ELEVATOR BALANCING - ADJUSTMENT/TEST

EFFECTIVITY: ALL

1. General

A. This section gives the necessary procedures to do the static balancing of the left and right elevators after a rework, repair, or painting of the elevator and/or of the spring tab.

NOTE:
- Static balance is the equal distribution of weight around the centerline of the flight control surface hinge. In other words, a flight control surface is statically balanced when its center of gravity aligns with the centerline of the flight control surface hinge.
- The static balance value is the necessary moment to balance a flight control surface that is out of balance.
- The static balance value is usually given in kg x cm or in kg x mm.

B. The procedures in this section are given in the sequence below. The tasks identified with (♦) are part of the Scheduled Maintenance Requirements Document (SMRD).

TASK NUMBER	*DESCRIPTION*	*EFFECTIVITY*
51-60-00-700-801-A	ELEVATOR STATIC BALANCING	ALL

TASK 51-60-00-700-801-A
EFFECTIVITY: ALL

2. ELEVATOR STATIC BALANCING

A. General

(1) This task gives the procedures necessary to do the static balancing of the left and right elevators.

(2) If the elevator was repaired or painted, it is necessary to statically balance it before you install it on the aircraft again.

NOTE: To find the moment of a force (weight), multiply the magnitude of the force (weight) by the perpendicular distance (d) between the force line of action and the rotation point (flight control surface hinge).

B. References

REFERENCE	*DESIGNATION*
AMM TASK 27-30-00-000-801-A/400	ELEVATOR - REMOVAL
AMM TASK 27-30-00-400-801-A/400	ELEVATOR - INSTALLATION
AMM TASK 55-20-01-000-801-A/400	ELEVATOR TIPS - REMOVAL
AMM TASK 55-20-01-400-801-A/400	ELEVATOR TIPS - INSTALLATION
AMM TASK 55-21-00-000-801-A/400	ELEVATOR MASS ADJUSTMENT PLATE - REMOVAL
AMM TASK 55-21-00-400-801-A/400	ELEVATOR MASS ADJUSTMENT PLATE - INSTALLATION
S.B.145-27-0034	-
SRM 51-20-01	-

C. Zones and Accesses

ZONE	*PANEL/DOOR*	*LOCATION*
335	-	LH Elevator
336	-	RH Elevator

D. Tools and Equipment

ITEM	*DESCRIPTION*	*PURPOSE*	*QTY*
GSE 195	Elevator Mass Balance Weight (PRE-MOD. S.B.145-27-0034)	To do the elevator static balancing	
GSE 194	Elevator Mass Balance Weight (POST-MOD. S.B.145-27-0034)	To do the elevator static balancing	
GSE 140	Control-Surface Balancer	To do the elevator static balancing	
Commercially available	Precision beam scale	To weigh the elevator assembly and the weights used to do the elevator static balancing	
Commercially available	Torque wrench	To tighten the attachment nuts	

(Continued)

ITEM	DESCRIPTION	PURPOSE	QTY
Commercially available	Height Gage	To do the elevator static balancing	

E. Auxiliary Items

ITEM	DESCRIPTION	PURPOSE	QTY
Commercially available	Soft (cotton), lint-free cloths	To clean the elevator assembly	AR
Commercially available	Bench vise	To tie the elevator mass adjustment plate and cut or file it	1
Commercially available	Pliers or scissors	To cut the mass adjustment plate and/or the steel shim	1
Commercially available	Hacksaw for metal	To cut the mass adjustment plate and/or the steel shim	1
Commercially available	Dead smooth file	To rough down the mass adjustment plate	1
Commercially available	Scriber	To mark the mass adjustment plate and/or steel shim	1
Commercially available	Hammer	To crush out the lead to make it thin	1
Commercially available	Level table	To statically balance a level surface	1

F. Consumable Materials

SPECIFICATION (BRAND)	DESCRIPTION	QTY
MIL-S-81733 type IV - 12	Sealant P/S 870C-12	AR
Commercially available	Tape (3/4 inch)	AR
Commercially available	Nylon thread	AR
TT-T-266	Thinner	AR
MIL-S-22499/3	Delaminable Steel Shim (0.5 mm, 1.6 mm or 2.0 mm)	AR
ASTM A240	Delaminable Steel Shim	AR
Commercially available	Lead Mass Balance	AR

