
SERVICE BULLETIN

N° 139-539

DATE: January 26, 2022

REV. : /

TITLE

ATA 53 - TRDL BEARING SUPPORT PANEL REINFORCEMENT

REVISION LOG

This is the first issue of Service Bulletin 139-539, that supersedes Service Bulletin 139-467.

An appropriate entry should be made in the aircraft log book upon accomplishment.
If ownership of aircraft has changed, please, forward to new owner.

1. PLANNING INFORMATION

A. EFFECTIVITY

All AW139 helicopters installing bearing support assy P/N 3G6510A05232 (part of TRDL P/N 4G6500A00212 and Tail rotor drive variant P/N 3G6506P00111), and equipped with tail boom assy P/N 3G5350A00132, P/N 3G5350A00133, P/N 3G5350A00134 or P/N 3G5350A00135.

B. COMPLIANCE

Part I:

Within twenty-five (25) flight hours from the last accomplishment of Service Bulletin 139-467 and then every twenty-five (25) flight hours, until compliance with Part III.

Part II:

- Immediately after compliance with Part I on the helicopters that have recorded cracks on the tail panels performing Part I of this Service Bulletin.
- Three months before accomplishment of Part III on helicopters that do not record cracks on the tail panels performing Part I of this Service Bulletin.

Part III:

- Within one hundred (100) flight hours from accomplishment of Part I, on all the helicopters that have recorded cracks on the tail panels performing Part I of this Service Bulletin.
- Within fifteen hundred (1500) flight hours or two (2) years, whichever comes first, from the issue date of this Service Bulletin, on helicopters that do not record cracks on the tail panels performing Part I of this Service Bulletin.

C. CONCURRENT REQUIREMENTS

N.A.

D. REASON

This Service Bulletin is issued to prescribe the reinforcement of the TRDL support bearing backup structure, performing interim repetitive inspections until implementation of the retromodification.

E. DESCRIPTION

Investigation following cases of cracks in the bearing support reported in service prompted the issuance of Service Bulletin 139-467, introducing a periodic inspection of

the tail rotor bearing support bracket for cracks and condition and a one-off torque check of the tail rotor bearing support bolts/nuts.

Since cases of cracks have been never recorded on tail boom assy P/N 3G5350A00136, whose bearing support panels are already designed with an increased thickness that avoid the formation of cracks, as confirmed after monitoring the in-service fleet by means of the current periodic inspection, this Service Bulletin is issued to introduce a similar structural reinforcement in the TRDL bearing support area, as the terminating action for the periodic inspection prescribed by Part I, on helicopters equipped with tail boom assy P/N 3G5350A00135 and previous P/N.

This purpose is obtained by adding two doublers on the upper side of the bearing support panel and two others on the lower side, as described in Part III, while adapting to possible repairs existing in the bearing support area.

Before installation of such reinforcements, an additional one-off inspection is prescribed, with bearing support removal required, in order to identify any potential damage in the area, as described in Part II.

This Service Bulletin supersedes Service Bulletin 139-467, that is meanwhile cancelled.

F. APPROVAL

The technical content of this Service Bulletin is approved under the authority of DOA nr. EASA.21.J.005. For helicopters registered under other Aviation Authorities, before applying the Service Bulletin, applicable Aviation Authority approval must be checked within Leonardo Helicopters customer portal.

EASA states mandatory compliance with inspections, modifications or technical directives and related time of compliance by means of relevant Airworthiness Directives.

If an aircraft listed in the effectivity embodies a modification or repair not LHD certified and affecting the content of this Service Bulletin, it is responsibility of the Owner/Operator to obtain a formal approval by Aviation Authority having jurisdiction on the aircraft, for any adaptation necessary before incorporation of the present Service Bulletin.

G. MANPOWER

To comply with this Service Bulletin the following MMH are deemed necessary:

Part I: approximately one (1) MMH;

Part II: approximately four (4) MMH;

Part III: approximately sixty (60) MMH (repair not included).

MMH are based on hands-on time and can change with personnel and facilities available.

H. WEIGHT AND BALANCE

WEIGHT (Kg)		0.82
LONGITUDINAL BALANCE	ARM (mm) 8849	MOMENT (Kgmm) 7256.2

I. REFERENCES

1) PUBLICATIONS

Following Data Modules refer to AMP:

<u>DATA MODULE</u>	<u>DESCRIPTION</u>	<u>PART</u>
DM01 39-A-00-20-00-00A-120A-A	Helicopter on ground for a safe maintenance.	I, II, III
DM02 39-A-06-41-00-00A-010A-A	Access doors and panels	I, II, III
DM03 39-A-53-40-00-00A-520A-A	Tail section (structure) - Remove procedure	III
DM04 39-A-53-40-00-00A-520B-A	Tail section (structure) - Remove procedure	III
DM05 39-A-53-40-00-00A-720B-A	Tail section (structure) – Install procedure	III
DM06 39-A-53-40-00-00A-720A-A	Tail section (structure) - Install procedure	III
DM07 39-B-65-11-11-00A-520A-A	Bearing support – Remove procedure	II, III
DM08 39-B-65-11-11-00A-720A-A	Bearing support - Install procedure	II, III
DM09 39-B-65-11-11-00A-530A-B	Bearing support - Disassemble procedure	I
DM10 39-B-65-11-11-00A-710A-B	Bearing support - Assemble procedure	I
DM11 39-B-65-11-01-00A-520A-A	Number 1 drive shaft - Remove procedure	III
DM12 39-B-65-11-02-00A-520A-A	Number 2 drive shaft - Remove procedure	III
DM13 39-B-65-11-01-00A-720A-A	Number 1 drive shaft - Install procedure	III
DM14 39-B-65-11-02-00A-720A-A	Number 2 drive shaft - Install procedure	III

Following Data Modules refer to CSRP:

<u>DATA MODULE</u>	<u>DESCRIPTION</u>	<u>PART</u>
DM15	CSRP-A-51-10-00-00A-028A-D Damage assessment - General	II, III
DM16	CSRP-A-51-21-00-00A-028A-D Surface treatments - General	III
DM17	CSRP-A-51-21-05-00A-028A-D Cleaning of structural parts - General	III
DM18	CSRP-A-51-21-06-00A-644A-D Chromate conversion treatments of alluminium alloys - Chromate	III
DM19	CSRP-A-51-22-00-00A-028A-D Bonding and sealing - General	III
DM20	CSRP-A-51-41-00-00A-663A-D Riveted structures - Standard repair procedure	III
DM21	CSRP-A-51-42-00-00A-028A-D Potted Inserts - General	III
DM22	CSRP-A-51-70-00-00A-010A-D Standard repairs - General data	III

2) ACRONYMS

AMDI	Aircraft Material Data Information
AMP	Aircraft Maintenance Publication
ASRP	Aircraft Structural Repair Publication
CSRP	Common Structural Repair Publication
DM	Data Module
FH	Flight Hours
FOC	Free Of Charge
IETP	Interactive Electronic Technical Publication
ITEP	Illustrated Tool and Equipment Publication
LHD	Leonardo Helicopters Division
MMH	Maintenance Man Hours
MMIR	Maintenance Malfunction Information Report
TRDL	Tail Rotor Drive Line

3) ANNEX

Annex A	TRDL Limited Direct Alignment Check
Annex B	TRDL Final Alignment Check
Annex C	Tail Alignment Procedure
Annex D	Tail boom assy repairs
Annex E	ASRP DM 39-A-53-51-01-01E-664A-D (Repair SK139-1510)

J. PUBLICATIONS AFFECTED

N.A.

