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Mass & Balance

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031
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2008

031 - Mass & Balance

JAA Test Prep
031 - Mass & Balance
Edition 2008

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*** ATPL, CPL, IR questions included for both Airplanes and Helicopters**
*** Picture supplements included where applicable**
*** Organized by subject matter areas**

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Dear fellow pilots,

Thank you for purchasing the Aviationexam.com JAA Test Prep series question books. Our question books have been helping pilots in Europe prepare for their JAA examinations with great success since 2005.

The most significant change to the previous edition is the addition of new JAA questions into every subject matter area. Some questions already included in the previous edition have also been revised. Furthermore, most of the JAA picture supplements have been re-drawn to provide you with illustrations of better quality.

JAA Test Prep series question books contain thousands of questions that you can see on your official JAA examinations for ATPL, CPL or IR licenses, both for Airplanes and Helicopters. All of the questions have been carefully arranged into chapters based on the JAR-FCL syllabus and the individual JAA Learning Objectives. Every question is clearly marked for relevance to ATPL, CPL or IR – Airplane or Helicopter.

This book is not intended to serve as the only means of student preparation material and source of essential information for the JAA examinations. Instead, it should serve as an effective tool to assist students in their detailed familiarization with the actual content of the JAA examinations and to verify the level of their readiness to sit the official exams. This book should be used in conjunction with other training materials or Flight Training Organization training course. We suggest that you start by reading this book cover-to-cover, then go back and focus on individual questions that are not clear to you while researching the relevant topics in your course study materials. It is essential that you fully understand the knowledge concept of each question rather than memorizing the A, B, C, D correct answer choice (JAA may rearrange the individual answer stems to appear in different order on your exam than you see in this book). You can also greatly supplement your exam preparation by performing practice JAA examinations using www.aviationexam.com online testing system.

Please note that the JAA has not supplied the correct answers to the questions in this book and is not responsible in any way for its content. Our correct answers are based on careful research of all available resources. If during your studies you encounter a question where you will doubt the correct answer we recommend that you seek the assistance of your ground instructor or your flight training organization. If you then still believe our correct answer needs a review, please, forward your comment to us along with the question ID# to: support@aviationexam.com

We are confident that with proper use of this book you will not only pass your JAA knowledge examinations on your first try, but you will also achieve an excellent score. We wish you best of luck on your JAA exams!

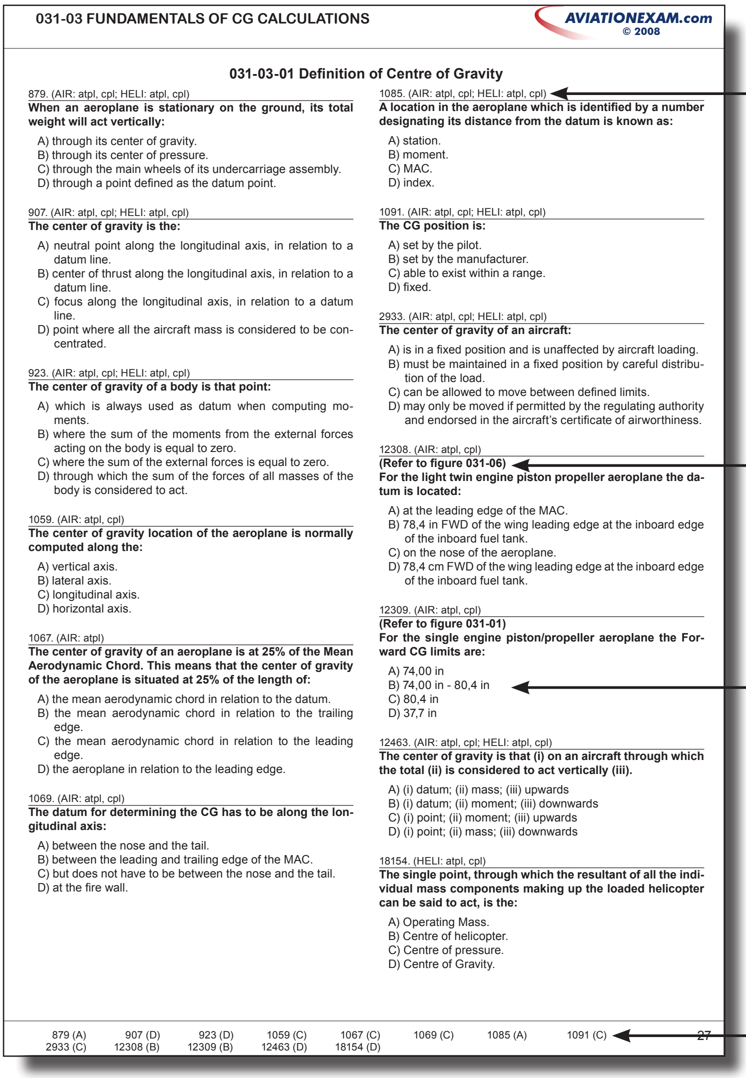
Aviationexam.com
Editorial Team
April 2008