G. Expandable Parts

Not Applicable

H. Persons Recommended

QTY	FUNCTION	PLACE
1	A - Does the task	In the work area
1	B - Helps technician A	In the work area

I. Preparation

SUBTASK 841-002-A

CAUTION:
- MAKE SURE THAT THE PRECISION BEAM SCALE, TORQUE WRENCH, AND HEIGHT GAGE ARE CORRECTLY CALIBRATED.
- DO THE STATIC BALANCING PROCEDURE IN A CLOSED AREA, WITH NO AIR CURRENT.
- LEVEL THE CONTROL-SURFACE BALANCER ASSEMBLY CORRECTLY.
- MAKE SURE THAT THE ELEVATOR IS FREE OF DIRT (GREASE, OIL, ADHESIVE TAPE, ETC). DIRT CAN CAUSE WRONG RESULTS DURING THE STATIC BALANCING PROCEDURE.
- THE ELEVATOR MUST MOVE FREELY WHEN IT IS INSTALLED ON THE CONTROL-SURFACE BALANCER ASSEMBLY.
- MAKE SURE THAT THE ELEVATOR IS PAINTED OR POLISHED, AS APPLICABLE.
- THE ELEVATOR ASSEMBLY MUST BE COMPLETE WITH THESE COMPONENTS INSTALLED: SERVO TAB, SPRING TAB (ALREADY BALANCED), ACCESS PANELS, FAIRINGS, STATIC DISCHARGER, HINGE PINS, FAIL-SAFE ACTUATION LINK, ADJUSTABLE RODS, SPRING-TAB BELLCRANK, AND TORSION BAR.
- INSTALL ALL COMPONENTS OF THE ELEVATOR IN THEIR CORRECT POSITION AS IF THEY WERE ATTACHED TO THE HORIZONTAL STABILIZER.
- MAKE SURE THAT THE MASS ADJUSTMENT PLATE IS CORRECTLY INSTALLED.

(1) Remove the elevator (AMM TASK 27-30-00-000-801-A/400).

(2) Install the elevator bolts in position to install the elevator on control-surface balancer GSE 140 (Refer to Figure 501).

NOTE: It will allow the axial hinge of elevator during the balancing.

(3) Put the control-surface balancer assembly on a level table. Align and level the control surface (Figure 501).

(4) Set the height gage indicator to 182 mm (Figure 502).

(5) Clean the elevator assembly with a lint-free cloth and thinner.

J. Inspection/Check

SUBTASK 750-002-A

(1) Put the elevator assembly on the control surface balancer assembly, with its undersurface down, and let it move freely.

(2) Put the spring tab (tab I) on the same plane as the elevator, align it with the elevator trailing edge and fasten with an adhesive tape (Figure 501).

NOTE: Do not change the position of the elevator assembly during the balancing procedure.

(3) Remove the first screw (the nearest to the leading edge) of the elevator tip undersurface and install GSE 194 or GSE 195 (Figure 502).

NOTE: GSE 194 (638.4 grams) - APPLICABLE TO POST-MOD. S.B.145-27-0034 and GSE 195 (967.3 grams) - APPLICABLE TO PRE-MOD. S.B. 145-27-0034

(4) Put the height gage in front of the elevator assembly trailing edge (Figure 502).

(5) Do a check for the position of the elevator with the height gage (Figure 502 shows the different positions); if they are aligned, the elevator is already balanced. If they are not aligned, do one of these steps according to the position:

(a) Upward deflection:

1 Add weights to position "A" until the trailing edge is aligned with the height gage indicator (Figure 502).

NOTE: The position "A" corresponds to the last screw (the nearest to the trailing edge) that attaches the elevator tip to its upper surface.

2 Weigh the added weights on a precision beam scale and write this value.

3 Divide this value by 2; write the result.

4 The result is the mass that must be removed from the elevator mass adjustment plate.

NOTE: This result can be a few grams different than the necessary exact mass. Do not remove more than that now.

5 Remove GSE 194 (or GSE 195 as applicable).

6 Remove the elevator tip (AMM TASK 55-20-01-000-801-A/400).

7 Remove the four bolts and the mass adjustment plate (AMM TASK 55-21-00-000-801-A/400).

8 Weigh all mass adjustment plates and the bolts. Write this value. This value minus the result of step "3" must not be larger than 600 grams.