K. SOFTWARE ACCOMPLISHMENT SUMMARY

N.A.

2. MATERIAL INFORMATION

A. REQUIRED MATERIALS

1) PARTS

PART III

#	P/N	ALTERNATIVE P/N	DESCRIPTION	Q.TY	LVL	NOTE	LOG P/N
1	3G5350P00311		TAIL ROTOR DRIVE RETROMOD	REF	.		
2	3G5350P00351		Doubler	1	..	(1)(2)	139-539L2
3	3G5350P00352		Peeling	2	..	(1)(3)(4)	
4	3G5350P00353		Doubler	1	..	(1)(2)(4)	139-539L2 139-539L3
5	3G5350P00354		Doubler	1	..	(2)(5)	139-539L4
6	3G5350P00355		Doubler	1	..	(2)(5)	139-539L4
7	3G5350P00356		Doubler	1	..	(2)(5)	139-539L4
8	3G5350P00357		Doubler	1	..	(2)(4)	139-539L3
9	3G5350P00358		FWD Doubler	1	..	(2)(6)	139-539L5
10	3G5350P00359		RWD Doubler	1	..	(2)(6)	139-539L5
11	3G5350P00361		Doubler	1	..	(2)(6)	139-539L5
12	A299A05TW05		Rivet	4	..		139-539L1
13	NAS9301B-4-03		Rivet	12	..	(5)	139-539L1
14	NAS9301B-5-02		Rivet	16	..	(1)(4)(6)	139-539L1
15	NAS9301B-5-03		Rivet	6	..		139-539L1
16	NAS9301B-5-04		Rivet	22	..		139-539L1
17	NAS9301B-5-05		Rivet	4	..		139-539L1
18	3G5350P00611		TAIL ROTOR DRIVE INTERNAL SIDE RETROMOD	REF	.		
19	3G5350P00651		Doubler	2	..	(7) (8)	139-539L6
20	NAS9301B-4-01		Rivet	36	..	(8)	139-539L6
21	A388A3E16C		Standoff	1	.		139-539L1
22	A366A3E22C		Standoff	1	.		139-539L1

2) CONSUMABLES

The following consumable materials, or equivalent, are necessary to accomplish this Service Bulletin:

#	P/N	DESCRIPTION	Q.TY	NOTE	PART
23	MS20995C32	Lockwire	AR	(9)	III
24	TT-N-95 Type II Code No 531055030	Aliphatic naphtha (C059)	AR	(9)	I, III
25	Commercial	Clean, lint-free, cloth (C011)	AR	(9)	I, II, III
26	MIL-PRF-16173 grade 1 Code No 999999999000000191	Corrosion inhibitor (C002)	AR	(9)	III
27	MIL-PRF-680, Type II cod. 505405407	Cleaning solvent, Ardrox 5503A (C010)	AR	(9)	III
28	MMM-A-132, Type 2, Class II Code No. 900000581 199-05-002, Type I, Class 2	Adhesive EA9309.3NA (C021)	AR	(9)	III
29	/	PTFE Sealant Tape (C405), thickness 0.3 mm, width 21 mm	AR	(9) (10)	III

#	P/N	DESCRIPTION	Q.TY	NOTE	PART
30	AWMS05-001 Type 1, Class B, Grade 2 Code No. 999999999000015245	Sealant MC-780 B-2 (C465)	AR	(9)	III
31	AWMS28-002 Type I, Class 1, Grade A or B	Epoxy primer (C596)	AR	(9)	III
32	MMM-A-132 Type I, Class 3 199-05-002, Type II, Class 2	Adhesive EA934NA (C057)	AR	(9)	III

Refer also to AMDI for the consumable materials required to comply with the AMP DM referenced in the accomplishment instructions.

3) LOGISTIC MATRIX

In order to apply this Service Bulletin, the following Logistic P/N can be ordered in accordance with the applicable notes:

LOGISTIC P/N	Q.TY (PER HELO)	NOTE	PART
139-539L1	1		III
139-539L2	1	(1)	III
139-539L3	1	(4)	III
139-539L4	1	(5)	III
139-539L5	1	(6)	III
139-539L6	1	(8)	III

NOTE

- (1) Required for helicopters not equipped with the tail boom repairs on the upper side.
- (2) This item can also be obtained from raw material according to Figures 9 thru 11.
- (3) Obtained by peeling existing shims. Peel the existing shims according to the thickness of the added doublers (see Figure 9).
- (4) Required for helicopters equipped with the tail boom assy STA 8947.66 repair RS139-5351-0249.
- (5) Required for helicopters equipped with the tail boom assy STA 8947.66 repair P/N 3G5350R00211 or SK139-1322.
- (6) Required for helicopters equipped with the tail boom assy STA 8947.66 repair RS139-5351-0348.
- (7) This item can also be obtained from raw material according to Figure 14.
- (8) Required only for helicopters not equipped with the tail boom repairs on the lower side.
- (9) Item to be procured as local supply.
- (10) It is allowed to use any kind of PTFE tape, with or without ribs, with or without the adhesive applied on one side. Use of GSC-21-95338-011 or GSC-21-95313-011 (Code No. AW005ME01T104212), GSC-21-95338-03 or GSC-21-95313-03 (Code No. AW005ME01T104210) is suggested.

B. SPECIAL TOOLS

#	P/N	DESCRIPTION	Q.TY	NOTE	PART
33	RMGE3G-103A	Deck servicing platform RH (GG-02-00) or approved alternative	AR	(B1)	I, II, III
34	Commercial	Magnifying glass, 10-power	1	(B1)	I, II
35	Commercial	Strong light	1	(B1)	I, II
36	Commercial	Plastic scraper	1	(B1)	III
37	PEC-139-009-01	TRDL alignment check tool assy	1	(B2) (B5)	III
38	139H6300D002A651D	Linear gauge support	1	(B3) (B5)	III
39	TALL0000M1A686A	Linear gauge bench	1	(B3) (B5)	III
40	TECO6-147	Optical device (Telescope Keuffel & Esser or equivalent)	1	(B4)	III
41	TECO6-148	Target glass (Telescope Keuffel & Esser or equivalent)	1	(B4)	III
42	3G6510H05232A651A	Central support	1	(B4)	III
43	3G5350H00131A651A	Tail module sustaining strut	1	(B4)	III
44	3G6500H00211A651A	IGB target adapter	1	(B4)	III
45	3G6500H00311A651A	Telescope support kit (TGB)	1	(B4)	III
46	3G6510A01531A651A	Damper adapter (STA 10587.80)	1	(B4)	III

Refer also to ITEP for the special tools required to comply with the AMP DM referenced in the accomplishment instructions.

