DOCUMENT
GSM-G-CPL.022

DOCUMENT TITLE

GENERAL OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 5 – LOADING SYSTEM BRAVO

Version 1.0
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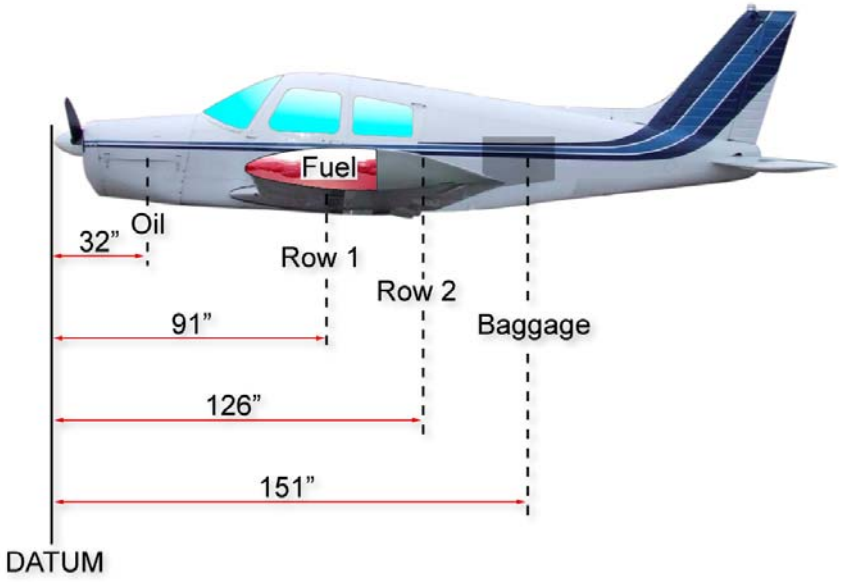
LOADING SYSTEM BRAVO (4 SEATS)

INSTRUCTIONS FOR USE

To check the loading of the aircraft before Take-Off, calculate the total weight and total moments as shown in the examples to follow.

Plot the total weight and moment on the centre of gravity envelope chart and if the C of G location is within the envelope the loading is acceptable, if not some rearranging may be necessary.

Example Aircraft used for Exam Bravo



AIRCRAFT LIMITATIONS

Maximum Take-off weight :

Normal category	1000 kg / 2200lbs
Utility category	841 kg / 1850lbs
Maximum baggage compartment	53 kg / 120 lbs

Notes:

1. The aircraft is fitted with standard fuel tanks (37 US Gallons)
2. Empty weight includes unusable fuel and undrainable oil
3. Obtain Moment/ 1000 inch pounds from load graph

Example	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	0.48
Row 1 (Pilot & co pilot)	320	91	29.12
Row 2 (Pax)	350	126	44.10
Baggage	25	151	3.78
Zero Fuel Weight	1970		178.30
Fuel (141 litres)	222	91	20.20
Take-off weight	2192		198.30

BRAVO EXAMPLE 1

Step 1

Enter the example weight information onto the load sheet. The aircraft data weights, arm and moment /1000inlb (index unit) you will be given for any of the questions.

Load Sheet

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15		
Row 1 (Pilot & co pilot)	320		
Row 2 (Pax)	350		
Baggage	25		
Zero Fuel Weight	1970		
Fuel (141 litres)	222		
Take-off weight	2192		

Step 2

Enter the aircraft ARMS (Stations) onto the load sheet, these can be found in the sample question or on the example bravo aircraft, both shown previously.