NOTE: If the total weight is more than 600 grams, contact the Embraer Technical Support Department.

9 Remove material of the mass adjustment plate to get the balancing (use file, scissors, pliers, hammer, saw, etc.).

NOTE:
- Be careful not to remove more material than it is necessary.
- Refer to Figure 504 for mass adjustment plate shape.

10 Reinstall the mass adjustment plate, the bolts, and the elevator tip with all screws (do not tighten them now).

NOTE: Do not install the first screw (GSE position in Figure 503).

11 Install GSE 194 (or 195 as applicable) and do a check on the position of the elevator with the height gage:

– If they are aligned, the balancing is correct. Go to item "(6)".

– If they are not aligned (still in upward deflection), do steps "1" thru "11" again to get the balancing. If you get downward deflection, go to sub item "(b)" below.

(b) Downward deflection:

1 Add weights to position "B" until the trailing edge is aligned with the height gage indicator (Figure 502).

NOTE: The position "B" corresponds to the position above the mass adjustment plate (between the two first screws) on the tip of the elevator.

2 Weigh the added weights on a precision beam scale and write this value.

3 This value is the weight of the mass that must be added to the elevator mass adjustment plate.

NOTE: This value can be a few grams different than the necessary weight. Be careful and assume that the total mass to be added is the weight got plus 5 (or 10) grams. This action will allow a subsequent more accurate adjustment, if necessary.

4 Remove GSE 194 (or GSE 195 as applicable).

5 Remove the elevator tip (AMM TASK 55-20-01-000-801-A/400).

6 Remove the four bolts and the mass adjustment plate (AMM TASK 55-21-00-000-801-A/400).

7 Weigh all the mass adjustment plates and the bolts. Write this value. This value plus the result of step "3" must not be larger than 600 grams.

NOTE: If the total weight is more than 600 grams, contact Embraer Technical Support Department.

8 Prepare the additional mass to install on the elevator mass adjustment plate. To prepare the additional mass, use one of these procedures.

a Use the mass adjustment plate made by Embraer, that weights approximately 265 grams.

b Make a mass adjustment plate as shown in Figure 504 with a piece of lead or stainless laminated shim stock.

NOTE:
- Figure 504 shows the estimated weight for lead.
- Rework the lead or stainless laminated shim stock with the most applicable tool (hammer, scissors, pliers, file, etc.); only the shape of the external steel plate area must fit.

- If necessary, use longer bolts with the same characteristics. Different bolts can have different weights.
- To drill the holes for bolts, use the external steel plate as a reference.

9 Reinstall the mass adjustment plate plus the additional mass and the bolts, and the elevator tip with all its screws (do not tighten them now).

NOTE: It is not necessary to install the first screw (GSE position in Figure 503).

10 Install GSE 194 (or 195 as applicable) and do a check on the position of the elevator with the height gage:

– If they are aligned, the balancing is correct. Go to item "(6)".

– If they are not aligned (still in downward deflection), do steps "1" thru "10" again to get the balancing. If you get the upward deflection, go to sub item "(a)" above.

(6) After you get the balancing, remove the elevator tip.

(7) Remove all mass adjustment plates and the bolts.

NOTE: Make sure that the total weight is less than 600 grams.

(8) Prepare the surfaces of the elevator and the mass adjustment plate and apply the sealant (SRM 51-20-01) to each surface of the mass adjustment plate.

(9) Install all the mass adjustment plates and the bolts (AMM TASK 55-21-00-400-801-A/400).

NOTE:
- Apply a coat of epoxy primer to the delaminated shim surface before the installation, if ASTM A240 is used.
- When you install the four bolts, apply a 25-30-lbf.in torque.

(10) Install the elevator tip (AMM TASK 55-20-01-400-801-A/400).

(11) Remove the tape from the tab.

(12) Weigh the elevator assembly and write the value.

NOTE:
- After the static balancing, the elevator assembly must weigh 34000 ± 1000 g (APPLICABLE TO PRE-MOD. S.B.145-27-0034) or 37000 ± 1700 g (APPLICABLE TO POST-MOD. S.B. 145-27-0034).
- If this condition does not occur, contact Embraer Customer Support Division for more information.