How to use this book...

All of the questions have been arranged into chapters according to the relevant JAR-FCL syllabus. Within each chapter, the questions have been further classified into sub-areas according to the individual JAA Learning Objectives.

The correct answers to each question are found at the bottom of each page. Some questions require the use of a picture supplement – these are located at the rear part of the book. Exam picture supplements are also freely available for download as PDF files for easy printing from www.aviationexam.com (especially useful for charts in subjects 031, 032 and 033).

EXAMPLE:



031-03 FUNDAMENTALS OF CG CALCULATIONS — AVIATIONEXAM.com © 2008

031-03-01 Definition of Centre of Gravity

879. (AIR: atpl, cpl; HELI: atpl, cpl)
When an aeroplane is stationary on the ground, its total weight will act vertically:
A) through its center of gravity.
B) through its center of pressure.
C) through the main wheels of its undercarriage assembly.
D) through a point defined as the datum point.

907. (AIR: atpl, cpl; HELI: atpl, cpl)
The center of gravity is the:
A) neutral point along the longitudinal axis, in relation to a datum line.
B) center of thrust along the longitudinal axis, in relation to a datum line.
C) focus along the longitudinal axis, in relation to a datum line.
D) point where all the aircraft mass is considered to be concentrated.

923. (AIR: atpl, cpl; HELI: atpl, cpl)
The center of gravity of a body is that point:
A) which is always used as datum when computing moments.
B) where the sum of the moments from the external forces acting on the body is equal to zero.
C) where the sum of the external forces is equal to zero.
D) through which the sum of the forces of all masses of the body is considered to act.

1059. (AIR: atpl, cpl)
The center of gravity location of the aeroplane is normally computed along the:
A) vertical axis.
B) lateral axis.
C) longitudinal axis.
D) horizontal axis.

1067. (AIR: atpl)
The center of gravity of an aeroplane is at 25% of the Mean Aerodynamic Chord. This means that the center of gravity of the aeroplane is situated at 25% of the length of:
A) the mean aerodynamic chord in relation to the datum.
B) the mean aerodynamic chord in relation to the trailing edge.
C) the mean aerodynamic chord in relation to the leading edge.
D) the aeroplane in relation to the leading edge.

1069. (AIR: atpl, cpl)
The datum for determining the CG has to be along the longitudinal axis:
A) between the nose and the tail.
B) between the leading and trailing edge of the MAC.
C) but does not have to be between the nose and the tail.
D) at the fire wall.

1085. (AIR: atpl, cpl; HELI: atpl, cpl)
A location in the aeroplane which is identified by a number designating its distance from the datum is known as:
A) station.
B) moment.
C) MAC.
D) index.

1091. (AIR: atpl, cpl; HELI: atpl, cpl)
The CG position is:
A) set by the pilot.
B) set by the manufacturer.
C) able to exist within a range.
D) fixed.

2933. (AIR: atpl, cpl; HELI: atpl, cpl)
The center of gravity of an aircraft:
A) is in a fixed position and is unaffected by aircraft loading.
B) must be maintained in a fixed position by careful distribution of the load.
C) can be allowed to move between defined limits.
D) may only be moved if permitted by the regulating authority and endorsed in the aircraft's certificate of airworthiness.