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	
Row 1 (Pilot & co pilot)	320	91	
Row 2 (Pax)	350	126	
Baggage	25	151	
Zero Fuel Weight	1970		
Fuel (141 litres)	222	91	
Take-off weight	2192		

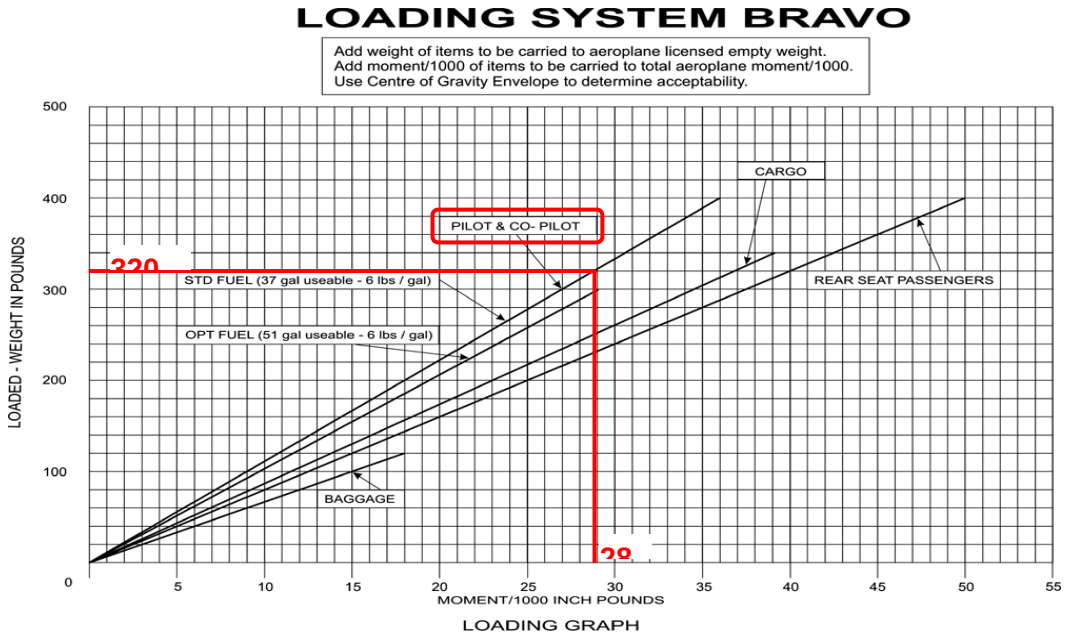
Step 3

Enter the index unit onto the load sheet, this information may not be given so you will have to find it.

There are a couple of ways of finding the index unit, remember INDEX UNIT is what we call the MOMENT divided by a specified number, in this case 1000.

First method is to use the Bravo Index Chart shown below :

The method of use is to locate the weight on the left hand side of the graph. The example gives Row 1 as 320 lbs this is the entry point, from there draw a horizontal line to the right until it intersects the diagonal line representing the load station, at this intersection draw a line vertically down to the bottom scale and read of the Index unit. The figures shown are IU, they are moments divided by a specified number (1000)



Enter this Index Unit number (28.8) in the column marked Moment/1000in lbs against the row relevant to the station (Row 1).

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	
Row 1 (Pilot & co pilot)	320	91	28.8
Row 2 (Pax)	350	126	
Baggage	25	151	
Zero Fuel Weight	1970		
Fuel (141 litres)	222	91	
Take-off weight	2192		

As we can see there is a discrepancy between the index unit given in the example 29.12iu and what we have extracted from the Bravo index chart 28.8iu

Example	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	0.48
Row 1 (Pilot & co pilot)	320	91	29.12
Row 2 (Pax)	350	126	44.10
Baggage	25	151	3.78
Zero Fuel Weight	1970		178.30
Fuel (141 litres)	222	91	20.20
Take-off weight	2192		198.30

This is because the example is worked out mathematically which is much more accurate than a graphical representation, this leads us to the second method of calculating the IU :

To refresh our memory on the formula for calculating a moment :

Weight x Arm = Moment

We need to take this a step further and find the Index Unit :

Moment ÷ Specified number (1000 for Bravo) = Index Unit

The calculation with numbers :

320 (weight lbs) x 91 (arm inches) = 29120 (moment in lbs)

29120 (moment in lbs) ÷ 1000 (specified number) = 29.12 (index unit)

Enter this Index Unit number (29.12) in the column marked Moment/1000in lbs against the row relevant to the station (Row 1).