K. Follow-on

SUBTASK 842-002-A

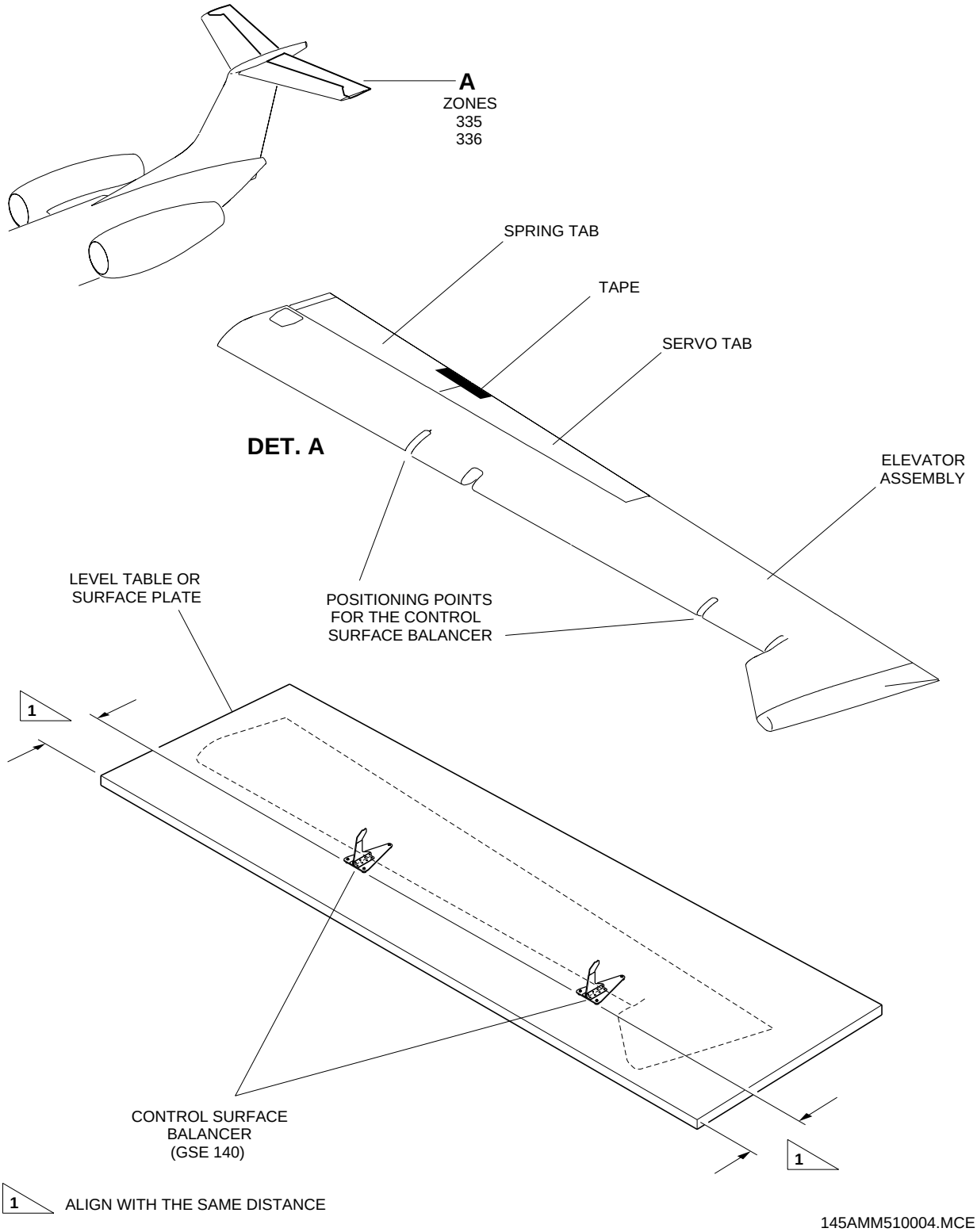
(1) Remove the bolts of the control-surface balancer positioning points from the elevator.

(2) Remove the elevator from the control-surface balancer.

(3) Install the elevator (AMM TASK 27-30-00-400-801-A/400).