12308. (AIR: atpl, cpl)
(Refer to figure 031-06)
For the light twin engine piston propeller aeroplane the datum is located:
A) at the leading edge of the MAC.
B) 78,4 in FWD of the wing leading edge at the inboard edge of the inboard fuel tank.
C) on the nose of the aeroplane.
D) 78,4 cm FWD of the wing leading edge at the inboard edge of the inboard fuel tank.

12309. (AIR: atpl, cpl)
(Refer to figure 031-01)
For the single engine piston/propeller aeroplane the Forward CG limits are:
A) 74,00 in
B) 74,00 in - 80,4 in
C) 80,4 in
D) 37,7 in

12463. (AIR: atpl, cpl; HELI: atpl, cpl)
The center of gravity is that (i) on an aircraft through which the total (ii) is considered to act vertically (iii).
A) (i) datum; (ii) mass; (iii) upwards
B) (i) datum; (ii) moment; (iii) downwards
C) (i) point; (ii) moment; (iii) upwards
D) (i) point; (ii) mass; (iii) downwards

18154. (HELI: atpl, cpl)
The single point, through which the resultant of all the individual mass components making up the loaded helicopter can be said to act, is the:
A) Operating Mass.
B) Centre of helicopter.
C) Centre of pressure.
D) Centre of Gravity.

879 (A)	907 (D)	923 (D)	1059 (C)	1067 (C)	1069 (C)	1085 (A)	1091 (C)	27
2933 (C)	12308 (B)	12309 (B)	12463 (D)	18154 (D)				

Question number and category designation
AIR = Airplane; HELI = Helicopter; all = ATPL, CPL, IR
e.g. "AIR: all; HELI: atpl" – question relates to all (ATPL, CPL, IR) levels for Airplanes and only to ATPL level for HELICOPTERS.

Question picture reference
Picture supplements can be found at the rear part of the book.

Question and possible answers

Correct answer

Note: question ID numbers used in this book represent only the internal question numbering system of Aviationexam.com – these numbers do not represent the official question numbers in the JAA Central Question Bank (CQB).

You can also find useful information relating to your JAA exam preparation on the following websites:

www.aviationexam.com	(Aviationexam.com - Online Aviation Library, Study Materials, etc…)
www.easa.eu	(European Aviation Safety Agency – Regulations)
www.jaa.nl	(Joint Aviation Authorities – Regulations, Learning Objectives)

031-01-01 Mass Limitations

941. (AIR: atpl, cpl)

For a conventional, nose tricycle gear aircraft configuration, the higher the takeoff mass:

1) Maneuverability is reduced.
2) Range will decrease but endurance will increase.
3) Gliding range will reduce.
4) Stalling speed will increase.

A) 1, 2, 3, 4
B) 3
C) 1, 4
D) 4

961. (AIR: atpl, cpl)

When considering the effects of increased mass on an aeroplane, which of the following is true.

A) Flight endurance will be increased.
B) Stalling speeds will be lower.
C) Gradient of climb for a given power setting will be higher.
D) Stalling speeds will be higher.

991. (AIR: atpl, cpl)

If an aeroplane is at a higher mass than anticipated, for a given airspeed the angle of attack will:

A) remain constant, drag will decrease and endurance will decrease.
B) be decreased, drag will decrease and endurance will increase.
C) be greater, drag will increase and endurance will decrease.
D) remain constant, drag will increase and endurance will increase.

994. (AIR: atpl, cpl)

Fuel loaded onto an aeroplane is 15.400 kg but is erroneously entered into the load and trim sheet as 14.500 kg. This error is not detected by the flight crew but they will notice that:

A) V_1 will be reached sooner than expected.
B) speed at un-stick will be higher than expected.
C) V_1 will be increased.
D) the aeroplane will rotate much earlier than expected.

1007. (AIR: atpl, cpl)

In order to provide an adequate buffet boundary at the commencement of the cruise a speed of 1,3 V_S is used. At a mass of 120.000 kg this is a CAS of 180 kts. If the mass of the aeroplane is increased to 135.000 kg the value of 1,3 V_S will be:

A) increased to 202 kts but, since the same angle of attack is used, drag and range will remain the same.
B) unaffected as V_S always occurs at the same angle of attack.
C) increased to 191 kts, drag will decrease and air distance per kg of fuel will increase.
D) increased to 191 kts, drag will increase and air distance per kg of fuel will decrease.