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	
Row 1 (Pilot & co pilot)	320	91	29.12
Row 2 (Pax)	350	126	
Baggage	25	151	
Zero Fuel Weight	1970		
Fuel (141 litres)	222	91	
Take-off weight	2192		

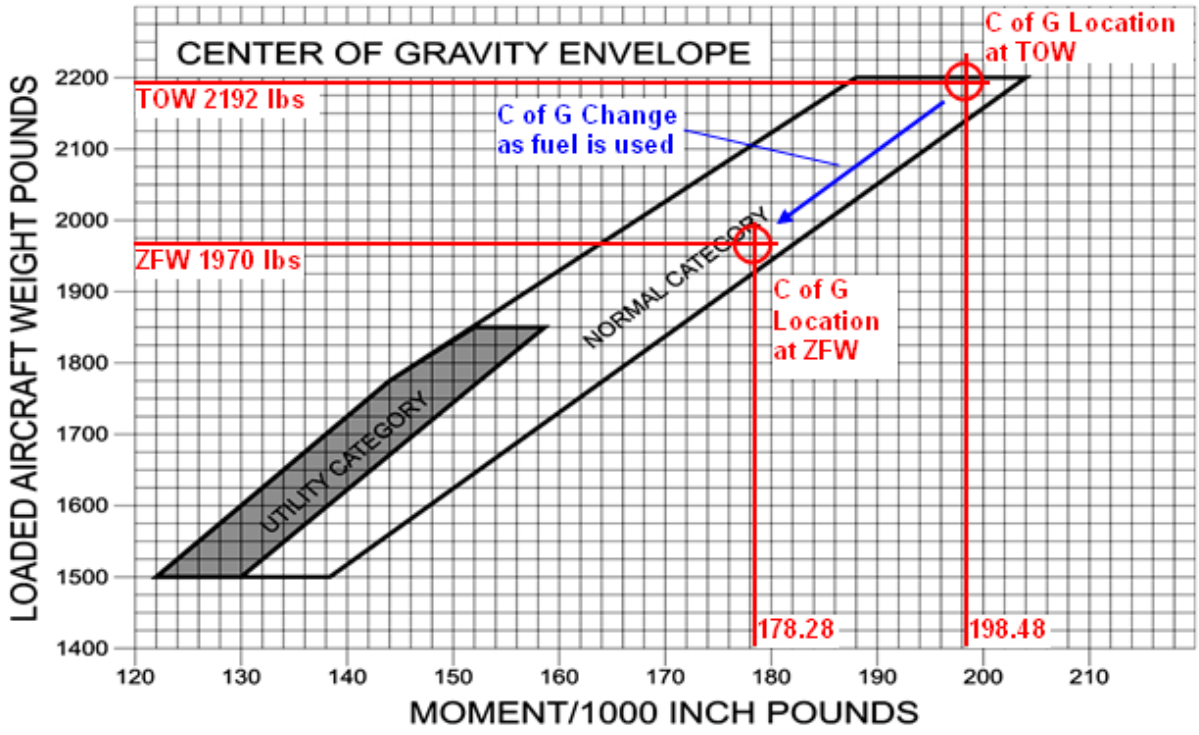
Now complete the Load sheet by either method, Mathematically is recommended as it is more accurate :

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1260	80	100.80
Oil	15	32	0.48
Row 1 (Pilot & co pilot)	320	91	29.12
Row 2 (Pax)	350	126	44.10
Baggage	25	151	3.78
Zero Fuel Weight	1970		178.28
Fuel (141 litres)	222	91	20.20
Take-off weight	2192		198.48

Step 4

Plot the Zero fuel weight & Zero fuel weight IU on the Bravo Centre of Gravity envelope along with the Take-off weight & take-off weight IU

	Weight (lbs)	Arm (in)	Moment/1000in lb
Zero Fuel Weight	1970		178.28
Take-off weight	2192		198.48



Centre of gravity is within the envelope at all stages of flight

BRAVO EXAMPLE 2 : ADDING WEIGHT

What is the maximum baggage that could be carried on this flight and remain within weight and balance limitations ?

