



EMB145 - EMB135

AIRCRAFT
MAINTENANCE MANUAL

RUDDER HYDRAULIC ACTUATION - ADJUSTMENT/TEST

EFFECTIVITY: ACFT MODEL(S) EMB-135

1. General

- A. This section gives the procedures to do the functional check of the rudder backlash.
- 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
27-22-00-700-801-A	RUDDER BACKLASH - FUNCTIONAL CHECK	ACFT MODEL(S) EMB-135
27-22-00-700-802-A	RUDDER HYDRAULIC DAMPING - FUNCTIONAL CHECK	JAA CERTIFIED-AIR-CRAFT

TASK 27-22-00-700-801-A

EFFECTIVITY: ACFT MODEL(S) EMB-135

2. RUDDER BACKLASH - FUNCTIONAL CHECK

A. General

- (1) This task gives the procedures to measure the rudder backlash.
- (2) [Figure 501](#) shows the GSE locations.

B. References

REFERENCE	DESIGNATION
AMM MPP 06-41-01/100	-
AMM TASK 20-40-01-860-801-A/200	ENERGIZATION OF THE AIRCRAFT WITH AN EXTERNAL POWER SOURCE
AMM TASK 25-12-06-000-801-A/400	PEDAL ASSEMBLY LINING - REMOVAL
AMM TASK 27-20-00-700-801-A/500	ADJUSTMENT OF THE RUDDER NEUTRAL POSITION AND DEFLECTIONS OF RUDDER I AND RUDDER II
AMM TASK 29-10-00-860-801-A/200	HYDRAULIC SYSTEM - PRESSURIZATION WITH HTS
FIM TASK 27-22-00-810-807-A	-

C. Zones and Accesses

ZONE	PANEL/DOOR	LOCATION
123	123BL	Area below the cockpit floor
325	325AL	Vertical stabilizer

D. Tools and Equipment

ITEM	DESCRIPTION	PURPOSE	QTY
GSE 036	Hydraulic platform	To get access to the vertical stabilizer	
GSE 056	Dynamometer	To apply the loads	
GSE 058	Kit, Rig Pins	To lock the rudder in the neutral position	
GSE 069	Kit, rudder backlash measurement	To measure the rudder backlash	
GSE 489	Dial indicator	To measure the rudder deflections	
GSE 336	Gauge, Rudder Neutral Position Setting	To do the check of the rudder neutral position	
GSE 378	Control Surface Backlash Calculation Software (Alternative)	To calculate the rudder backlash	

E. Auxiliary Items

Not Applicable

F. Consumable Materials

Not Applicable

G. Expandable Parts

Not Applicable

H. Persons Recommended

<i>QTY</i>	<i>FUNCTION</i>	<i>PLACE</i>
2	Do the task	Vertical stabilizer
1	Does the task	Cockpit and vertical stabilizer

I. Preparation
SUBTASK 841-010-D

CAUTION: EMBRAER RECOMMENDS: THE AIRCRAFT MUST STAY IN THE HANGAR AND ON GROUND.

- (1) Make sure that the aircraft is safe for maintenance.
- (2) Do not do other tasks on the aircraft because it will cause error on the surface position measurement.
- (3) Energize the aircraft with the external DC power supply ([AMM TASK 20-40-01-860-801-A/200](#)).

WARNING: THE HYDRAULIC SYSTEM CONTAINS PHOSPHATE-ESTER HYDRAULIC FLUID. THE FLUID CAN CAUSE IRRITATION IN YOUR SKIN OR INJURY TO YOUR EYES. USE THE APPLICABLE RUBBER GOGGLES AND GLOVES. IF THE FLUID TOUCHES YOU, FLUSH YOUR SKIN WITH WATER AND GET MEDICAL HELP.