SPECIAL TOOLS NOTE

- (B1) Item to be procured as local supply.
- (B2) Tool assy to be used only to comply with the TRDL Limited Direct Alignment Check described in Annex A.
- (B3) Tool assy to be used to comply with the TRDL Final Alignment Check in Annex B and that may be used also to comply with the TRDL Limited Direct Alignment Check described in Annex A, if required.
- (B4) Tool assy to be used only to comply with the Tail Alignment Procedure described in Annex C, if required.
- (B5) Customer must contact AW139 Customer Support and Service at least three (3) months in advance from the scheduled Service Bulletin application, to request this special tool. Please contact LH order administration to request the tool supplying on loan (1 for fleet, except where differently indicated). As soon as the present Service Bulletin is implemented, the tools supplied on loan must be promptly returned to LH.

C. INDUSTRY SUPPORT INFORMATION

Owners/Operators who comply with the instructions of this Service Bulletin no later than the applicable date in the “Compliance” section will be eligible to receive REQUIRED MATERIALS on free of charge basis, except for Consumable Materials and Special Tools.

Customers who fail to comply with the instructions in this Service Bulletin before the compliance date are not eligible for the aforementioned special policy.

Please issue relevant MMIR form to your Warranty Administration Dpt, complete of pictures of cracks found and TQ's evaluation received by Engineering Support Team with the list of components to replace. In case the request is not accompanied by this documentation, it will be rejected.

3. ACCOMPLISHMENT INSTRUCTIONS

WARNING

CLEANING SOLVENT, ALIPHATIC NAPHTHA AND CORROSION PROTECTION COMPOUND ARE DANGEROUS MATERIALS. BEFORE YOU DO THIS PROCEDURE, MAKE SURE THAT YOU KNOW ALL THE SAFETY PRECAUTIONS AND FIRST AID INSTRUCTIONS FOR THESE MATERIALS.

CAUTION

Performing this procedure, do not touch the components made of metal with your bare hands. Put on applicable cotton gloves before you touch the components. Contamination from your bare hands will cause corrosion of the metals.

GENERAL NOTES

- a) Place an identification tag on all components that are re-usable, including the attaching hardware that has been removed to gain access to the modification area and adequately protect them until their later re-use.
- b) Exercise extreme care during drilling operations to prevent instruments, cables and hoses damage.
- c) After drilling, remove all swarf and sharp edges. Apply on bare metal a light film of primer unless the hole is used for ground connection.
- d) Protect properly all those equipment not removed from area affected by the modification during installation procedure.
- e) Use aliphatic naphtha to degrease. Cleaned surfaces shall be allowed to air dry for at least 30 minutes before bonding.
- f) Let adhesive cure at room temperature for at least 24 hours unless otherwise specified.

- g) Exposed thread surface and nut must be protected using a layer of tectyl according to MIL-C-16173 grade I.
- h) All lengths are in mm.

PART I

1. In accordance with AMP DM 39-A-00-20-00-00A-120A-A, prepare the helicopter on ground for a safe maintenance. Disconnect the battery, all electrical power sources and/or the external power supply.
2. Put the platform (GG-02-00), or an approved alternative, adjacent to the right side of the fuselage.
3. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, remove access panel 310AL and access panel 310BL to get access to the TRDL bearing support panel.
4. Do a visual inspection of the bearing support bracket as described in the following procedure:

CAUTION

Do not remove paint from the bearing support bracket performing following step 4.1. Even in case of cracks in the paint, replacement of the bearing support bracket is required.

NOTE

To clean the bearing support bracket to perform the inspection at following step 4.1, refer to Figure 1 to identify the areas to be inspected. Remove sealing compound from those areas, if present.

- 4.1 With reference to Figure 1, get access to the bearing support area and clean the bearing support bracket from dust, particles and lubricant using a clean, lint-free cloth (C011) and aliphatic naphtha (C059).
- 4.2 Perform the visual inspection for cracks of the bearing support bracket according to Figure 1, using a magnifying glass and a strong light.
- 4.3 If you find any crack, proceed as follows:
 - 4.3.1 Replace the bearing support bracket with a serviceable one P/N 3G6510A05432. Refer to AMP DM 39-B-65-11-11-00A-530A-B and DM 39-B-65-11-11-00A-710A-B.

- 4.3.2 Return the defective bearing support bracket to LHD. Contact Product Support Engineering (engineering.support.lhd@leonardocompany.com) for the appropriate instruction to return defective components.
5. With reference to Figure 2 View D and to Figures D1 thru D5, D22 and D23 in Annex D, perform the visual inspection for cracks and signs of corrosion of the left and right tail boom panels, on both the upper and the lower side (under roof) of the panel. If there are cracks or signs of corrosion, proceed to step 4 of Part II, to better define the damage limits.
 6. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, install access panel 310AL and access panel 310BL removed at step 3.
 7. Remove the platform from the right side of the fuselage.
 8. Return the helicopter to flight configuration and record for compliance with Part I on the helicopter logbook.

PART II

1. In accordance with AMP DM 39-A-00-20-00-00A-120A-A, prepare the helicopter on ground for a safe maintenance, if required. Disconnect the battery, all electrical power sources and/or the external power supply.
2. Put the platform (GG-02-00), or an approved alternative, adjacent to the right side of the fuselage.
3. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, remove access panel 310AL and access panel 310BL to get access to the TRDL bearing support panel.
4. In accordance with AMP DM 39-B-65-11-11-00A-520A-A, remove the bearing support.
5. With reference to Figure 2 and to Figures D1 thru D5, D22 and D23 in Annex D, perform the visual inspection for cracks and signs of corrosion of the left and right tail boom panels, on both the upper side and the lower side (under roof) of the panel. If there are cracks or signs of corrosion proceed as follows:
 - 5.1 In accordance with DM CSRPA-51-10-00-00A-028A-D examine the damaged area.
 - 5.2 Identify the damage in accordance with the Figures D1 thru D5, D22 and D23 in Annex D.
 - 5.3 If the damage is not among those indicated in the figures, contact Product Support Engineering (engineering.support.lhd@leonardocompany.com) for the appropriate instructions, otherwise plan to perform the applicable repair when complying with Part III:
 - For the damage area 1 (see Figure D2), perform tail boom assy repair 3G5350R00211 described in paragraph 4 of Annex D;
 - For the damage area 2 (see Figure D3), perform tail boom assy repair SK139-1322 described in paragraph 5 of Annex D;
 - For the damage area 3 (see Figure D4), perform tail boom assy repair RS139-5351-0348 described in paragraph 6 of Annex D;
 - For the damage area 4 (see Figure D5), perform tail boom assy repair RS139-5351-0249 described in paragraph 7 of Annex D;
 - For the damage area 5 (see Figure D22), perform tail boom assy repair SK139-1510, described in paragraph 9 of Annex D;
 - For the damage area 6 (see Figure D23), perform tail boom assy repair RS139-5351-0714, described in paragraph 8 of Annex D.
6. In accordance with AMP DM 39-B-65-11-11-00A-720A-A, install the bearing support.
7. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, install access panel 310AL and access panel 310BL removed at step 3.

8. Remove the platform from the right side of the fuselage.
9. Return the helicopter to flight configuration and record for compliance with Part II on the helicopter logbook.

