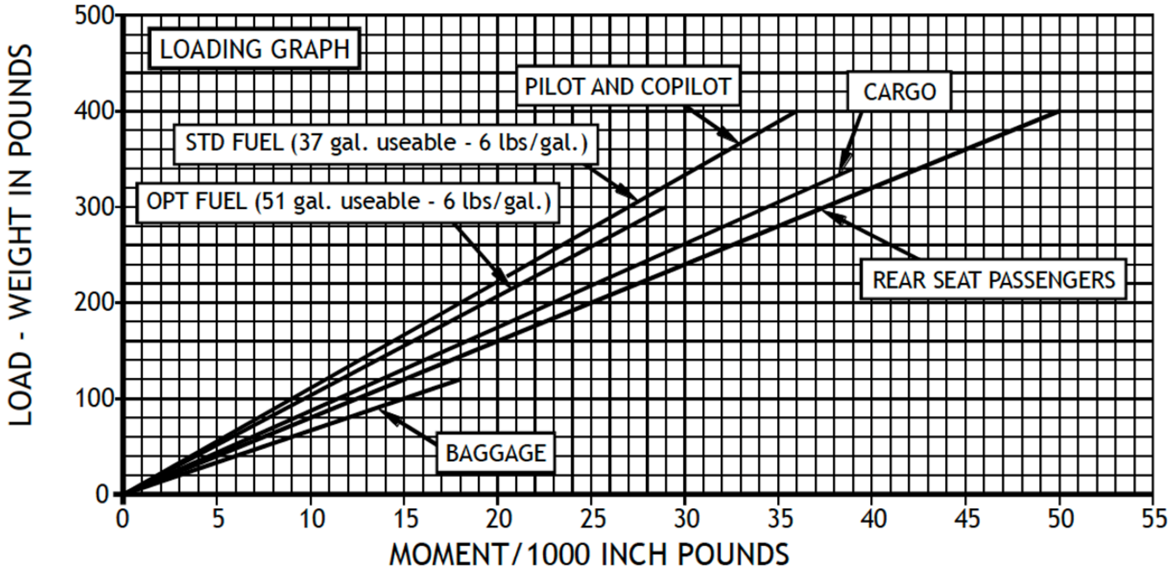
In the example given below, the empty weight is given as 1260 lbs and the empty moment index is given as 100.80. In practice, these figures would be obtained from the aircraft's flight manual. Working through this load sheet example, it will look like this:

ITEM	WEIGHT [lbs]	ARM	MOMENT INDEX
Empty aircraft	1260		100.80
Oil	15	32	.48
Fuel	222	91	20.20
Row 1	320	91	29.12
Row 2	350	126	44.10
Baggage	25	151	3.78
Take-off	**2192**		**198.48**