- (4) Pressurize the hydraulic system ([AMM TASK 29-10-00-860-801-A/200](#)).
- (5) Make sure that the RUDDER SHUTOFF SYS 1 and RUDDER SHUTOFF SYS 2 pushbutton lights, installed on the Overhead Panel, are on. The EICAS display shows the RUDDER SYS 1-2 INOP caution message.
- (6) Cycle 10 times the rudder surface and stop the surface in the neutral position after the last cycle.
- (7) On the Overhead Panel, push the RUDDER SHUTOFF SYS 1 pushbutton, to turn on rudder system 1.
 - Make sure that the pushbutton light goes off. The EICAS display shows the RUDDER SYS 2 INOP caution message.
- (8) Make sure that the yaw trim indicator, on the EICAS, shows zero position.
- (9) On the circuit breaker panel, open the YAW TRIM circuit breaker and attach a DO-NOT-CLOSE tag to it.
- (10) Remove cockpit underfloor access hatch 123BL (AMM MPP 06-41-01/100).
- (11) Remove the pedal assembly linings ([AMM TASK 25-12-06-000-801-A/400](#)).
- (12) Put the rudder pedals in the neutral position and install the rig pins ([Figure 502](#)).

- (13) Remove the two screws that attach access panel 325AL to attach the straight edge GSE 069, as shown in DET. B ([Figure 501](#)).
- (14) Do a check of the rudder neutral position, as follows:
 - (a) Install the gauge (GSE 336) using the rivet row as reference as shown in DET. E ([Figure 501](#)).
 - (b) The rudder is in the neutral position when the rudder II trailing edge centerline is between the zero degree limit marks of the gauge setting with a tolerance of ± 1 degree.
 - (c) If the rudder is in the neutral position, remove the gauge setting. If it is not, do ([AMM TASK 27-20-00-700-801-A/500](#)).
- (15) Install the dial indicator (GSE 489) as shown in DET. D ([Figure 501](#)).

NOTE: The dial indicator stylus must be perpendicular to the rudder surface.

- (16) Adjust the dial indicator in its mid-scale position.
- (17) Install the dynamometer attachment device (GSE 069) on the rudder-II trailing edge as shown in DET. C ([Figure 501](#)).

J. Functionally Check Rudder Backlash ([Figure 501](#))

SUBTASK 720-010-D

- (1) Set the dial indicator to zero
- (2) Start to apply the load to the left. Let the rudder move to the left until you have a limit load of 25 kgf (55 lbf).
- (3) Measure the displacement only for 10 kgf (22 lbf) and 20 kgf (44 lbf) positions, and write down in ([Table 501](#)) the values shown on the dial indicator for cycle 1.
- (4) Slowly start to decrease the load applied to it. Let the rudder go back to the neutral position.
- (5) Measure the displacement only for 20 kgf (44 lbf) and 10 kgf (22 lbf) positions, and write down in ([Table 501](#)) the values shown on the dial indicator for cycle 1.
- (6) Start to apply the load to the right. Let the rudder move to the right until you have a limit load of 25 kgf (55 lbf).
- (7) Measure the displacement only for 10 kgf (22 lbf) and 20 kgf (44 lbf) positions, and write down in ([Table 501](#)) the values shown on the dial indicator for cycle 1.
- (8) Slowly start to decrease the load applied to it. Let the rudder go back to the neutral position.
- (9) Measure the displacement only for 20 kgf (44 lbf) and 10 kgf (22 lbf) positions, and write down in ([Table 501](#)) the values shown on the dial indicator for cycle 1.
- (10) Remove the dynamometer from the attachment device.

- (11) Grasp the rudder trailing edge and force the surface 5 times to the right and left directions before starting the next cycle.
- (12) Install the dynamometer (GSE 056) in the attachment device (GSE 069).
- (13) Repeat the steps (1) thru (11) for cycle 2 and cycle 3.

Table 501 - DISPLACEMENT X LOAD APPLIED

	LOAD VAL- UE kgf (lbf)	DISPLACEMENT mm (in)		
		CYCLE 1	CYCLE 2	CYCLE 3
WHILE YOU APPLY THE LOAD TO THE RIGHT	0	-----	-----	-----
	10 (22)	A1 = +	A1 = +	A1 = +
	20 (44)	B1 = +	B1 = +	B1 = +
WHILE YOU RELEASE THE LOAD	25 (55)	-----	-----	-----
	20 (44)	B2 = +	B2 = +	B2 = +
	10 (22)	A2 = +	A2 = +	A2 = +
WHILE YOU APPLY THE LOAD TO THE LEFT	0	-----	-----	-----
	10 (22)	A3 = -	A3 = -	A3 = -
	20 (44)	B3 = -	B3 = -	B3 = -
WHILE YOU RELEASE THE LOAD	25 (55)	-----	-----	-----
	20 (44)	B4 = -	B4 = -	B4 = -
	10 (22)	A4 = -	A4 = -	A4 = -
	0	-----	-----	-----