PART III

1. In accordance with AMP DM 39-A-00-20-00-00A-120A-A, prepare the helicopter on ground for a safe maintenance, if required. disconnect the battery, all electrical power sources and/or the external power supply.
2. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, remove access panel 310AL and access panel 310BL to get access to the TRDL bearing support panel.

NOTE

Data listed in Table 1 have been recorded performing TRDL Final Alignment Check on the helicopter before aircraft delivery. If the tailboom assy has been installed as an in-service replacement, data in Table 1 are not applicable.

3. If the helicopter S/N is listed in Table 1 and the original tail boom assy has never been replaced, perform the first part of the TRDL limited direct alignment check according to step 1 of Annex A.
4. In accordance with AMP DM 39-B-65-11-11-00A-520A-A, remove the bearing support P/N 3G6510A05232.

NOTE

It is allowed to remove also the N. 1 drive shaft, in accordance with AMP DM 39-B-65-11-01-00A-520A-A, if required to get an easier access to the work area.

5. In accordance with AMP DM 39-B-65-11-02-00A-520A-A, remove the N. 2 drive shaft.
6. If required following the inspection, as per step 5 of Part II, repair the panels in accordance with the applicable repair procedure in Annex D.

NOTE

Following step 7 is applicable to the helicopters not equipped with the tail boom assy STA 8947.66 repair P/N 3G5350R00211 or SK139-1322 or repair RS139-5351-0249 or repair RS139-5351-0348.

7. With reference to Figures 3 thru 5 and Figure 9, perform the tail rotor drive retro-modification P/N 3G5350P00311 as described in the following procedure:
 - 7.1 With reference to Figures 3 and 4, remove n°2 peeling shims P/N 3G6510A05651 from the tail boom.

- 7.2 With reference to Figure 4, drill out the existing rivets whose position shall be used to install the doublers P/N 3G5350P00351 and P/N 3G5350P00353 on the tail boom.

NOTE

Peel the existing shims according to the thickness of the added doublers (see Figure 9).

- 7.3 With reference to Figure 9, manufacture locally the n°2 peeling shims P/N 3G5350P00352 reworking the existing peeling shims P/N 3G6510A05651.
- 7.4 Clean and degrease the tail boom area where the doubler P/N 3G5350P00351 shall be installed, using a clean lint-free cloth (C011) and aliphatic naphtha (C059).
- 7.5 With reference to Figure 4, temporarily locate the doublers P/N 3G5350P00351 and P/N 3G5350P00353 on the tail boom.
- 7.6 With reference to Figure 4, countermark position of n°30 rivet holes on the doublers (BL 0.0 position).
- 7.7 With reference to Figure 4 and Figure 5 Detail D, countermark the position of n°4 existing inserts on the doubler P/N 3G5350P00351.
- 7.8 With reference to Figure 4, countermark the position of n°22 rivets necessary to complete the fixing of the doubler P/N 3G5350P00351 and the doubler P/N 3G5350P00353 on the tail boom.
- 7.9 With reference to Figure 4, drill n°30 holes $\varnothing 4.09 \div 4.22$ through doublers P/N 3G5350P00351 and P/N 3G5350P00353 (BL 0.0 position).
- 7.10 With reference to Figure 4 Detail D, drill n°4 insert holes $\varnothing 7.94 \div 8.09$ through doubler P/N 3G5350P00351 (shims installation position).
- 7.11 With reference to Figure 4, drill n°22 holes $\varnothing 4.09 \div 4.22$ through doubler P/N 3G5350P00351, doubler P/N 3G5350P00353 and upper skin of the tail boom honeycomb panel.
- 7.12 With reference to Figure 4, install the doubler P/N 3G5350P00351 and the doubler P/N 3G5350P00353 by means of adhesive EA9309.3NA (C021) on the tail boom.
- 7.13 With reference to Figure 4, complete the installation of the doublers P/N 3G5350P00351 and P/N 3G5350P00353 by means of n°4 rivets P/N A299A05TW05, n°16 rivets P/N NAS9301B-5-02, n°6 rivets P/N NAS9301B-5-03, n°22 rivets P/N NAS9301B-5-04 and n°4 rivets P/N NAS9301B-5-05 in the indicated positions.

- 7.14 With reference to Figure 5 Section B-B, seal all around the perimeter of the doubler P/N 3G5350P00351 and of the doubler P/N 3G5350P00353 by means of sealant MC-780 B-2.
- 7.15 With reference to Figure 4, install the n°2 peeling shims P/N 3G5350P00352 by means of adhesive EA9309.3NA (C021) on the doubler P/N 3G5350P00351.
- 7.16 With reference to Figure 5 Section C-C, seal all around the perimeter of the peeling shims P/N 3G5350P00352 by means of sealant MC-780 B-2.

NOTE

Following step 8 is applicable to the helicopters equipped with the tail boom assy STA 8947.66 repair P/N 3G5350R00211 or SK139-1322.

- 8. With reference to Figures 3 and 6, perform the tail rotor drive retro-modification P/N 3G5350P00311 as described in the following procedure:

NOTE

For helicopters equipped with the tail boom assy repair SK139-1322, it is allowed to trim the contour of the doubler P/N 3G5350P00355 to fit with the existing doubler.

- 8.1 With reference to Figure 6 Detail F, drill out the existing rivets whose position shall be used to install the doublers P/N 3G5350P00354, P/N 3G5350P00355 and P/N 3G5350P00356 on the tail boom.
- 8.2 Clean and degrease the tail boom area where the doublers P/N 3G5350P00355 and P/N 3G5350P00356 shall be installed, using a clean lint-free cloth (C011) and aliphatic naphtha (C059).
- 8.3 With reference to Figure 6 Detail F, temporarily locate the doublers P/N 3G5350P00354, P/N 3G5350P00355 and P/N 3G5350P00356 on the tail boom and countermark position of n°42 rivet holes on the doublers.
- 8.4 With reference to Figure 6 Detail F, drill n°30 holes $\varnothing 4.09 \div 4.22$ through the doublers P/N 3G5350P00354, P/N 3G5350P00355 and P/N 3G5350P00356 (BL 0.0 position).
- 8.5 With reference to Figure 6 Detail F, drill n°12 holes $\varnothing 3.26 \div 3.38$ through the doublers P/N 3G5350P00354 and P/N 3G5350P00356 in the other countermarked position.
- 8.6 With reference to Figure 6 Detail F, countermark the position of n°6 rivets necessary to complete the fixing of the doubler P/N 3G5350P00354 on the tail boom.

- 8.7 With reference to Figure 6 Detail F, drill n°6 holes $\varnothing 4.09 \div 4.22$ through doubler P/N 3G5350P00354 and upper skin of the tail boom honeycomb panel.
- 8.8 With reference to Figure 6 Detail F, install the doublers P/N 3G5350P00354, P/N 3G5350P00355 and P/N 3G5350P00356 by means of adhesive EA9309.3NA (C021) on the tail boom.
- 8.9 With reference to Figure 6 Detail F, complete the installation of the doublers P/N 3G5350P00354, P/N 3G5350P00355 and P/N 3G5350P00356 by means of n°4 rivets P/N A299A05TW05, n°12 rivets P/N NAS9301B-4-03, n°6 rivets P/N NAS9301B-5-03, n°22 rivets P/N NAS9301B-5-04 and n°4 rivets P/N NAS9301B-5-05 in the indicated positions.
- 8.10 With reference to Figure 6 Section G-G, seal all around the perimeter of the doubler P/N 3G5350P00354 by means of sealant MC-780 B-2.