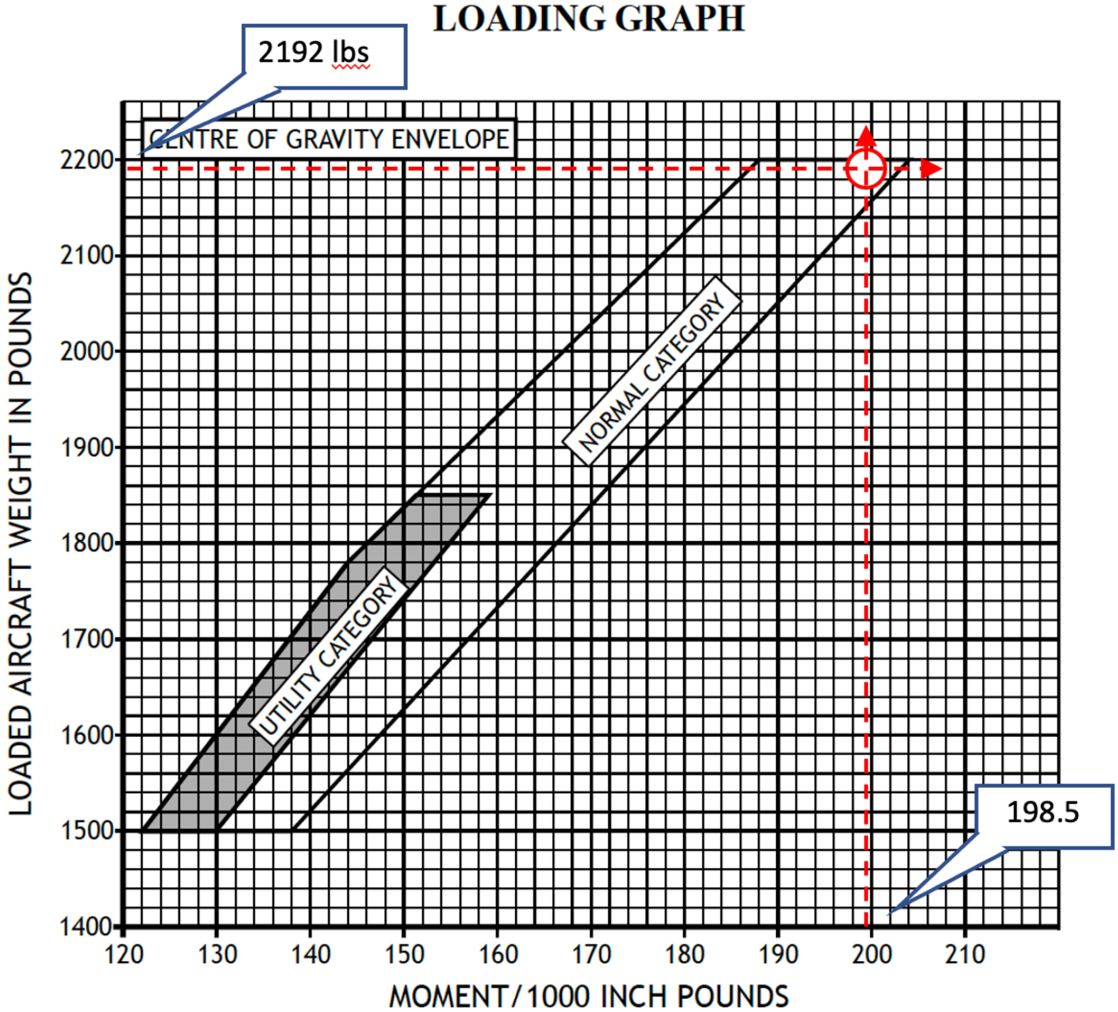
Plot the total weight and total moment on the centre of gravity envelope opposite. If the point falls within the envelope, the aeroplane is safe to fly. Note that two envelopes are given, one for normal and one for utility category. Utility category is defined in the flight manual. Normally the aircraft is considered to be in the utility category providing there are no aft passengers and, in some cases, a limit to the fuel on board. If the aircraft is loaded in the utility category, it is permitted to perform specified training manoeuvres such as intentional stalls, spins and some gentle aerobatic type manoeuvres such as wing-overs. Note that the aft limit is brought much further forward and the maximum weight is restricted in the utility category.

LOADING SYSTEM BRAVO
Figure 8

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 Centre of Gravity Envelope to determine acceptibility.



LOADING GRAPH



CENTRE OF GRAVITY ENVELOPE

LOADING SYSTEM CHARLIE

Charlie is very similar to loading system Bravo except for the centre of gravity envelope.

In the case of loading system Bravo, the envelope is presented as a graph of weight against moment. In loading system Charlie, the envelope is presented as a graph which plots weight against centre of gravity position [or arm].

Let's work through the example given below referring to the envelope on the opposite page.

EXAMPLE: We begin by completing a load sheet which totals weight and moment index as usual. Note that in this case the moment index is obtained by multiplying weight in kg by arm in mm and dividing the result by 100 [not 1000 as with Bravo]. The empty aircraft weight and moment are given as 687 kg and 19 522 index units.

ITEM	WEIGHT	ARM	MOMENT
Empty aircraft	687		19 522
Full oil*	7	1230	86
1 pilot and 1 passenger in Row 1	140	2750	3 850
2 passengers in Row 2	160	3600	5760
Baggage	20	4210	842
ZFW	**1014**		**30 060**
Fuel	99	2950	2 920
Take-off	**1113**		**32 980**

* Note that like Bravo, this loading system does not include engine oil with the empty aircraft weight. Oil must be added as an item in the load sheet for each calculation [Please don't ask me why?].