- (14) (Only if the GSE 378 is not available) For each cycle, find the backlash as follows:
 - (a) Find the "X1", "X2", "X3", and "X4" values as follows:

NOTE: You must use the (+) and (-) signs when you calculate the "X" value

 - $X1 = (2 \times A1) - B1$
 - $X2 = (2 \times A2) - B2$
 - $X3 = (2 \times A3) - B3$
 - $X4 = (2 \times A4) - B4$
 - (b) Do a check to make sure that the calculated values are equivalent to these values:
 - $X4 \quad X1 \text{ and } X3 \quad X2$

NOTE: If the values do not agree, ignore them and do a new cycle. Continue to use the backlash formula only when the values agree.
 - (c) Do this step to calculate the rudder backlash:

Table 502 - BACKLASH CALCULATION

	Cycle 1	Cycle 2	Cycle 3
$G1 = (X1 - X4)$			
$G2 = (X2 - X3)$			
$GA = (G1 + G2)/2$		- x - x - x -	- x - x - x -
$GB = (G1 + G2)/2$	- x - x - x -		- x - x - x -
$GC = (G1 + G2)/2$	- x - x - x -	- x - x - x -	
$G = (GA + GB + GC)/3$ ^[1]			

[1] G is the backlash value.

- For each of the cycles, find the “G1” and “G2” values as follows:

1. $G1 = (X1 - X4)$

2. $G2 = (X2 - X3)$

- Find the “GA”, “GB”, and “GC” values as follows:

1. $GA = (G1 + G2)/2$

2. $GB = (G1 + G2)/2$

3. $GC = (G1 + G2)/2$

- Calculate the G values for each of the three cycles and find the average value between them as follows:

1. $G = (GA + GB + GC)/3$

- (d) The G value is the rudder backlash. The maximum value permitted for the rudder backlash is 3.82 mm (0.1504 in)

Table 503 - MAXIMUM PERMITTED RUDDER BACKLASH

MAXIMUM PERMITTED RUDDER BACKLASH mm (in)	
3.82 mm	0.1504 in

NOTE: If the value found is out of the limit, refer to FIM TASK 27-22-00-810-807-A.

- (15) (Only if the GSE 378 is available) For each cycle, find the backlash as follows:

- Enter in the software with values of the Cycles 1, 2, and 3 indicated in the table 501.
- Check the value of the Rudder Backlash according to the Table 503.

- (16) Turn on rudder system 2 and make sure that the pushbutton light goes off.

- (17) Turn off rudder system 1 and make sure that the pushbutton light comes on.

- (18) Do steps (1) thru (15) for hydraulic system 2.

- (19) Turn off hydraulic system 2 and make sure that the pushbutton light goes off.