NOTE

Following step 9 is applicable to the helicopters equipped with the tail boom assy STA 8947.66 repair RS139-5351-0249.

9. With reference to Figures 3 and 7, perform the tail rotor drive retro-modification P/N 3G5350P00311 as described in the following procedure:
 - 9.1 With reference to Figure 7 Detail H, remove the peeling shim from RH side of the tail boom. Retain for later reuse.
 - 9.2 With reference to Figure 7 Detail H, drill out the existing rivets whose position shall be used to install the doublers P/N 3G5350P00353 and P/N 3G5350P00357 on the tail boom.
 - 9.3 Clean and degrease the tail boom area where the doubler P/N 3G5350P00357 shall be installed, using a clean lint-free cloth (C011) and aliphatic naphtha (C059).
 - 9.4 With reference to Figure 7 Detail H, temporarily locate the doublers P/N 3G5350P00353 and P/N 3G5350P00357 on the tail boom.
 - 9.5 With reference to Figure 7 Detail H, countermark position of n°30 rivet holes on the doublers (BL 0.0 position).
 - 9.6 With reference to Figure 7 Detail H, countermark the position of N°2 existing inserts on the doubler P/N 3G5350P00357.
 - 9.7 With reference to Figure 7 Detail H, countermark the position of n°22 rivets necessary to complete the fixing of the doubler P/N 3G5350P00353 and the doubler P/N 3G5350P00357 on the tail boom.

- 9.8 With reference to Figure 7 Detail H, drill n°30 holes \varnothing 4.09 \div 4.22 through doublers P/N 3G5350P00353 and P/N 3G5350P00357 (BL 0.0 position).
- 9.9 With reference to Figure 7 Detail H, drill n°2 insert holes \varnothing 7.94 \div 8.09 through doubler P/N 3G5350P00357 (shim installation position).
- 9.10 With reference to Figure 7 Detail H, drill n°22 holes \varnothing 4.09 \div 4.22 through doubler P/N 3G5350P00357, doubler P/N 3G5350P00353 and upper skin of the tail boom honeycomb panel.
- 9.11 With reference to Figure 7 Detail H, install the doubler P/N 3G5350P00357 and the doubler P/N 3G5350P00353 by means of adhesive EA9309.3NA (C021) on the tail boom.
- 9.12 With reference to Figure 7 Detail H, complete the installation of the doublers P/N 3G5350P00353 and P/N 3G5350P00357 by means of n°4 rivets P/N A299A05TW05, n°8 rivets P/N NAS9301B-5-02, n°6 rivets P/N NAS9301B-5-03, n°28 rivets P/N NAS9301B-5-04 and n°4 rivets P/N NAS9301B-5-05 in the indicated positions.
- 9.13 With reference to Figure 7 Detail H, install n°2 rivets P/N NAS9301B-5-02 in the indicated positions.
- 9.14 With reference to Figure 7 Section J-J, seal all around the perimeter of the doubler P/N 3G5350P00353 and of the doubler P/N 3G5350P00357 by means of sealant MC-780 B-2.

NOTE

Peel the existing shims according to the thickness of the added doublers (see Figure 9).

- 9.15 With reference to Figure 9, manufacture locally the peeling shim P/N 3G5350P00352 reworking the existing peeling shim previously removed.
- 9.16 With reference to Figure 4, reinstall the peeling shim P/N 3G5350P00352 by means of adhesive EA9309.3NA (C021) on the doubler P/N 3G5350P00357.
- 9.17 With reference to Figure 7 Detail H, seal all around the perimeter of the peeling shim P/N 3G5350P00352 by means of sealant MC-780 B-2.

NOTE

Following step 10 is applicable to the helicopters equipped with the tail boom assy STA 8947.66 repair RS139-5351-0348.

10. With reference to Figures 3 and 8, perform the tail rotor drive retro-modification P/N 3G5350P00311 as described in the following procedure:

- 10.1 With reference to Figure 8 Detail K, drill out the existing rivets whose position shall be used to install the doublers P/N 3G5350P00358, P/N 3G5350P00359 and P/N 3G5350P00361 on the tail boom.
- 10.2 Clean and degrease the tail boom area where the doublers P/N 3G5350P00358 and P/N 3G5350P00359 shall be installed, using a clean lint-free cloth (C011) and aliphatic naphtha (C059).
- 10.3 With reference to Figure 8 Detail K, temporarily locate the doublers P/N 3G5350P00358, P/N 3G5350P00359 and P/N 3G5350P00361 on the tail boom and countermark position of n°30 rivet holes on the doublers (BL 0.0 position).
- 10.4 With reference to Figure 8 Detail K, countermark the position of n°20 rivets necessary to complete the fixing of the doubler P/N 3G5350P00361 on the tail boom.
- 10.5 With reference to Figure 8 Detail K, drill n°30 holes \varnothing 4.09 ÷ 4.22 through the doublers P/N 3G5350P00358, P/N 3G5350P00359 and P/N 3G5350P00361 (BL 0.0 position).
- 10.6 With reference to Figure 8 Detail K, drill n°20 holes \varnothing 4.09 ÷ 4.22 through doubler P/N 3G5350P00361 and upper skin of the tail boom honeycomb panel.
- 10.7 With reference to Figure 8 Detail K, install the doublers P/N 3G5350P00358, P/N 3G5350P00359 and P/N 3G5350P00361 by means of adhesive EA9309.3NA (C021) on the tail boom.
- 10.8 With reference to Figure 8 Detail K, complete the installation of the doublers P/N 3G5350P00358, P/N 3G5350P00359 and P/N 3G5350P00361 by means of n°4 rivets P/N A299A05TW05, n°16 rivets P/N NAS9301B-5-03, n°22 rivets P/N NAS9301B-5-04 and n°4 rivets P/N NAS9301B-5-05 in the indicated positions.
- 10.9 With reference to Figure 8 Detail K, install n°4 rivets P/N NAS9301B-5-02 in the indicated positions.
- 10.10 With reference to Figure 8 Section L-L, seal all around the perimeter of the doubler P/N 3G5350P00361 by means of sealant MC-780 B-2.

NOTE

Following step 11 is applicable to the helicopters not equipped with the tail boom repairs on the lower side. Compliance with repairs on the lower side of the tail panels is equivalent to the accomplishment of retro-modification P/N 3G5350P00611.

