



EAST AFRICAN SCHOOL OF AVIATION
EXAMINATION
SAFETY SECTION

DIPLOMA IN FLIGHT DISPATCH

FLD 39

FINAL EXAMINATION

SUBJECT: MASS AND BALANCE

Duration: 02 Hrs: 30 Min

DAY/DATE:

TIME: 0830HRS – 1030HRS

Instructions to Candidate:

1. Total marks are 70
2. This paper consists of Ten (10) printed pages
3. Examination rules and regulations shall be adhered to
4. Answer all the questions in section one and section two

SECTION ONE 40 MARKS

1. The actual 'Take-off Mass' is equivalent to:

- A Actual Zero Fuel Mass plus the traffic load
- B Dry Operating Mass plus the take-off fuel
- C Actual Landing Mass plus the take-off fuel
- D Dry Operating Mass plus take-off fuel and the traffic load

2. Which of the following is unlikely to have any effect on the position of the centre of gravity on an aeroplane in flight?

- A Lowering the landing gear.
- B Movement of cabin attendants going about their normal duties.
- C Normal consumption of fuel for a swept wing aeroplane.
- D Changing the tailplane (horizontal stabiliser) incidence angle.

3. Given that the total mass of an aeroplane is 112 000 kg with a centre of gravity position at 22.62m aft of the datum. The centre of gravity limits are between 18m and 22m. How much mass must be removed from the rear hold (30 m aft of the datum) to move the centre of gravity to the middle of the limits:

- A 8 680 kg
- B 43 120 kg
- C 29 344 kg
- D 16 529 kg

4. The maximum load per running meter of an aero plane is 350 kg/m. The width of the floor area is 2 meters. The floor strength limitation is 300 kg per square meter. Which one of the following crates (length x width x height) can be loaded directly on the floor?

- A A load of 400 kg in a crate with dimensions 1.2 m x 1.2 m x 1.2 m.
- B A load of 500 kg in a crate with dimensions 1.5 m x 1 m x 1 m.
- C A load of 400 kg in a crate with dimensions 1.4 m x 0.8 m x 0.8 m.
- D A load of 700 kg in a crate with dimensions 1.8 m x 1.4 m x 0.8 m

5. The distance from the datum to the Centre of Gravity of a mass is known as

- A the lever.
- B the moment.
- C the index.
- D the moment arm or balance arm.

6. At a mass of 1 800 kg, a helicopter equipped with a winch has a lateral CG-position of 5 cm to the left. The CG of the load suspended from the winch is at a distance of 60 cm to the right. With a winch load of 200 kg the lateral CG-position of the helicopter will be:

- A 10,5 cm to the right
- B 1.5 cm to the right
- C 1.5 cm to the left
- D 10.5 cm to the right

7. Length of the mean aerodynamic chord = 1 m

Moment arm of the forward cargo: -0,50 m

Moment arm of the aft cargo: + 2,50 m

The aircraft mass is 2 200 kg and its centre of gravity is at 25% MAC

To move the centre of gravity to 40%, which mass has to be transferred from the forward to the aft cargo hold?

- A 183 kg
- B 165 kg
- C 104 kg
- D 110 kg

8. In calculations with respect to the position of the centre of gravity a reference is made to a datum. The datum is

A an arbitrary reference chosen by the pilot which can be located anywhere on the aeroplane.

B calculated from the data derived from the weighing procedure carried out on the aeroplane after any major modification.

C a reference plane which is chosen by the aeroplane manufacturer. Its position is given in the aeroplane Flight or Loading Manual.

D calculated from the loading manifest.

9. An aero plane must be re-weighed at certain intervals. Where an operator uses 'fleet masses' and provided that changes have been correctly documented, this interval is

A whenever a major modification is carried out.

B 9 years for each aeroplane.

C 4 years for each aeroplane.

D whenever the Certificate of Airworthiness is renewed.

10. After weighing a helicopter the following values are noted:

Forward point: 350 kg

Aft right point: 995 kg

Aft left point: 1 205 kg

What is the longitudinal CG-position in relation to the datum situated 4 m in front of the rotor axis, knowing that the forward point is at 2.5 m forward of the rotor axis and the aft points are 1 m aft of the rotor axis?