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K. Follow-on

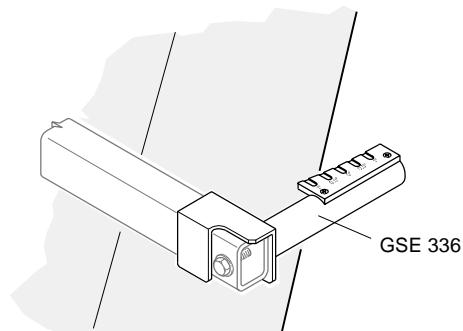
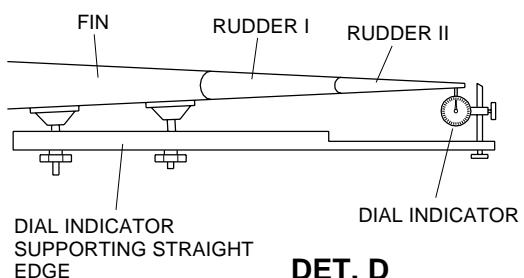
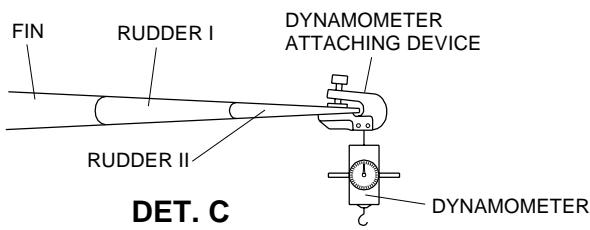
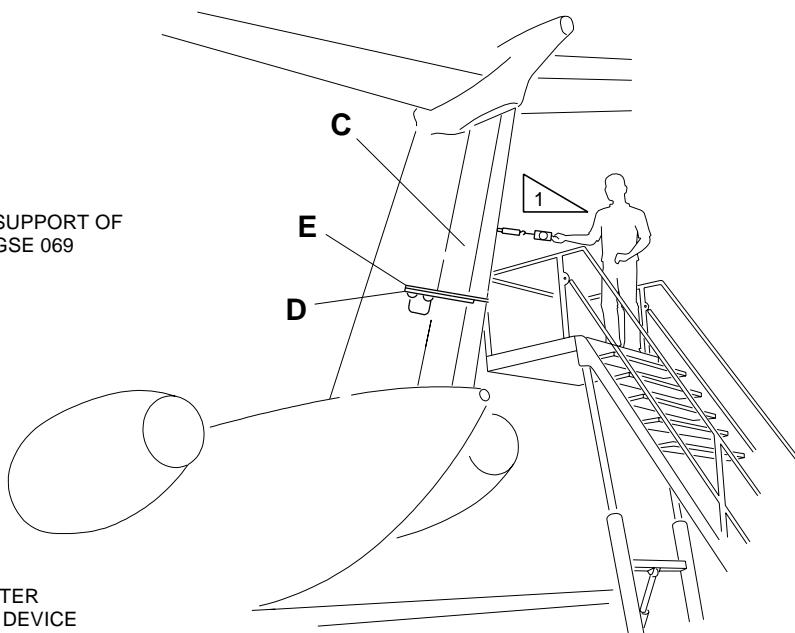
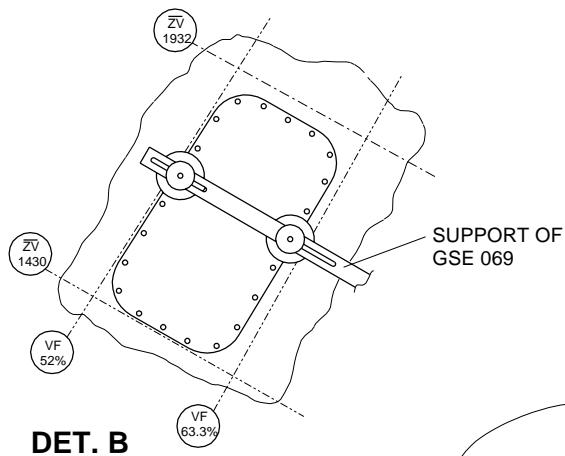
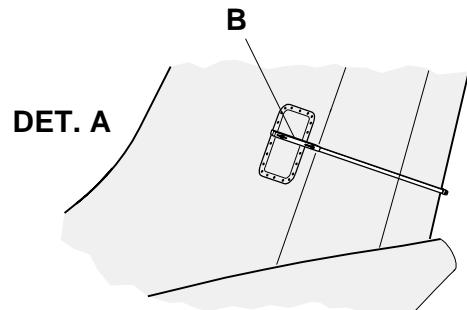
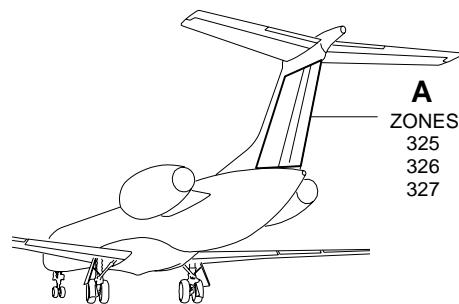
SUBTASK 842-010-D

- (1) On the Circuit Breaker Panel, close the YAW TRIM circuit breaker and remove the DO-NOT-CLOSE tag from it.
- (2) Release the pressure of the hydraulic system ([AMM TASK 29-10-00-860-801-A/200](#)).
- (3) Deenergize the aircraft ([AMM TASK 20-40-01-860-801-A/200](#)).
- (4) Remove the rig pins from the rudder pedals ([Figure 502](#)).
- (5) Remove tools and equipment from the rudder.
- (6) Install cockpit underfloor access hatch 123BL (AMM MPP 06-41-01/100).
- (7) Install the pedal assembly linings ([AMM TASK 25-12-06-000-801-A/400](#)).