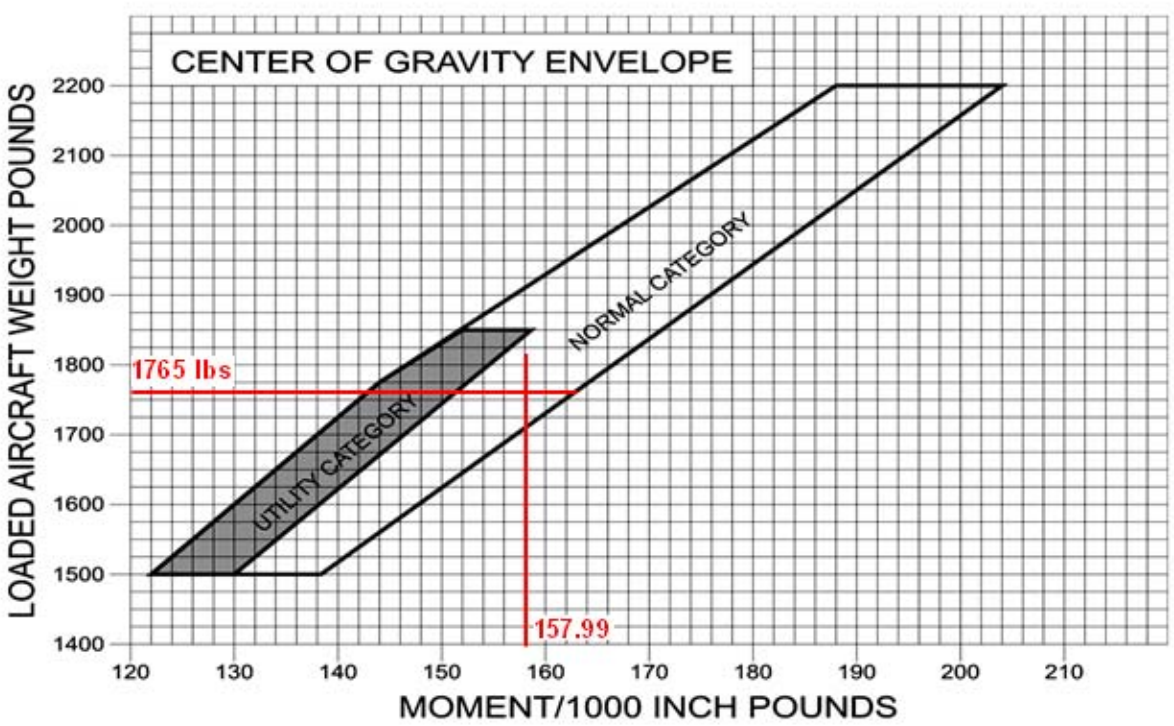
Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1240	80	100.80
Oil	15	32	
Row 1 (Pilot @ 170lbs)	170	91	
Row 2 (2 Pax @ 170 each)	340	126	
Baggage		151	
Zero Fuel Weight			
Fuel (141 litres)	222	91	
Take-off weight			

Start with a load sheet, fill in the blanks and check the take off weight to see how much weight you have available.

Take off weight prior to baggage being added is 1987 lbs, the maximum take off weight is 2200lbs (no performance considerations) this would mean that as far as weight is concerned we could carry the maximum in the baggage locker of 120 lbs.