11. With reference to Figures 12 thru 14, perform the tail rotor drive internal side retro-modification P/N 3G5350P00611 as described in the following procedure:
 - 11.1 Clean and degrease the upper inside skin area of the tail boom where n°2 doublers P/N 3G5350P00651 shall be installed, using a clean lint-free cloth (C011) and aliphatic naphtha (C059).
 - 11.2 With reference to Figure 13 Section A-A, temporarily locate n°2 doublers P/N 3G5350P00651 and countermark position of n°36 rivet holes on the upper inside skin of the tail boom.
 - 11.3 With reference to Figure 13 Section A-A, drill n°36 holes through the upper inside skin on the previously countermarked positions as required.
 - 11.4 With reference to Figure 13 Section A-A, install n°2 doublers P/N 3G5350P00651 by means of adhesive EA9309.3NA (C021) on the upper inside skin of the tail boom.
 - 11.5 With reference to Figure 13 Section A-A, complete the installation of n°2 doublers P/N 3G5350P00651 by means of n°36 rivets P/N NAS9301B-4-01.
12. In accordance with AMP DM 39-B-65-11-11-00A-720A-A, install the bearing support P/N 3G6510A05232.

NOTE

Re-install also the N. 1 drive shaft, in accordance with AMP DM 39-B-65-11-01-00A-720A-A, if previously removed to get an easier access to the work area.

13. Re-install the N. 2 drive shaft in accordance with AMP DM 39-B-65-11-02-00A-720A-A.
14. Perform the TRDL final alignment check according to:
 - Annex A (steps 2 and 3), on helicopters listed in Table 1 that have not replaced the original tail boom assy;
 - Annex B on helicopters not listed in Table 1 and on helicopters that have replaced the original tail boom assy.
15. If the check fails, do as follows:
 - 15.1 Perform the tail alignment procedure according to Annex C.
 - 15.2 Repeat the TRDL final alignment check according to Annex B.

- 15.3 If the check fails again, contact Product Support Engineering (engineering.support.lhd@leonardocompany.com) for further instruction.
16. In accordance with AMP DM 39-A-06-41-00-00A-010A-A, install access panel 310AL and access panel 310BL removed at step 2.

NOTE

The sealant tape can be supplied with or without the adhesive applied on one side; if it is without adhesive, use biadhesive tape to keep it in position during installation.

17. With reference to Figure 3 Detail E, if necessary, seal the existing gap between the tail boom structure and the rotor shaft cowling by means of sealant tape (C405).
18. In accordance with weight and balance changes, update the Chart A (see Rotorcraft Flight Manual, Part II, section 6).
19. Return the helicopter to flight configuration, record for compliance with Part III of this Service Bulletin on the helicopter logbook.
20. Send the attached compliance form to the following mail box:
engineering.support.lhd@leonardocompany.com

As an alternative, gain access to My Communications section on Leonardo WebPortal and compile the “Service Bulletin Application Communication”.

Table 1	MGB (A)		IGB (B)		MGB (A)		IGB (B)	
	Helicopter S/N	Δ_A	Δ_B	X_A	Y_A	X_B	Y_B	
31403			-8.61	3.36	-8.30	2.06		
31413			-4.86	7.98	-5.22	-3.54		
31420	0.18	0.17						
31427	0.08	0.23						
31434	0.33	0.38						
31439	0.21	0.22						
31448	0.16	0.16						
31469	0.2	0.31						
31481	0.13	0.1						
31489	0.19	0.15						
31499	0.2	0.13						
31504	0.04	0.05						
31507	0.22	0.35						
31512	0.26	0.21						
31518	0.32	0.21						
31519	0.24	0.26						
31521	0.25	0.18						
31524	0.39	0.19						
31526	0.14	0.4						
31529	0.21	0.15						
31533	0.19	0.21						
31535	0.21	0.32						
31536	0.2	0.08						
31537	0.19	0.22						
31538	0.19	0.21						
31539	0.18	0.1						
31540	0.21	0.26						
31541	0.19	0.21						
31542	0.17	0.1						
31543	0.17	0.13						
31544	0.21	0.19						
31545	0.21	0.19						
31546	0.19	0.24						
31547	0.29	0.22						
31548	0.21	0.19						
31550	0.17	0.21						
31551	0.21	0.32						
31552	0.47	0.31						
31553	0.25	0.25						
31554	0.19	0.26						
31555	0.19	0.15						

Table 1	MGB (A)		IGB (B)		MGB (A)		IGB (B)	
	Helicopter S/N	Δ_A	Δ_B	X_A	Y_A	X_B	Y_B	
31556	0.15	0.26						
31557	0.11	0.19						
31558	0.1	0.09						
31559	0.19	0.34						
31560	0.2	0.13						
31561	0.11	0.23						
31562	0.21	0.23						
31563	0.27	0.21						
31564	0.19	0.27						
31565	0.19	0.21						
31566	0.1	0.19						
31567	0.21	0.21						
31568	0.21	0.16						
31569	0.33	0.17						
31570	0.22	0.28						
31571	0.16	0.09						
31572	0.07	0.34						
31573	0.12	0.1						
31574	0.17	0.11						
31575	0.21	0.27						
31576	0.25	0.31						
31577	0.16	0.08						
31578	0.24	0.21						
31579	0.18	0.13						
31580	0.26	0.14						
31581	0.19	0.21						
31582	0.19	0.24						
31584	0.19	0.21						
31585	0.17	0.22						
31586	0.3	0.22						
31587	0.19	0.21						
31588	0.17	0.19						
31591	0.19	0.24						
31592	0.2	0.13						
31593	0.62	0.15						
31594	0.16	0.02						
31595	0.24	0.27						
31596	0.24	0.21						
31597	0.23	0.19						
31598	0.19	0.21						
31599	0.24	0.17						

Table 1	MGB (A)		IGB (B)		MGB (A)		IGB (B)	
	Helicopter S/N	Δ_A	Δ_B	X_A	Y_A	X_B	Y_B	
31600	0.19	0.21						
31601	0.17	0.13						
31602	0.24	0.11						
31603	0.17	0.19						
31604	0.16	0.1						
31605	0.18	0.21						
31606	0.21	0.23						
31607	0.17	0.07						
31608	0.27	0.17						
31609	0.19	0.28						
31610	0.13	0.1						
31612	0.19	0.2						
31614	0.12	0.49						
31615	0.14	0.17						
31616	0.28	0.07						
31617	0.13	0.17						
31618	0.21	0.17						
31619	0.21	0.34						
31620	0.19	0.18						
31621	0.2	0.23						
31622	0.01	0.02						
31623	0.12	0.08						
31625	0.11	0.09						
31626	0.17	0.56						
41363	0.22	0.18						
41368	0.21	0.1						
41369	0.24	0.22						
41370	0.29	0.63						
41371	0.32	0.24						
41372	0.37	0.27						
41373	0.25	0.14						
41375	0.33	0.23						
41376	0.2486	0.4825						
41378	0.378	0.186						
41379	0.3197	0.2922						
41380	0.31	0.25						
41381	0.366	0.162						
41382	0.32	0.08						
41383	0.338	0.319						
41384	0.48	0.07						
41385	0.31	0.15						