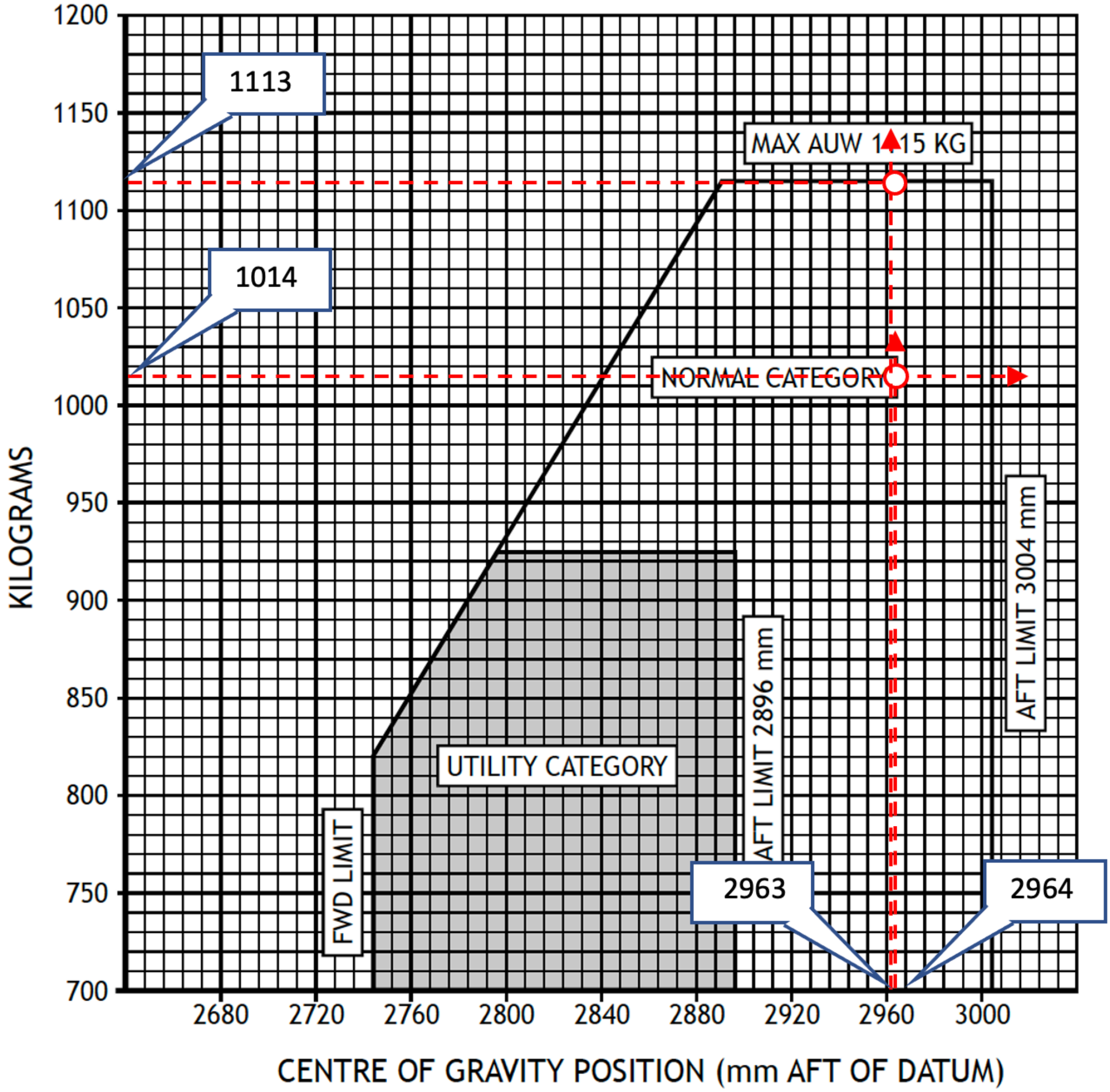
To check the Zero Fuel Weight condition, it is necessary to find the centre of gravity position [ie arm], when the weight is 1014 kg and the moment is 30 060 index units.

Since the weight multiplied by the arm gives the moment, it follows that the moment divided by the weight gives the arm. To find the ZFW centre of gravity position as mm aft of the datum, we must multiply 30 060 by 100 to turn it into kgmm, then divide it by the weight.

30 060 x 100 ÷ 1014 = 2964 mm aft of the datum. When we go to the centre of gravity envelope, we plot the weight of 1014 kg against the centre of gravity position of 2964, call this point A.

Now check the take-off condition. The centre of gravity position at take-off is 32 980 x 100 ÷ 1113 = 2963 mm aft of the datum. Plot 1113 kg against 2963 mm and call it Point B.