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1240	80	100.80
Oil	15	32	0.48
Row 1 (Pilot @ 170lbs)	170	91	15.47
Row 2 (2 Pax @ 170 each)	340	126	42.84
Baggage		151	157.99
Zero Fuel Weight	1765		
Fuel (141 litres)	222	91	20.20
Take-off weight	1987		178.19

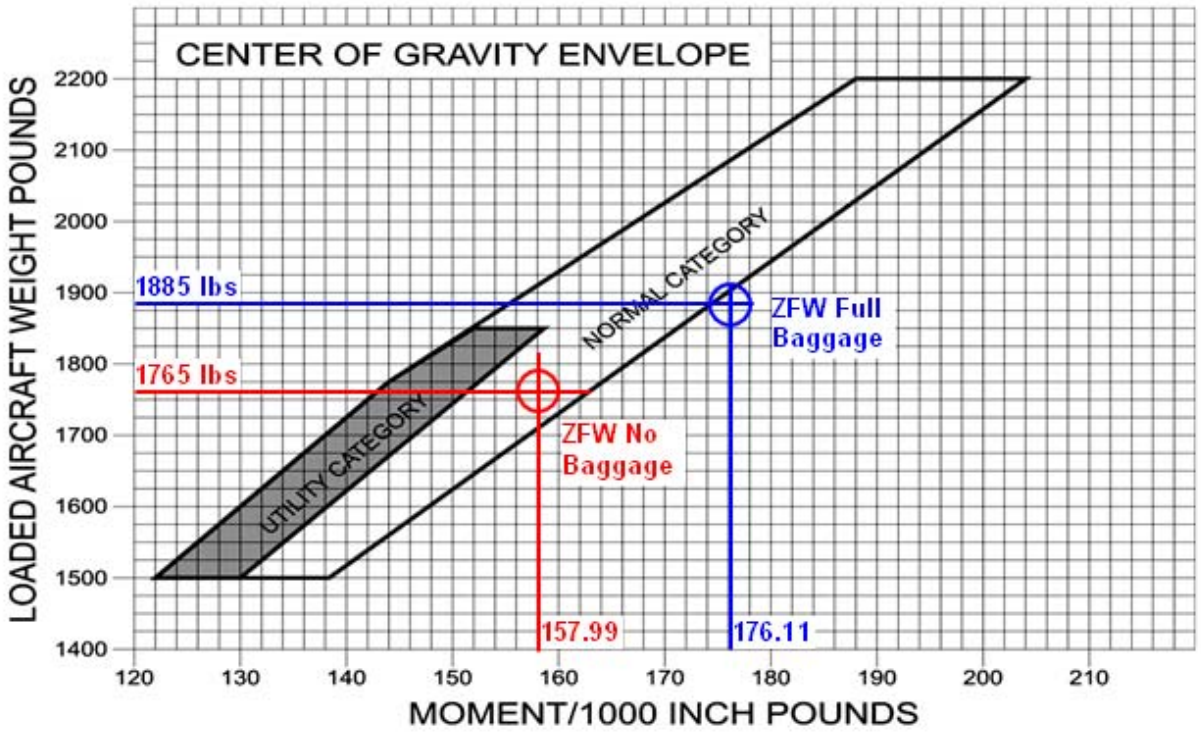
We now need to consider the balance side of the equation, first at Zero Fuel Weight by plotting on the C of G envelope



Zero Fuel weight with no baggage is within the envelope we also know we can place 120 lbs in the rear locker. Let's try, this will change our calculations on the load sheet.