Table 1	MGB (A)	IGB (B)	MGB (A)		IGB (B)	
Helicopter S/N	Δ_A	Δ_B	X_A	Y_A	X_B	Y_B
41386	0.22	0.19				
41387	0.212	0.215				
41388	0.036	0.5				
41389	0.458	0.24				
41390	0.25	0.29				
41391	0.47	0.1				
41392	0.158	0.448				
41393	0.08	0.1				
41394	0.18	0.15				
41395	0.386	0.119				
41396	0.16	0.06				
41397	0.1845	0.2307				
41398	0.306	0.157				
41399	0.17	0.26				
41400	0.13	0.59				
41401	0.12	0.11				
41402	0.18	0.17				
41403	0.31	0.37				
41404	0.13	0.08				
41405	0.21	0.24				
41406	0.15	0.13				
41407	0.26	0.16				
41408	0.32	0.24				
41409	0.27	0.2				
41411	0.32	0.28				
41413	0.07	0.19				

Table 1

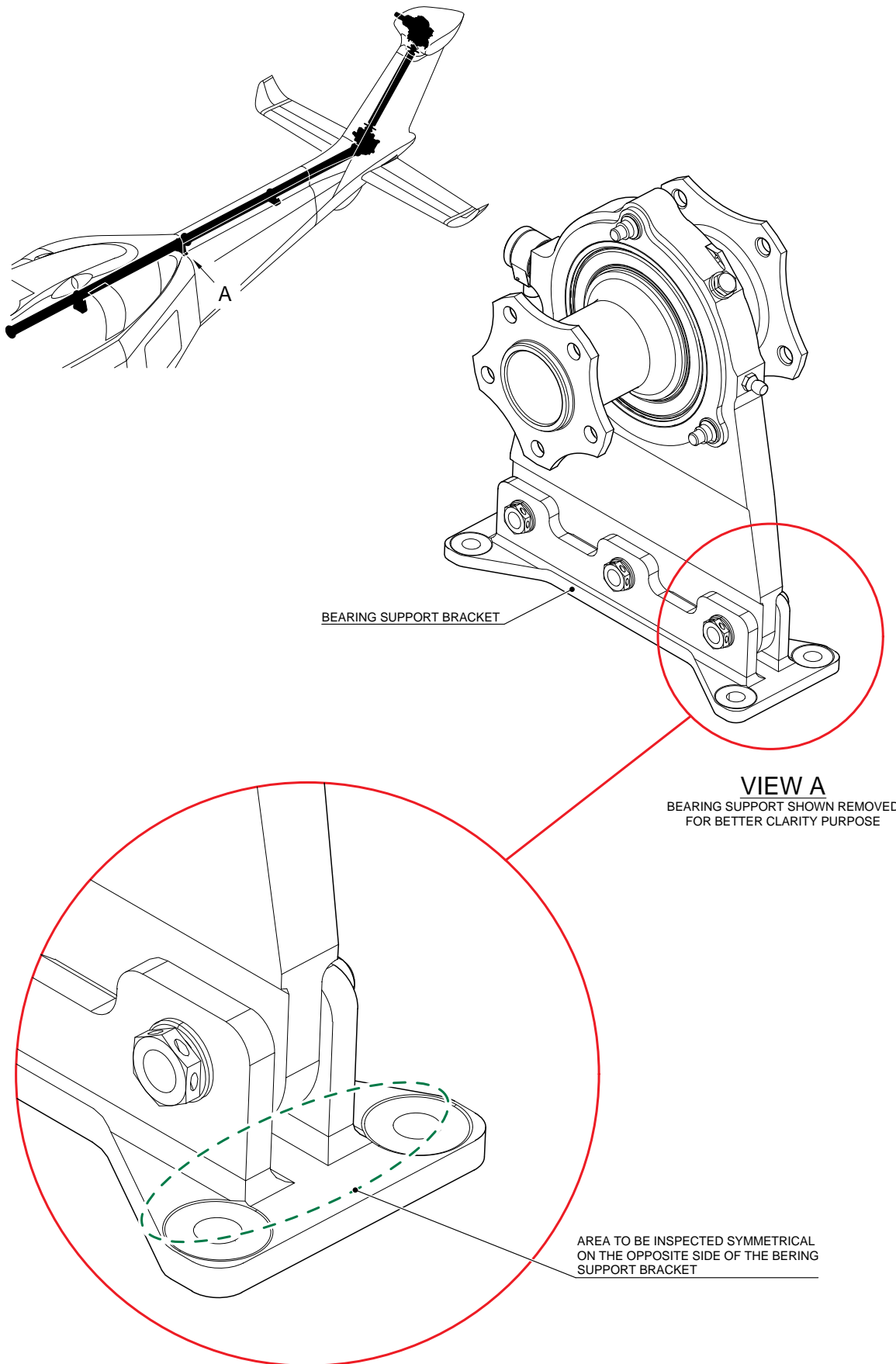
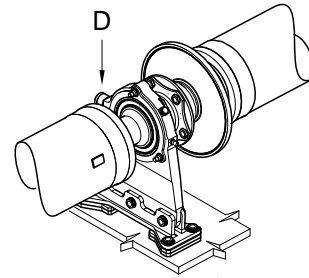
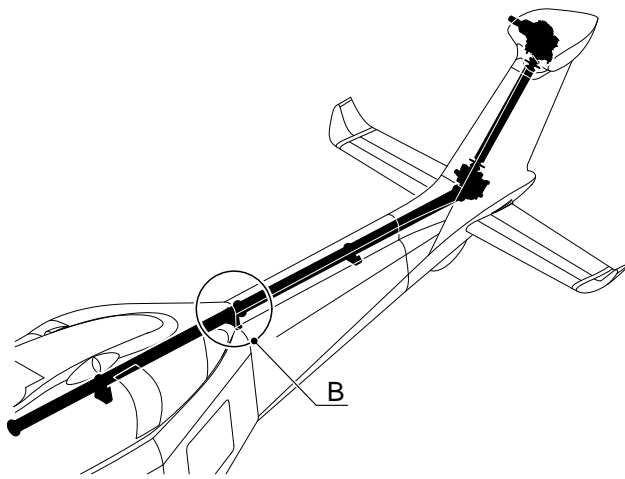
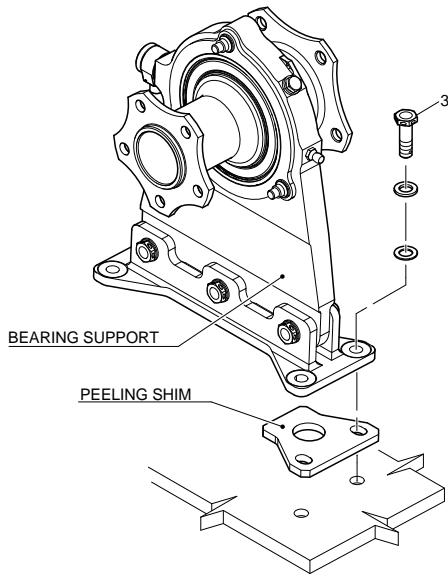