EFFECTIVITY: ALL

Elevator Static Balance - Component Locations
Figure 501



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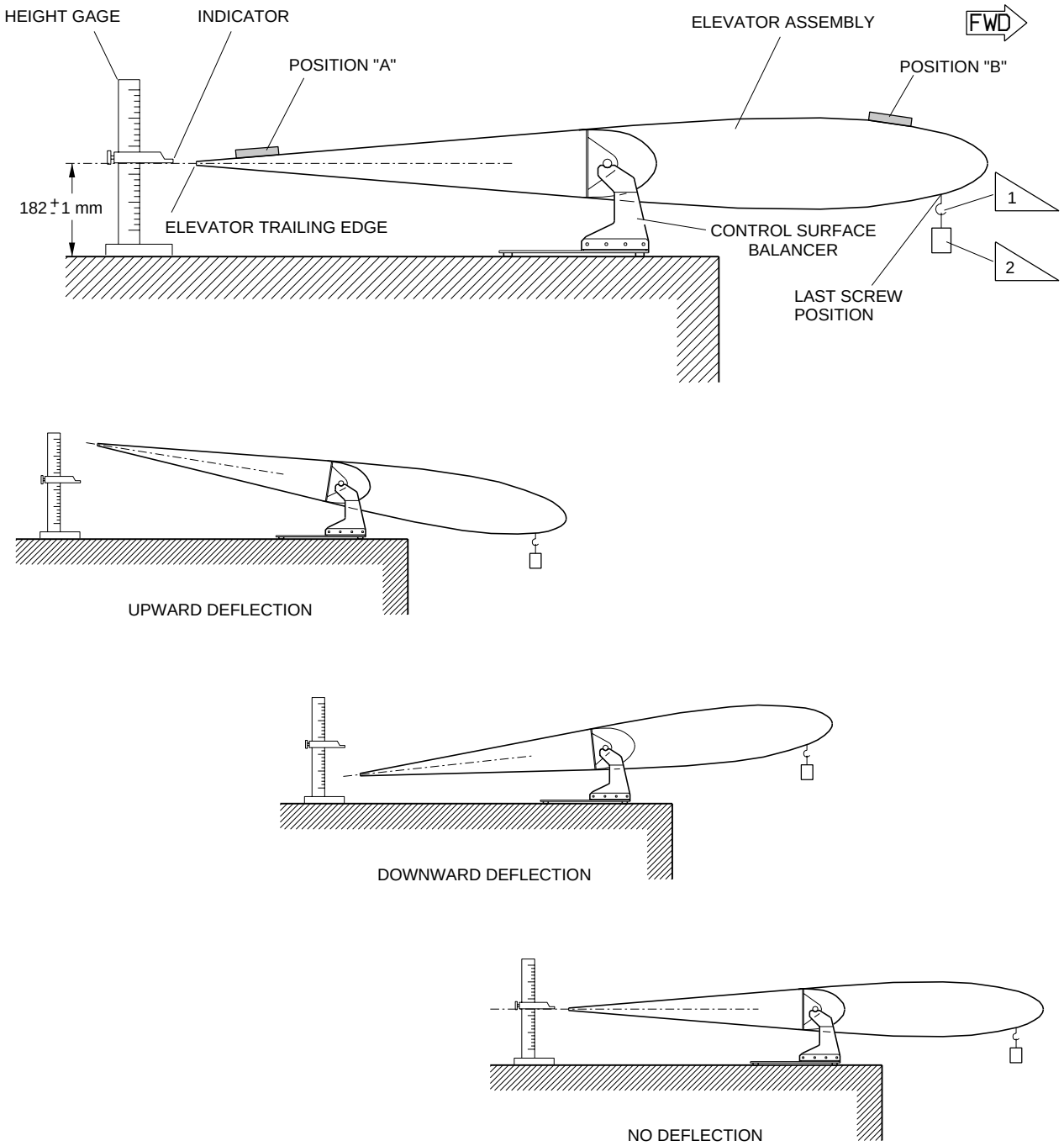
EFFECTIVITY: ALL