EFFECTIVITY: ACFT MODEL(S) EMB-135

Rudder Backlash - Functional Check

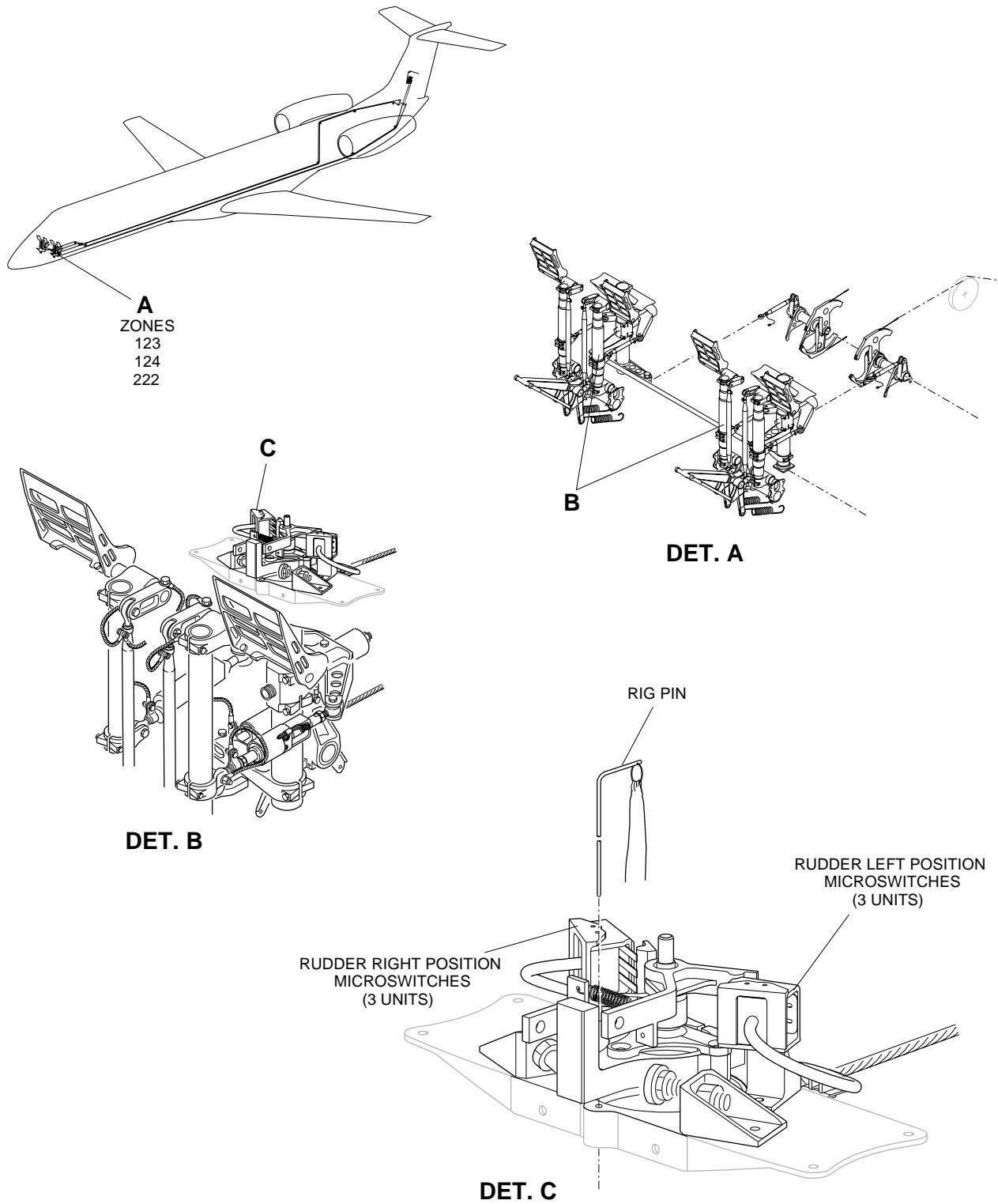
Figure 501



BE CAREFUL TO APPLY FORCE PERPENDICULARLY TO THE RUDDER SURFACE.