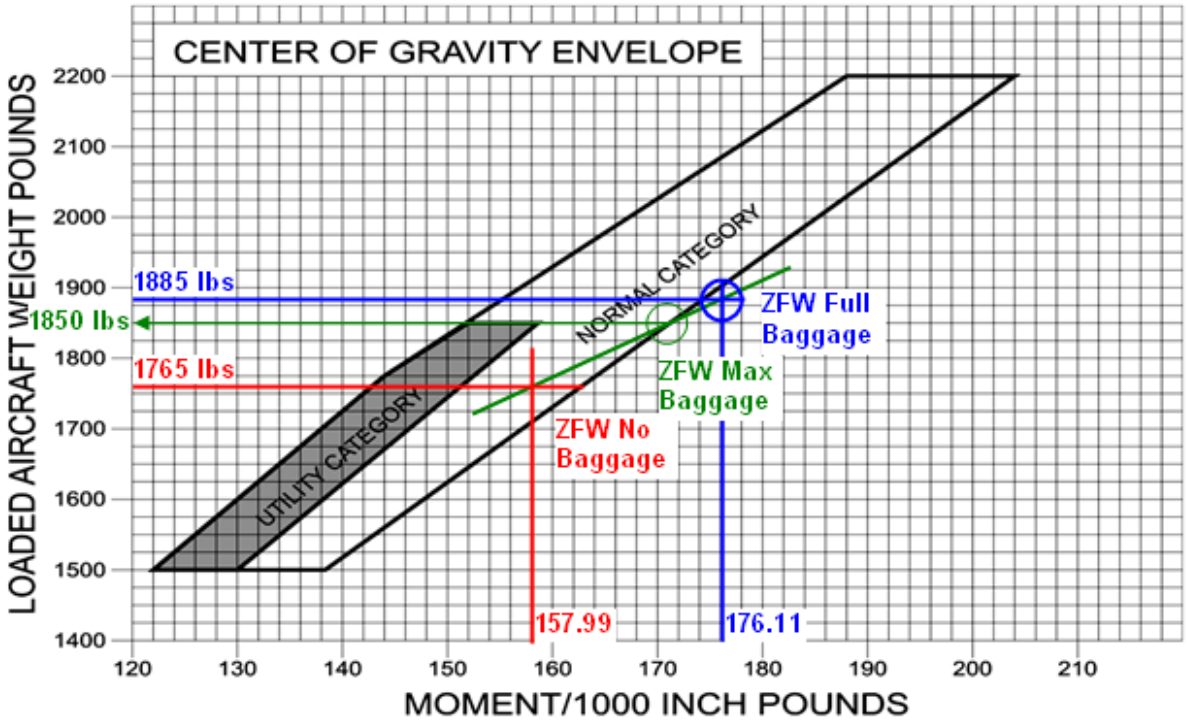
Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1240	80	100.80
Oil	15	32	0.48
Row 1 (Pilot @ 170lbs)	170	91	15.47
Row 2 (2 Pax @ 170 each)	340	126	42.84
Baggage	120	151	18.12
Zero Fuel Weight	1885		176.11
Fuel (141 litres)	222	91	20.20
Take-off weight			

Plot the new Zero Fuel Weight (with full baggage 120lbs) on to the Centre of Gravity envelope. There are now two Zero fuel Weights on the envelope.



The next step is to draw a diagonal line between the two Zero fuel Weights, where this diagonal line intersects the aft limit of the envelope is the maximum one could place in the rear locker and remain in balance.

From this intersection draw a horizontal line to the weights on the left hand side of the C of G envelope, read off the weight in this case 1850 lbs.