1024. (AIR: atpl, cpl)

An additional baggage container is loaded into the aft cargo compartment but is not entered into the load and trim sheet. The aeroplane will be heavier than expected and calculated takeoff safety speeds:

A) are unaffected but V_1 will be increased.
B) will not be achieved.
C) will be greater than required.
D) will give reduced safety margins.

12213. (AIR: atpl, cpl)

At maximum certificated takeoff mass, an aeroplane departs from an airfield which is not limiting for either takeoff or landing masses. During initial climb the number one engine suffers a contained disintegration. An emergency is declared and the aeroplane returns to departure airfield for an immediate landing. The most likely result of this action will be:

A) a landing short resultant from the increased angle of approach due to the very high aeroplane mass.
B) a high threshold speed and possible undercarriage or other structural failure.
C) a high threshold speed and a shorter stop distance.
D) a landing further along the runway than normal.

12231. (AIR: atpl, cpl)

During a violent avoidance manoeuvre, a light twin aircraft, certified to EASA requirements was subjected to an instantaneous load factor of 4,2. The Flight Manual specifies that the aircraft is certified in the normal category for a load factor of -1,9 to +3,8. Considering the certification requirements and taking into account that the manufacturer of the twin did not include, during its conception, a supplementary margin in the flight envelope, it might be possible to observe:

A) rupture of one or more structural components.
B) a permanent deformation of the structure.
C) an elastic deformation whilst the load was applied, but no permanent distortion.
D) no distortion, permanent or temporary of the structure.

12326. (AIR: atpl, cpl; HELI: atpl, cpl)

If an extra load is loaded into an aircraft, the stall speed is likely to:

A) stay the same.
B) decrease.
C) increase.
D) change depending on whether the load was placed FWD or AFT of the CG.

18120. (AIR: atpl, cpl)

Overloading has the following effects on performance:

A) increased takeoff and landing distance reduced rate of climb and increased fuel consumption.
B) increased takeoff and landing distance increased rate of climb and increased fuel consumption.
C) reduced takeoff and landing distance increased V_{NE} and increased fuel consumption.
D) reduced takeoff and landing distance increased V_{NE} and reduced rate of climb.

20076. (AIR: atpl, cpl; HELI: atpl, cpl)

Over-loading would result in:

A) a decrease in stalling speed.
B) a decrease in fuel consumption.
C) an increase in range.
D) a reduction of aircraft performance.

941 (C)	961 (D)	991 (C)	994 (B)	1007 (D)	1024 (D)	12213 (B)	12231 (B)
12326 (C)	18120 (A)	20076 (D)					

28494. (AIR: atpl, cpl; HELI: atpl, cpl)

Is it possible to fly a certified aircraft at a regulated takeoff mass with both full traffic load and a full fuel load?

A) All aircraft at all times.
B) No, it is not possible.
C) Only if the performance limited takeoff mass is less than the structural limited takeoff mass.
D) Some aircraft in some cases.

28495. (AIR: atpl, cpl)

For a conventional, nosewheel aircraft configuration, the higher the takeoff mass:

1) Range will decrease but endurance will increase.
2) Gliding range will reduce.
3) Stalling speed will increase.
4) Stick forces at rotation will increase.

Select the combination of correct statements:

A) 1, 3
B) 1, 3, 4
C) 2, 4
D) 3, 4

031-01-02 CG limitations

877. (AIR: atpl, cpl)

Which of the following statements is correct?

A) The station (STA) is always the location of the center of gravity in relation to a reference point, normally the leading edge of the wing at MAC.
B) A tail heavy aeroplane is less stable and stalls at a lower speed than a nose heavy aeroplane.
C) The center of gravity is given in percent of MAC calculated from the leading edge of the wing, where MAC always = the wing chord halfway between the center line of the fuselage and the wing tip.
D) If the actual center of gravity is located behind the aft limit the aeroplane longitudinal stability increases.

883. (AIR: atpl, cpl)

During takeoff you notice that, for a given elevator input, the aeroplane rotates much more rapidly than expected. This is an indication that:

A) the aeroplane is overloaded.
B) the center of gravity may be towards the aft limit.
C) the center of gravity is too far forward.
D) the center of pressure is aft of the center of gravity.