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EFFECTIVITY: ACFT MODEL(S) EMB-135
Rig Pins - Installation
Figure 502



EM145AMM270491A.DGN



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TASK 27-22-00-700-802-A

EFFECTIVITY: JAA CERTIFIED-AIRCRAFT

3. RUDDER HYDRAULIC DAMPING - FUNCTIONAL CHECK

A. General

(1) This task gives the procedures to do a check of the damping of the rudder.

B. References

REFERENCE	DESIGNATION
AMM TASK 20-40-01-860-801-A/200	ENERGIZATION OF THE AIRCRAFT WITH AN EXTERNAL POWER SOURCE
AMM TASK 29-10-00-860-801-A/200	HYDRAULIC SYSTEM - PRESSURIZATION WITH HTS
AMM TASK 29-10-00-860-802-A/200	HYDRAULIC SYSTEM - PRESSURIZATION WITH EMDP

C. Zones and Accesses

Not Applicable

D. Tools and Equipment

ITEM	DESCRIPTION	PURPOSE	QTY
GSE 036	Hydraulic Platform	To get access to the rudder trailing edge	
GSE 056	Dynamometer	To apply load to the rudder surface	
GSE 069	Rudder Measurement Backlash Kit	To use dynamometer attaching device AGE-00313-401 to apply loads to the rudder	
Commercially available	Stopwatch	To measure the time	

E. Auxiliary Items

Not Applicable

F. Consumable Materials

Not Applicable

G. Expandable Parts

Not Applicable

H. Persons Recommended

QTY	FUNCTION	PLACE
1	Does the task	Vertical stabilizer
1	Helps the other technician	Vertical stabilizer

I. Preparation

SUBTASK 841-011-D

(1) Make sure that the aircraft is safe for maintenance.

- (2) Install dynamometer attaching device AGE-00313-401 on the rudder trailing edge, in the middle point between the actuators. Refer to [Figure 503](#).
- (3) Energize the aircraft with the external DC power supply ([AMM TASK 20-40-01-860-801-A/200](#)).
- (4) Pressurize hydraulic systems 1 and 2 ([AMM TASK 29-10-00-860-801-A/200](#)).
- (5) Push RUDDER SHUTOFF SYS 1 and 2 to turn on the rudder system. Make sure that the pushbutton lights go off.

J. Functionally Check Rudder Hydraulic Damping ([Figure 503](#))

SUBTASK 720-011-D

WARNING: MAKE SURE THAT THERE ARE NO PERSONS OR EQUIPMENT IN THE RUDDER TRAVEL AREA.

- (1) Use the rudder pedals to do five rudder command cycles (fully left - neutral - fully right for each cycle).
- (2) Push RUDDER SHUTOFF SYS 1 and 2 to turn off the rudder system. Make sure that the pushbutton lights come on.
- (3) Release the pressure of the hydraulic system ([AMM TASK 29-10-00-860-802-A/200](#)).
- (4) Deenergize the aircraft ([AMM TASK 20-40-01-860-801-A/200](#)).
- (5) Install the dynamometer to its attaching device.
- (6) Move the rudder surface from the left stop to the right stop, while you apply a load of $7.5 \text{ kgf} \pm 0.5 \text{ kgf}$ to the rudder trailing edge.
- (7) Move the rudder surface from the right stop to the left stop, while you apply a load of $7.5 \text{ kgf} \pm 0.5 \text{ kgf}$ to the rudder trailing edge.
- (8) Smoothly do ten rudder command cycles in the mechanical reversion mode (fully left - neutral - fully right for each cycle).

NOTE: To do this step, move the rudder surface manually.

- (9) Measure the time to deflect the rudder, as follows:
 - (a) When you apply a load of $7.5 \text{ kgf} \pm 0.5 \text{ kgf}$ to move the rudder surface from the left stop to the right stop, the time must be of more than 3 seconds.
 - (b) When you apply a load of $7.5 \text{ kgf} \pm 0.5 \text{ kgf}$ to move the rudder surface from the right stop to the left stop, the time must be of more than 3 seconds.