A 4.52 m

B 4.09 m

C 4.21 m

D 4.15 m

11. The mass displacement caused by landing gear extension:

A creates a pitch-up longitudinal moment

B does not create a longitudinal moment

C creates a pitch-down longitudinal moment

D creates a longitudinal moment in the direction (pitch-up or pitch-down) determined by the type of landing gear

12. The following results were obtained after weighing a helicopter :

- mass at front point: 300 kg

- mass at right rear point : 1 100 kg

- mass at left rear point : 950 kg

It is given that the front point is located 0.30 m left of the longitudinal axis and the rear points are symmetrically located 1.20 m from this axis.

The helicopter's lateral CG-position relative to the longitudinal axis is:

A 4 cm left

B 11 cm right

C 11 cm left

D 4 cm right

13. 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 take-off safety speeds

- A will give reduced safety margins.
- B will not be achieved.
- C will be greater than required.
- D are unaffected but V1 will be increased.

14. With the centre of gravity on the forward limit which of the following is to be expected?

- A A decrease in the landing speed.
- B A decrease of the stalling speed.
- C A tendency to yaw to the right on take-off.
- D A decrease in range.

15. The maximum taxi (ramp) mass is governed by:

- A. tyre speed and temperature limitations.
- B. structural considerations.
- C. taxi distance to take - off point.
- D. bearing strength of the taxiway pavement.

16. Which of the following statements is correct?

- A. The Maximum Zero Fuel Mass ensures that the centre of gravity remains within limits after the uplift of fuel.
- B. The Maximum Landing Mass of an aeroplane is restricted by structural limitations, performance limitations and the strength of the runway.
- C. The Maximum Take-off Mass is equal to the maximum mass when leaving the ramp.
- D. The Basic Empty Mass is equal to the mass of the aeroplane excluding traffic load and useable fuel but including the crew

17. The Take-off Mass of an aeroplane is 66700 kg which includes a traffic load of 14200 kg and a usable fuel load of 10500 kg. If the standard mass for the crew is 545 kg the Dry Operating Mass is

- A. 56200 kg
- B. 41455 kg
- C. 42000 kg
- D. 42545 kg

18. Given the following:

- Maximum structural take-off mass 48 000 kg
- Maximum structural landing mass: 44 000 kg
- Maximum zero fuel mass: 36 000 kg
- Taxi fuel: 600 kg
- Contingency fuel: 900 kg
- Alternate fuel: 800 kg
- Final reserve fuel: 1 100 kg
- Trip fuel: 9 000 kg

The actual Take Off Mass can never be higher than:

- A. 48 000 kg
- B. 48 400 kg
- C. 47 800 kg
- D. 53 000 kg

19. With respect to aeroplane loading in the planning phase, which of the following statements is always correct ?

LM = Landing Mass

TOM = Take-off Mass

MTOM = Maximum Take-off Mass

ZFM = Zero Fuel Mass

MZFM = Maximum Zero Fuel Mass

DOM = Dry Operating Mass

A. $MTOM = ZFM + \text{maximum full tank fuel mass}$

B. $\text{Reserve Fuel} = TOM - \text{Trip Fuel}$

C. $MZFM = \text{Traffic load} + DOM$

D. $LM = TOM - \text{Trip Fuel}$

20. A jet transport has the following structural limits:

-Maximum Ramp Mass: 63 060 kg

-Maximum Take Off Mass: 62 800 kg

-Maximum Landing Mass: 54 900 kg

-Maximum Zero Fuel Mass: 51 300 kg

The aeroplane's fuel is loaded accordance with the following requirements:

-Taxi fuel: 400 kg

-Trip fuel: 8400 kg

-Contingency & final reserve fuel: 1800 kg

-Alternate fuel: 1100 kg

If the Dry Operating Mass is 34930 kg, determine the maximum traffic load that can be carried on the flight if departure and landing airfields are not performance limited.

A. 16 430 kg

B. 16 370 kg

C. 17 070 kg

D. 16 570 kg

21. A revenue flight is to be made by a jet transport. The following are the aeroplane's structural limits:

-Maximum Ramp Mass: 69 900 kg

-Maximum Take Off Mass: 69 300 kg

-Maximum Landing Mass: 58 900 kg

-Maximum Zero Fuel Mass: 52 740 kg

The performance limited take off mass is 67 450kg and the performance limited landing mass is 55 470 kg.