887. (AIR: atpl, cpl)

If the aeroplane is neutrally stable, this would suggest that:

A) the CG is forward.
B) the CG is in mid range.
C) the CG is on the rear limit.
D) the CG is behind the rear limit.

889. (AIR: atpl, cpl)

An aeroplane is loaded with its center of gravity towards the rear limit. This will result in:

A) an increased risk of stalling due to a decrease in tailplane moment.
B) a reduced fuel consumption as a result of reduced drag.
C) a reduction in power required for a given speed.
D) all of the statements are correct.

899. (AIR: atpl, cpl)

If the center of gravity of an aeroplane moves forward during flight the elevator control will:

A) become heavier making the aeroplane more difficult to manoeuvre in pitch.
B) become lighter making the aeroplane more difficult to manoeuvre in pitch.
C) become heavier making the aeroplane more easy to manoeuvre in pitch.
D) become lighter making the aeroplane more easy to manoeuvre in pitch.

900. (AIR: atpl, cpl)

An aeroplane is said to be neutrally stable. This is likely to:

A) be caused by a center of gravity, which is towards the forward limit.
B) be caused by a center of gravity, which is towards the rearward limit.
C) be totally unrelated to the position of the center of gravity.
D) cause the center of gravity to move forwards.

905. (AIR: atpl, cpl; HELI: atpl, cpl)

The mass displacement caused by landing gear extension:

A) does not create a longitudinal moment.
B) creates a pitch-up longitudinal moment.
C) creates a longitudinal moment in the direction (pitch-up or pitch-down) determined by the type of landing gear.
D) creates a pitch-down longitudinal moment.

906. (AIR: atpl, cpl)

What determines the longitudinal stability of an aeroplane?

A) The dihedral, angle of sweepback and the keel effect.
B) The effectiveness of the horizontal stabilizer, rudder and rudder trim tab.
C) The relationship of thrust and lift to weight and drag.
D) The location of the center of gravity with respect to the neutral point.

916. (AIR: atpl, cpl)

The stalling speed of an aeroplane will be highest when it is loaded with a:

A) high gross mass and aft center of gravity.
B) low gross mass and forward center of gravity.
C) low gross mass and aft center of gravity.
D) high gross mass and forward center of gravity.

28494 (D) 28495 (D) 877 (B) 883 (B) 887 (D) 889 (D) 899 (A) 900 (B)
905 (C) 906 (D) 916 (D)

919. (AIR: atpl, cpl)

If the center of gravity is near the forward limit, the aeroplane will:

A) benefit from reduced drag due to the decrease in angle of attack.
B) require elevator trim, which will result in an increase in fuel consumption.
C) require less power for a given airspeed.
D) tend to over rotate during takeoff.

924. (AIR: atpl, cpl)

Which of the following statements is correct?

A) If the actual center of gravity is close to the forward limit of the center of gravity the aeroplane may be unstable, making it necessary to increase elevator forces.
B) If the actual center of gravity is located behind the aft limit of center of gravity it is possible that the aeroplane will be unstable, making it necessary to increase elevator forces.
C) A tail heavy aeroplane is less stable and stalls at a lower speed than a nose heavy aeroplane
D) The lowest stalling speed is obtained if the actual center of gravity is located in the middle between the aft and forward limit of center of gravity.

927. (AIR: atpl, cpl)

Which of the following is most likely to affect the range of center of gravity positions on an aeroplane?

A) The need to minimize drag forces and so improve efficiency.
B) Location of the undercarriage.
C) The need to maintain a low value of stalling speed.
D) Elevator and tailplane (horizontal stabilizer) effectiveness in all flight conditions.

929. (AIR: atpl, cpl)

When the center of gravity is at the forward limit, an aeroplane will be:

A) extremely stable and will require excessive elevator control to change pitch.
B) extremely stable and require small elevator control to change pitch.
C) extremely unstable and require excessive elevator control to change pitch.
D) extremely unstable and require small elevator control to change pitch.

930. (AIR: atpl, cpl)

Assuming gross mass, altitude and airspeed remain unchanged, movement of the center of gravity from the forward to the aft limit will cause:

A) increased cruise range.
B) higher stall speed.
C) lower optimum cruising speed.
D) reduced maximum cruise range.