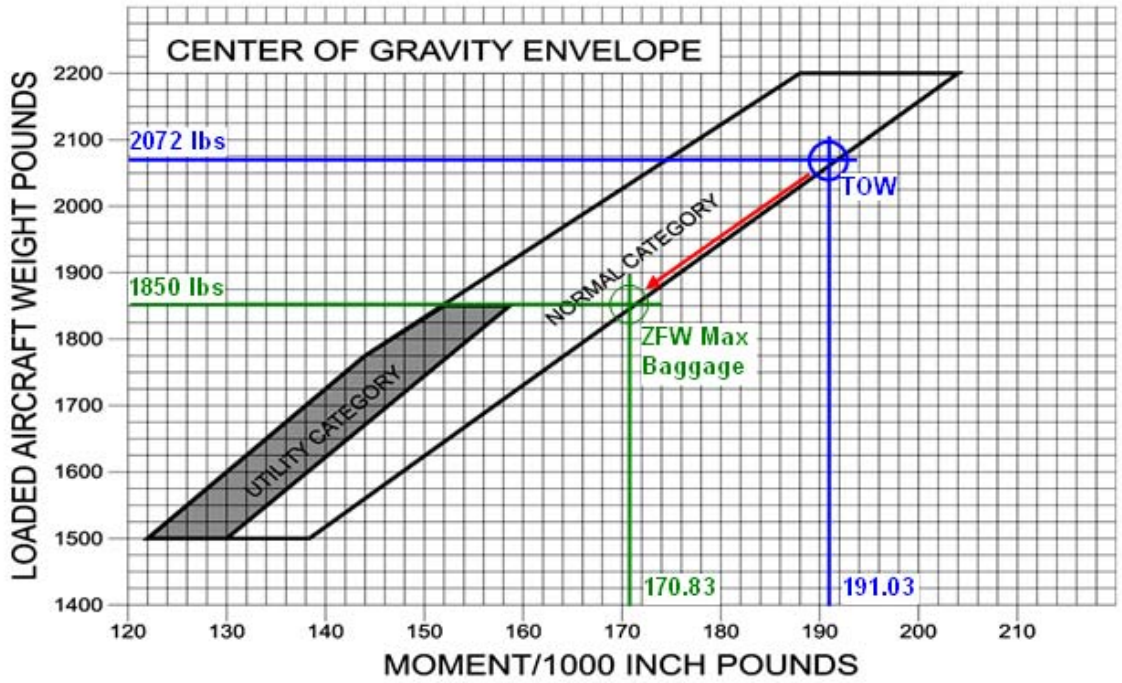


Subtract this weight off 1850 lbs from your Zero fuel Weight with no bags of 1765 lbs leaving a maximum baggage allowance of 85lbs.

All is not over yet, you have found that 85 lbs is the maximum baggage at a Zero fuel Weight, we need to know that take-off weight will also be within limits.

Re calculate the load sheet with new Zero fuel Weight and new Take-off weight then plot onto the C of G envelope, to ensure flight is safe at all stages.

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1240	80	100.80
Oil	15	32	0.48
Row 1 (Pilot @ 170lbs)	170	91	15.47
Row 2 (2 Pax @ 170 each)	340	126	42.84
Baggage	85	151	12.83
Zero Fuel Weight	1850		170.83
Fuel (141 litres)	222	91	20.20
Take-off weight	2072		191.03



BRAVO EXAMPLE 3 : ARE YOU SAFE

You are taking a friend on a flight to a neighbouring airfield you friend wishes to do some limited aerobatics over the departure airfield and also at the destination airfield.

- Aerobatics are only possible in Utility category.
- The flight will consume 120 lbs of fuel leaving 80lbs for aerobatics at the destination
- Is this Possible?

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1280	80	
Oil	15	32	
Row 1 (Pilot @ 170lbs)	340	91	
Row 2 (2 Pax @ 170 each)		126	
Baggage	120	151	
Zero Fuel Weight			
Fuel (141 litres)	200	91	
Take-off weight			

Load sheet x 2 : one for departure and destination

DEPARTURE LOAD SHEET

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1280	80	102.4
Oil	15	32	0.48
Row 1 (Pilot @ 170lbs)	340	91	30.94
Row 2 (2 Pax @ 170 each)		126	
Baggage	120	151	18.12
Zero Fuel Weight	1755		151.94
Fuel (141 litres)	200	91	18.20
Take-off weight	1955		170.14

You can see from the load sheet that the take off weight at departure will be 1955 lbs, this will exceed the limits of utility category of 1850 lbs. This is without plotting on the load sheet Aerobatics NOT possible at DEPARTURE

Aircraft Limitations

Maximum Take - off weight

Normal category	1000 kg / 2200 lbs
Utility category	841 kg / 1850 lbs
Maximum baggage compartment	53 kg / 120 lbs