Elevator Static Balance - Deflection Positioning
Figure 502



1 THE HOOK OF THE MASS BALANCE WEIGHT MUST BE INSTALLED WITH ITS OPENING IN THE FLIGHT DIRECTION AS SHOWN

2 MASS BALANCE WEIGHT

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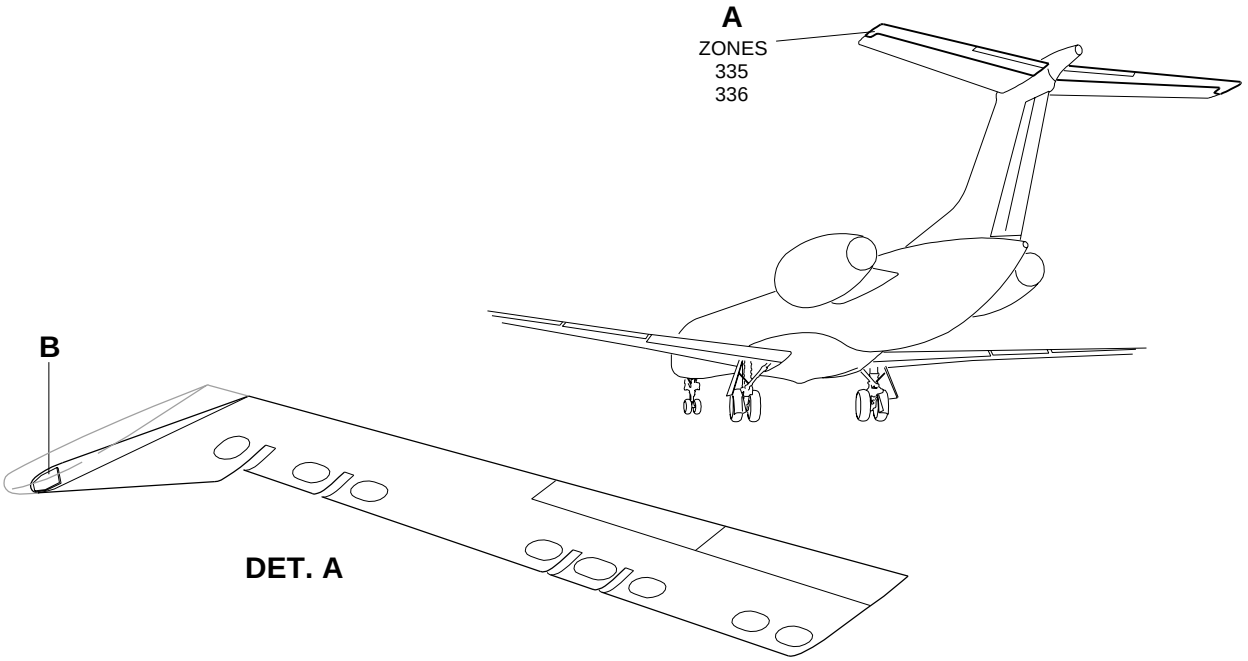
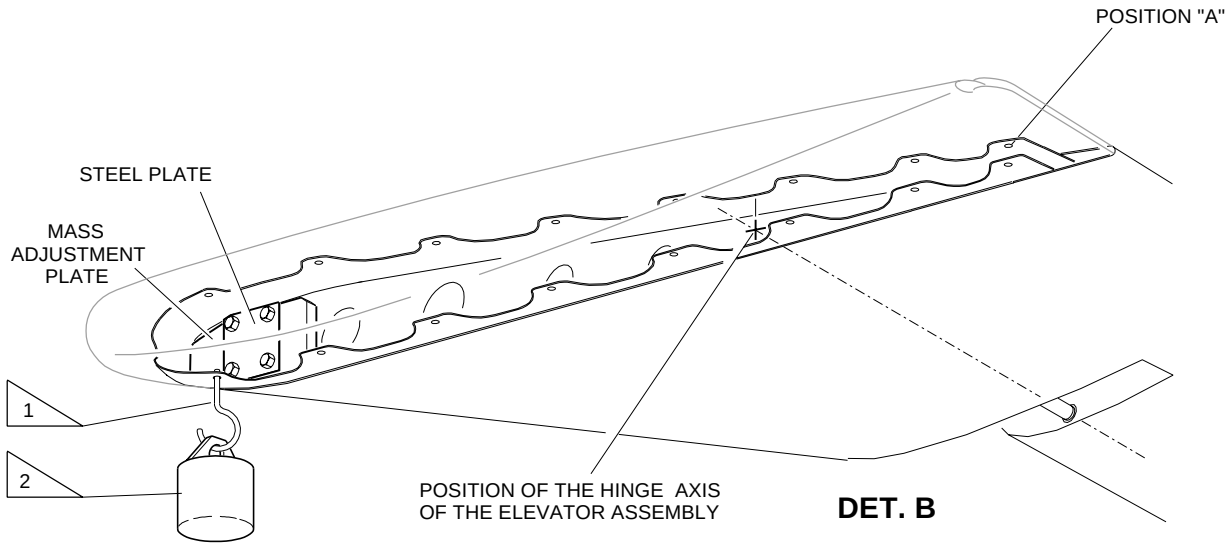
EFFECTIVITY: ALL