937. (AIR: atpl, cpl)

With the center of gravity on the forward limit which of the following is to be expected?

A) A decrease of the stalling speed.
B) A decrease in the landing speed.
C) A decrease in range.
D) A tendency to yaw to the right on takeoff.

12200. (AIR: atpl, cpl)

In cruise flight, an aft center of gravity location will:

A) decrease longitudinal static stability.
B) increase longitudinal static stability.
C) does not influence longitudinal static stability.
D) not change the static curve of stability into longitudinal.

12322. (AIR: atpl, cpl)

A forward CG would result in:

A) a reduced rate of climb.
B) a decrease in cruise range.
C) a decrease in both rate of climb and cruise range.
D) an increase in both rate of climb and cruise range.

12415. (AIR: atpl, cpl; HELI: atpl, cpl)

Who establishes the limits of CG?

A) The CAA.
B) The JAA.
C) The manufacturer.
D) The insurers.

12429. (AIR: atpl, cpl)

What effect does the CG on the aft limit have on the fuel consumption of an aeroplane?

A) Increases.
B) Decreases.
C) No effect.
D) Marginal increase.

12430. (AIR: atpl, cpl)

Which combination of weight and CG position will produce the highest stalling speed?

A) Heavy weight and aft CG.
B) Heavy weight and forward CG.
C) Low weight and aft CG.
D) Low weight and forward CG.

12433. (AIR: atpl, cpl; HELI: atpl)

If the CG is aft of the neutral point it results in:

A) increased stability with increased elevator trim.
B) decreased stability with decreased elevator trim.
C) neutral stability.
D) longitudinal instability.

12435. (AIR: atpl, cpl)

An aeroplane is said to be neutrally stable. This is likely to:

A) be caused by the CG towards the forward limit.
B) be caused by the CG at the aerodynamic center of the aircraft.
C) be totally unrelated to the position of the CG.
D) cause the CG to move forwards.

12449. (AIR: atpl, cpl)

The effect of operating an aeroplane with a CG too far forward is to experience:

A) inability or difficulty in trimming when flaps are retracted.
B) lower stick forces per G loading.
C) inability or difficulty in flaring on touchdown, resulting in nose-wheel landing first.
D) lower stalling speed.

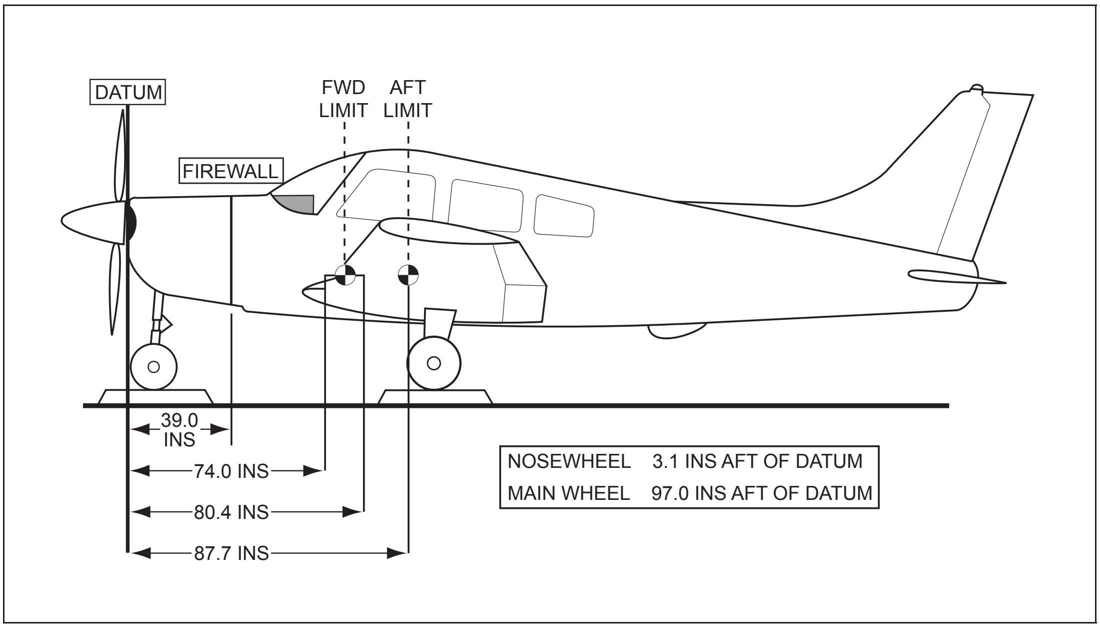
919 (B) 924 (C) 927 (D) 929 (A) 930 (A) 937 (C) 12200 (A) 12322 (C)
12415 (C) 12429 (B) 12430 (B) 12433 (D) 12435 (B) 12449 (C)