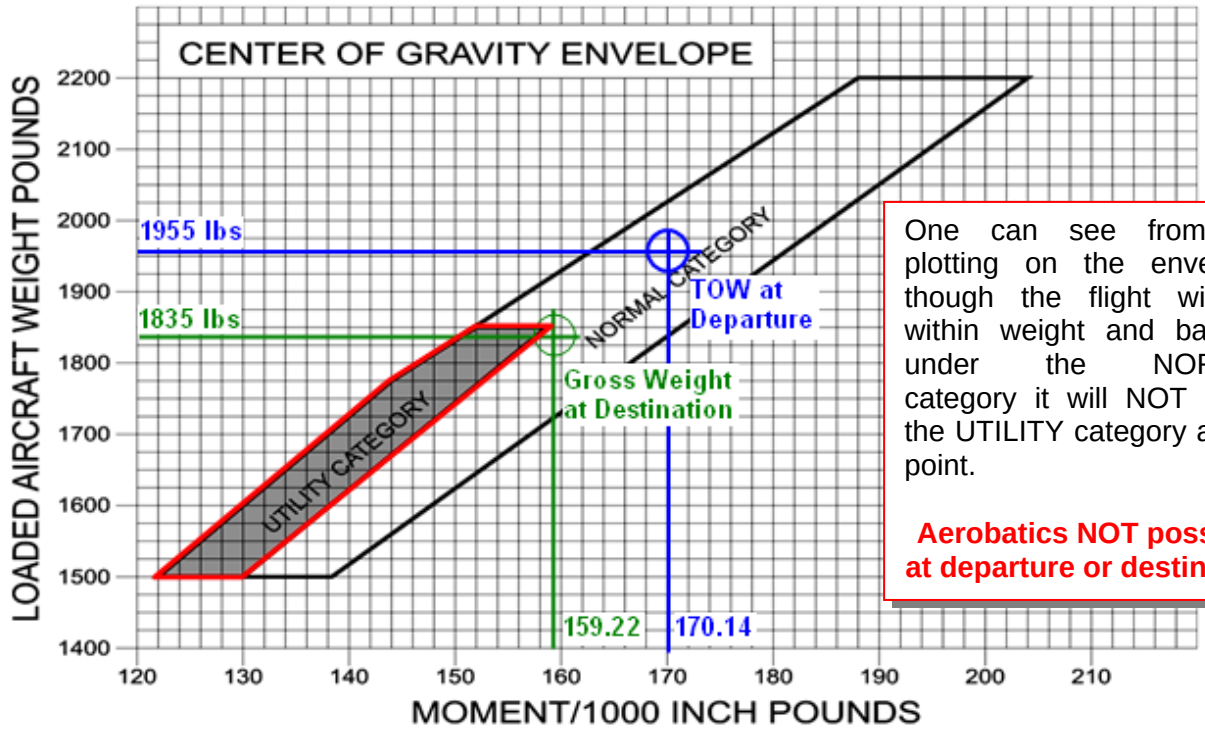
DESTINATION LOAD SHEET

Item	Weight (lbs)	Arm (in)	Moment/1000in lb
Empty weight	1280	80	102.4
Oil	15	32	0.48
Row 1 (Pilot @ 170lbs)	340	91	30.94
Row 2 (2 Pax @ 170 each)		126	
Baggage	120	151	18.12
Zero Fuel Weight	1755		151.94
Fuel (141 litres)	80	91	7.28
Take-off weight	1835		159.22

On the destination load sheet the only thing to change is the fuel quantity, this inturn will change our gross weight and index unit.The Gross weight has come in at 1835 lbs which is below our utility category weight, so we now need to plot on the C of G envelope.

Aircraft limitations

Maximum Take-off weight	
Normal category	1000 kg / 2200lbs
Utility category	841 kg / 1850lbs
Maximum baggage compartment	53 kg / 120 lbs



One can see from the plotting on the envelope, though the flight will be within weight and balance under the NORMAL category it will NOT be in the UTILITY category at any point.

Aerobatics NOT possible at departure or destination