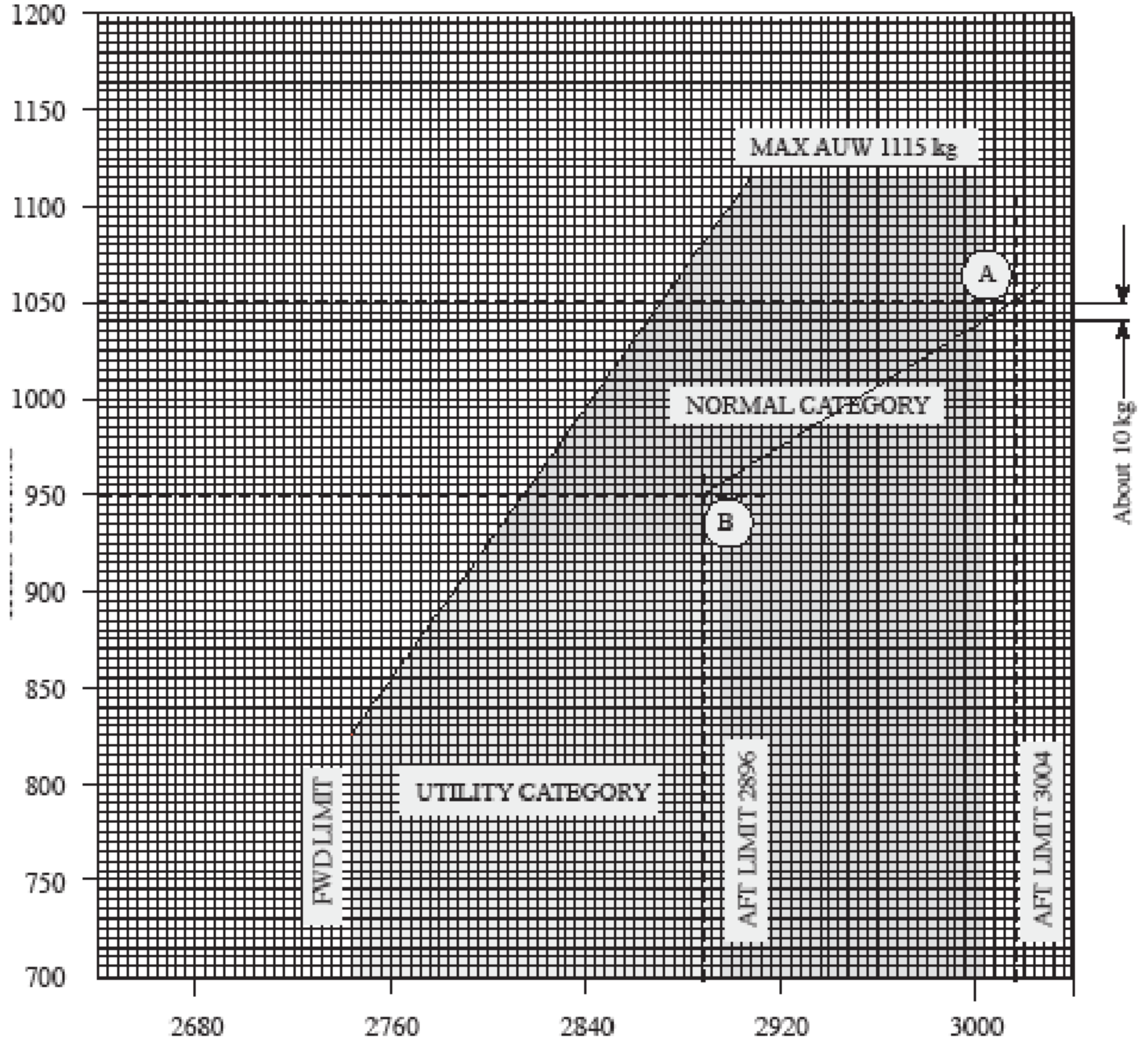
Since both point A and point B fall within the envelope, we can be sure that the aircraft will remain in balance at all stages of the flight.



ALLOWABLE CENTRE OF GRAVITY ENVELOPE

LOADING SYSTEM CHARLIE

Fig 1.27



Another example
An aircraft with a Charlie loading system is loaded at take-off as follows:
Gross weight 1050 kg Moment Index 31668.

Find the minimum amount of weight that must be off-loaded from the baggage compartment to place the aircraft within the centre of gravity limits [Fig 1.27].

Solution :
The centre of gravity at present is 31 668 x 100 ÷ 1050 = 3016 mm aft of the datum. Plot this point and call it point A. This is outside the aft limit of the centre of gravity envelope. Subtract any convenient weight from the baggage compartment [say 100 kg].*

ITEM	WEIGHT	ARM	MOMENT
Present condition	1050	3016	31 668
Subtract from baggage*	-100	4210	-4210
New condition	950	2890	27458

The centre of gravity position is now 27 458 x 100 ÷ 950 = 2890 mm aft of the datum. Plot this point and call it point B. Join point A to point B and note the point where this line crosses the back of the envelope. Estimate the weight loss this represents on the weight scale. It is about 10 kg. So 10 kg must be off loaded from the baggage compartment.

NOTE: *The examination will provide you with this table to allow you to obtain index units for various weights in various locations. However it is faster and easier to calculate the index units by multiplying the weight in a given location by the relevant arm and then dividing by 100 as shown in the example on page 10.14 at example will be given to you in the examination.*

OBTAINING INDEX UNITS FOR LOADING SYSTEM CHARLIE

FUEL [ARM : 2950]

LITRES	KG	INDEX UNITS
20	14	413
40	28	826
60	43	1,268
80	57	1,682
100	71	2,095
120	85	2,507
140	99	2,920
160	114	3,363
180	129	3,806
200	142	4,189
216	153	4,513

BAGGAGE [ARM: 4210]

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

OCCUPANTS

	ROW 1. [ARM: 2750]	ROW 2 [ARM: 3600]
KG	INDEX UNITS	INDEX UNITS
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