PICTURE SUPLEMENTS

FIGURE 033-01

Aeroplane Description and Data

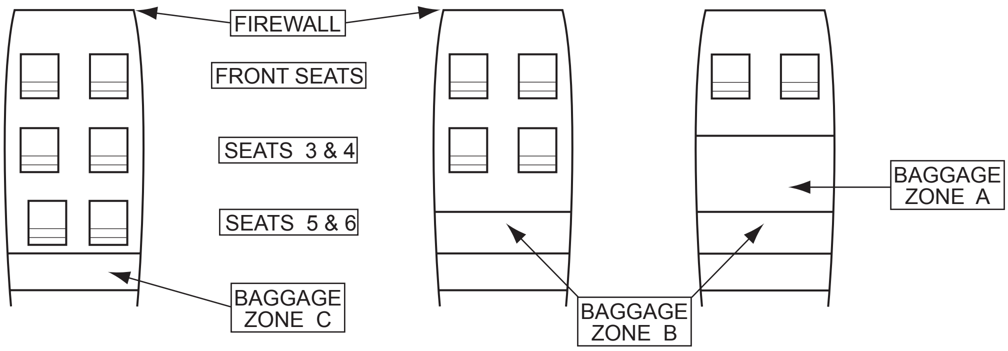
- Monoplane
- Single reciprocating engine
- Propeller - constant speed
- Retractable undercarriage
- Performance Class B



Location Diagram

Reference datum	39.00 inches forward of firewall
Centre of Gravity (CG) limits	forward limit 74.00 - 80.4 in aft limit 87.7 in
MSTOM MSLM	3,650 lb 3,650 lb
BEM	2,415 lb
BEM CG location	77.7 in
BEM Moment ÷ 100 =	1,876.46 in.lbs
Landing Gear retraction/extension	does not significantly affect CG position
Floor structure load limit	50 lb per square foot between front and rear spars (includes Baggage Zone A) 100 lb per square foot elsewhere (Baggage Zones B & C)

FIGURE 031-02



BAGGAGE/LOAD ZONE	ARM (INCHES)
A	108
B	150
C	180

Seating and Baggage Arrangements

FIGURE 031-03

Leading Edge Tanks (Fuel Tank Centroid Arm 75 in Aft of Datum)					
Gallons	**Weight (lb)**	**Moment ÷ 100 (in. lbs)**	**Gallons**	**Weight (lb)**	**Moment ÷ 100 (in. lbs)**
5	30	22.5	44	264	198
10	60	45	50	300	225
15	90	67.5	55	330	247.5
20	120	90	60	360	270
25	150	112.5	65	390	292.5
30	180	135	70	420	315
35	210	157.5	74	444	333
40	240	180			

Useful Mass and Moments of Usable Fuel

FIGURE 031-04

Item	Mass	Arm (in)	Moment ÷ 100
1. Basic Empty Condition			
2. Front Seat Occupants		79	
3. Third and Fourth Seat PAX		117	
4. Baggage Zone 'A'		108	
5. Fifth And Sixth Seat PAX		152	
6. Baggage Zone 'B'		150	
7. Baggage Zone 'C'		180	
Sub-total = Zero Fuel Mass			
8. Fuel Loading			
Sub-total = Ramp Mass			
9. Subtract Fuel for Start, Taxi and Run Up (see Note)			
Sub-total = Take-off Mass			
10. Trip Fuel			
Sub-total = Landing Mass			

NOTE: Fuel for start taxi and run up is normally 13 lb at an average entry of 10 in the column headed **Moment (÷ 100)**

Blank Loading Manifest SEP1

**PAGES 58 - 98 REMOVED
IN THIS SAMPLE BOOK**

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details on these books.**

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