Dry Operating Mass: 34 900 kg

Trip Fuel: 6 200 kg

Taxi Fuel: 250 kg

Contingency & final reserve fuel: 1 300 kg

Alternate Fuel: 1 100 kg

The maximum traffic load that can be carried is:

A. 13 950 kg

B. 18 170 kg

C. 17 840 kg

D. 25 800 kg

B.

22. Given:

Maximum structural take-off mass: 8600 kg

Maximum structural landing mass: 8600 kg

Zero Fuel Mass: 6500 kg

Taxi Fuel: 15 kg

Contingency fuel: 110 kg

Alternate fuel: 600 kg

Final Reserve Fuel: 130 kg

Trip Fuel: 970 kg

The expected Landing Mass at destination will be

- A. 8310 kg B. 7340 kg C. 8325 kg D. 8600 kg

23. Which of the following statements is correct?

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

24. The following data applies to a planned flight.

Dry Operating Mass 34900 kg

Performance limited Take-Off Mass 66300 kg

Performance limited Landing Mass 55200 kg

Maximum Zero Fuel Mass 53070 kg

Fuel required at ramp: -Taxi fuel 400 kg

trip fuel 8600 kg

contingency fuel 430 kg

alternate fuel 970 kg

holding fuel 900 kg

Traffic load 16600 kg

Fuel costs at the departure airfield are such that it is decided to load the maximum fuel quantity possible. The total fuel which may be safely loaded prior to departure is:

- A. 10730 kg B. 15200 kg C. 13230 kg D. 12700 kg

25. The centre of gravity of a body is that point

- A. through which the sum of the forces of all masses of the body is considered to act.
- B. where the sum of the external forces is equal to zero.
- C. which is always used as datum when computing moments.
- D. where the sum of the moments from the external forces acting on the body is equal to zero

26. At a given mass the CG position is at 15% MAC. If the leading edge of MAC is at a position 625.6 inches aft of the datum and the MAC is given as 134.5 inches determine the position of the CG in relation to the datum.

- A. 228.34 inches aft of datum
- B. 645.78 inches aft of datum
- C. 20.18 inches aft of datum
- D. 605.43 inches aft of datum

27. The maximum taxi (ramp) mass is governed by:

- A. tyre speed and temperature limitations.
- B. structural considerations.
- C. taxi distance to take - off point.
- D. bearing strength of the taxiway pavement.

28. Which of the following statements is correct?

- A. The Maximum Zero Fuel Mass ensures that the centre of gravity remains within limits after the uplift of fuel.
- B. The Maximum Landing Mass of an aeroplane is restricted by structural limitations, performance limitations and the strength of the runway.
- C. The Maximum Take-off Mass is equal to the maximum mass when leaving the ramp.
- D. The Basic Empty Mass is equal to the mass of the aeroplane excluding traffic load and useable fuel but including the crew.

29. The maximum zero-fuel mass:

- 1- is a regulatory limitation
- 2- is calculated for a maximum load factor of +3.5 g
- 3- is based on the maximum permissible bending moment at the wing root
- 4- is defined on the assumption that fuel is consumed from the outer wings tank first
- 5- is defined on the assumption that fuel is consumed from the centre wing tank first

The combination of correct statements is:

- A. 1, 3, 5
- B. 1, 2, 3
- C. 2, 3, 4
- D. 2, 3, 5

30. The operator of an aircraft equipped with 50 seats uses standard masses for passengers and baggage. During the preparation of a scheduled flight a group of passengers present themselves at the check-in desk, it is apparent that even the lightest of these exceeds the value of the declared standard mass.