Elevator Static Balance - Dimensions
Figure 503





1 THE HOOK OF THE MASS BALANCE WEIGHT MUST BE INSTALLED WITH ITS OPENING IN THE FLIGHT DIRECTION AS SHOWN

2 MASS BALANCE WEIGHT

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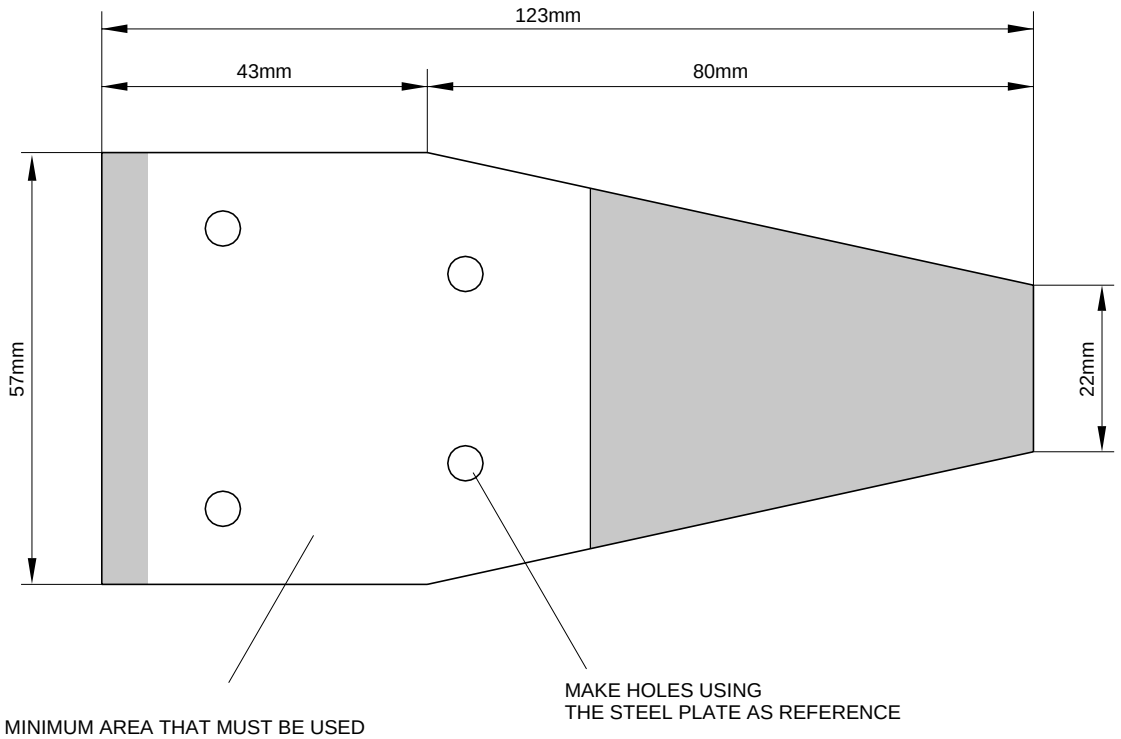
EFFECTIVITY: ALL

Elevator Static Balance - Mass Adjustment Plate
Figure 504



THICKNESS	WEIGHT MADE IN LEAD
1mm	73 grams
2mm	146 grams
3mm	219 grams
4mm	364 grams

NOTE: THE FIGURE SHOWS THE MAXIMUM SIZE OF THE ADDITIONAL MASS.

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