K. Follow-on

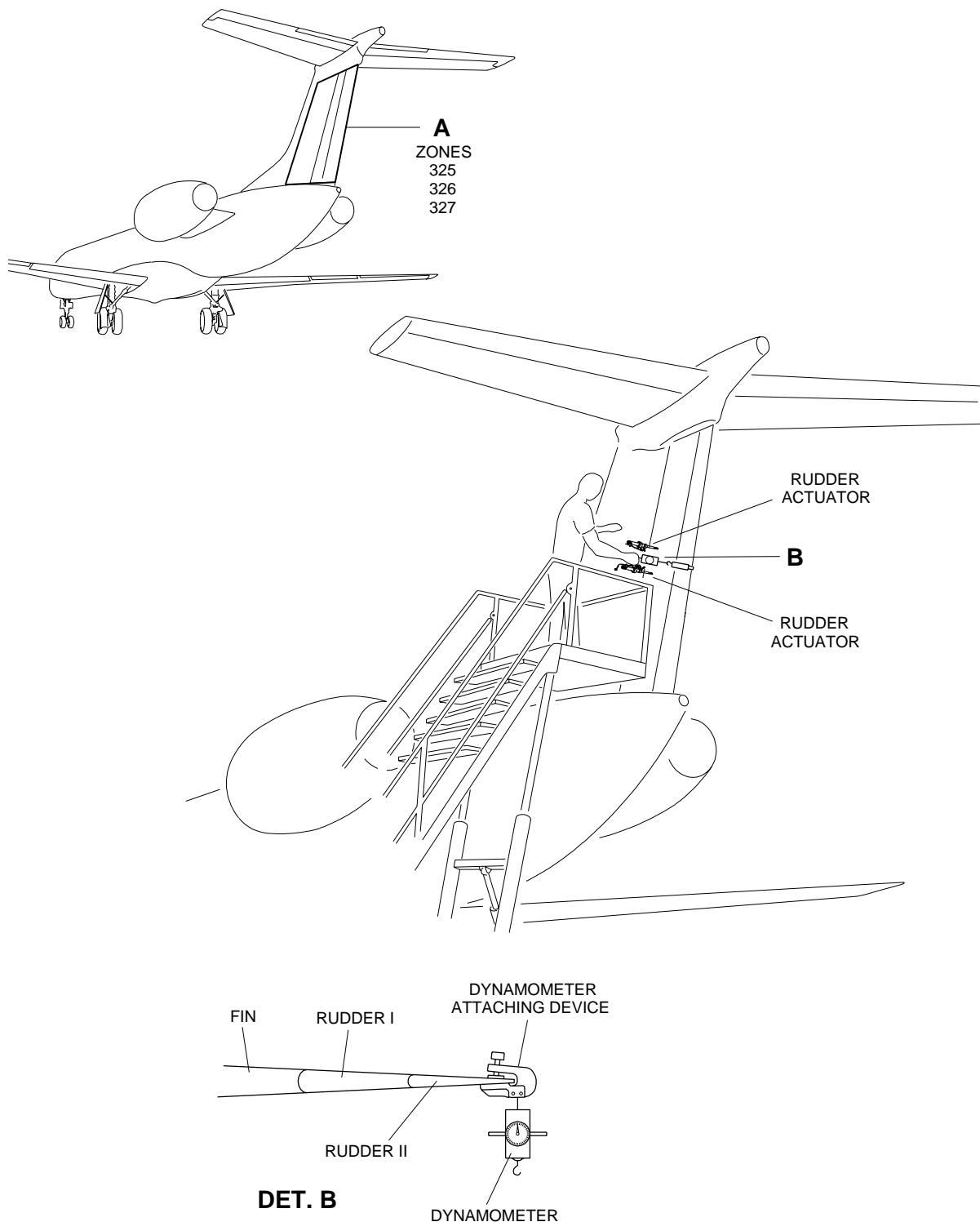
SUBTASK 842-011-D

- (1) Remove the dynamometer and its attaching device from the rudder trailing edge ([Figure 503](#)).
- (2) Remove GSE 036.

EFFECTIVITY: JAA CERTIFIED-AIRCRAFT

Rudder Hydraulic Damping

Figure 503



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