- A. the operator may use the standard masses for the load and balance calculation without correction
- B. the operator is obliged to use the actual masses of each passenger
- C. the operator should use the individual masses of the passengers or alter the standard mass
- D. the operator may use the standard masses for the balance but must correct these for the load calculation

31. Given that:

- Maximum structural take-off mass: 146 000 kg
- Maximum structural landing mass: 93 900 kg
- Maximum zero fuel mass: 86 300 kg
- Trip fuel: 27 000 kg
- Taxi fuel: 1 000 kg
- Contingency fuel: 1350 kg
- Alternate fuel: 2650 kg
- Final reserve fuel: 3000 kg

The actual Take Off Mass can never be higher than:

- A. 120 900 kg. B. 120 300 kg. C. 121 300 kg. D. 146 000 kg.

32. Given: Zero Fuel Mass: 6660 kg Trip Fuel: 990 kg Block Fuel: 1540 kg Taxi Fuel: 25 kg

The actual Take-Off Mass is equal to:

- A. 7210 kg B. 8175 kg C. 8110 kg D. 8200 kg

33. At maximum certificated take-off mass an aeroplane departs from an airfield which is not limiting for either take-off 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 high threshold speed and possible undercarriage or other structural failure.
- B. a high threshold speed and a shorter stop distance.
- C. a landing short resultant from the increased angle of approach due to the very high aeroplane mass.
- D. a landing further along the runway than normal.

34. The datum is a reference from which all moment (balance) arms are measured.

Its precise position is given in the control and loading manual and it is located

- A. at or near the focal point of the aircraft axis system.
- B. at or near the natural balance point of the empty aircraft.
- C. at or near the forward limit of the centre of gravity.
- D. at a convenient point which may not physically be on the aircraft.

35. A mass of 500 kg is loaded at a station which is located 10 metres behind the present

Centre of Gravity and 16 metres behind the datum.

(Assume: $g=10 \text{ m/s}^2$) The moment for that mass used in the loading manifest is:

- A. 80000 Nm B. 130000 Nm C. 50000 Nm D. 30000 Nm

36. Loads must be adequately secured in order to:

- A. prevent excessive 'g'-loading during the landing flare.
- B. avoid unplanned centre of gravity (cg) movement and aircraft damage.
- C. avoid any centre of gravity (cg) movement during flight.
- D. allow steep turns.

37. A load placed forward of the datum

- A. Has a negative arm and therefore generates a negative moment
- B. Has a negative arm and therefore generates a negative mass and moment
- C. Has a positive arm and therefore generates a positive moment
- D. Has a positive arm and therefore generates a positive mass and moment

38. Which force compensates the weight in uncelebrated straight and level flight?

- A. the resultant from lift and drag
- B. the lift
- C. the drag
- D. the thrust

39. The Dry Operating Mass includes:

- A. fuel and passengers baggage and cargo.
- B. crew and crew baggage, catering, removable passenger service equipment, potable water and lavatory chemicals.
- C. unusable fuel and reserve fuel.
- D. passengers baggage and cargo.

40. An aeroplane's weighing schedule indicates that the empty mass is 57320 kg.

The nominal

Dry Operating Mass is 60120 kg and the Maximum Zero Fuel Mass is given as 72100 kg.

Which of the following is a correct statement in relation to this aeroplane?

- A. operational items have a mass of 2800 kg and the maximum useful load is 14780 kg.
- B. operational items have a mass of 2800 kg and the maximum traffic load for this aeroplane is 14780 kg.
- C. operational items have a mass of 2800 kg and the maximum useful load is 11980 kg.
- D. operational items have a mass of 2800 kg and the maximum traffic load for this aeroplane is 11980 kg.

SECTION TWO 30 MARKS

MASS & BALANCE PROCESS: COMPLETION OF A LOAD PLAN- LOAD SHEET & BALANCE CHART

A: FLIGHT INFORMATION

Flight No.: EA002, Reg: 5YFLD, Date: 25th January, 2021,
Flight Origin: BGF, Destination: DLA, CREW 2/6

VERSION 16JM129

B: AIRCRAFT DATA

TAKE OFF FUEL 6720
TRIP FUEL 3830
PAX/16/123
100/36/3/0
PAX WEIGHTS USED M88 F70 C35 I0
A16 B90 C33
SI BW 41714
BI 43.7
DLA POTABLE WATER 236 / 3.3
CREW EFFECT 752 / 0
PANTRY EFFECT 866 / 3
LOAD IN CPTS 0/0 1/609 2/1701 3/2521 4/528