Figure 1



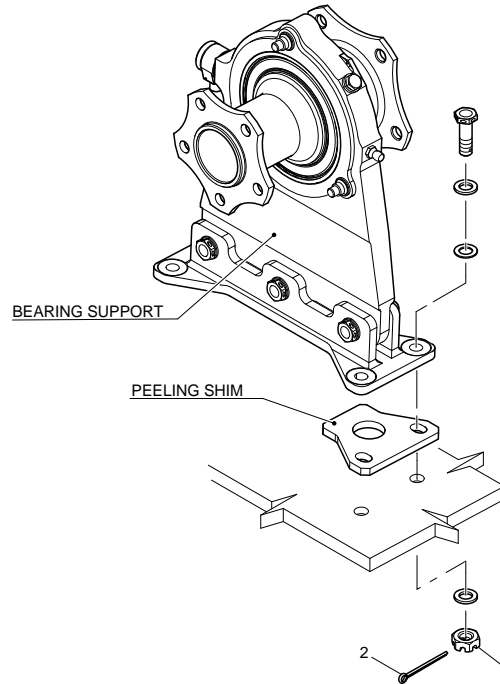
DETAIL B
C1, C2

STRUCTURES AND SYSTEMS ARE PARTIALLY OMITTED FOR BETTER CLARITY PURPOSE



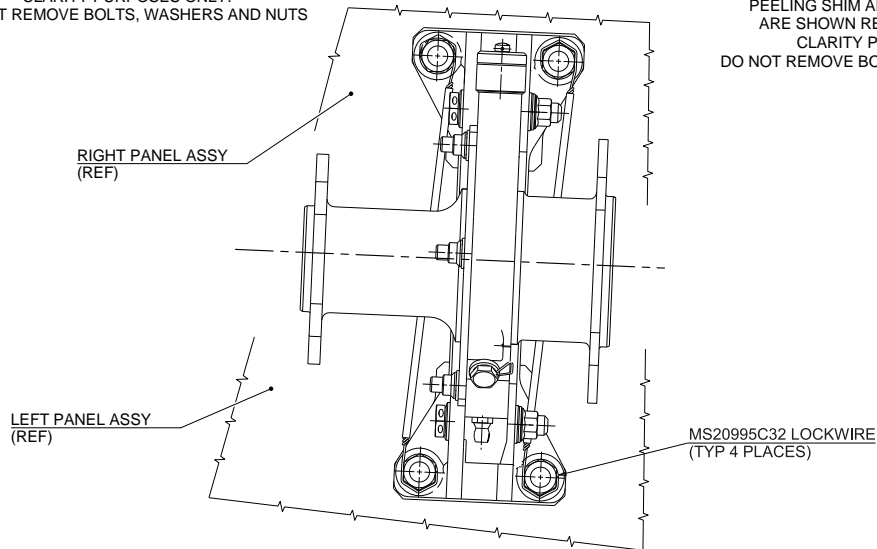
VIEW C1

PEELING SHIM AND BEARING SUPPORT ARE SHOWN REMOVED FOR BETTER CLARITY PURPOSES ONLY. DO NOT REMOVE BOLTS, WASHERS AND NUTS



VIEW C2

PEELING SHIM AND BEARING SUPPORT ARE SHOWN REMOVED FOR BETTER CLARITY PURPOSES ONLY. DO NOT REMOVE BOLTS, WASHERS AND NUTS



VIEW D

STRUCTURES AND SYSTEMS ARE PARTIALLY OMITTED FOR BETTER CLARITY PURPOSE

Figure 2

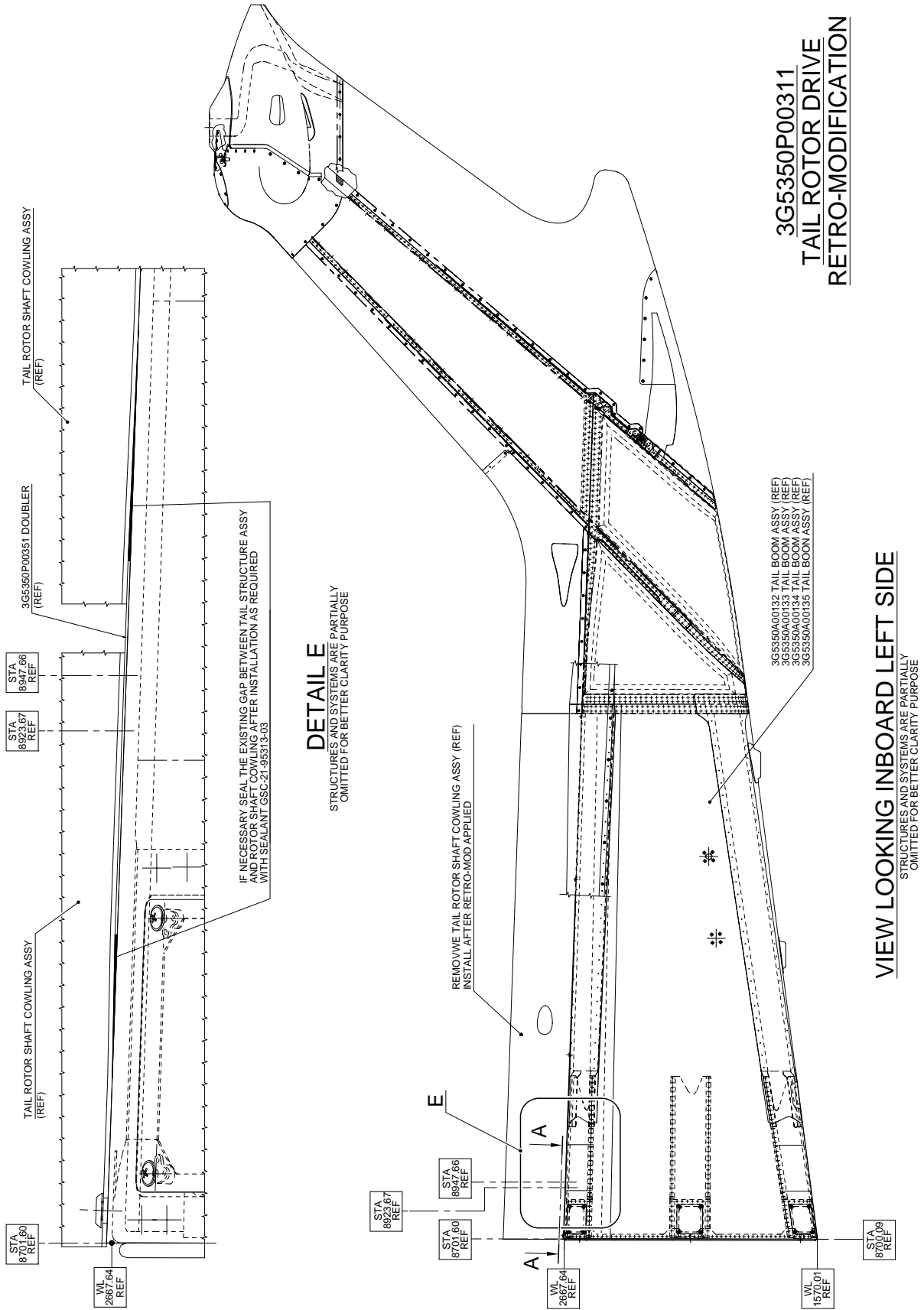


Figure 3

S.B. N°139-539
DATE: January 26, 2022
REVISION: /

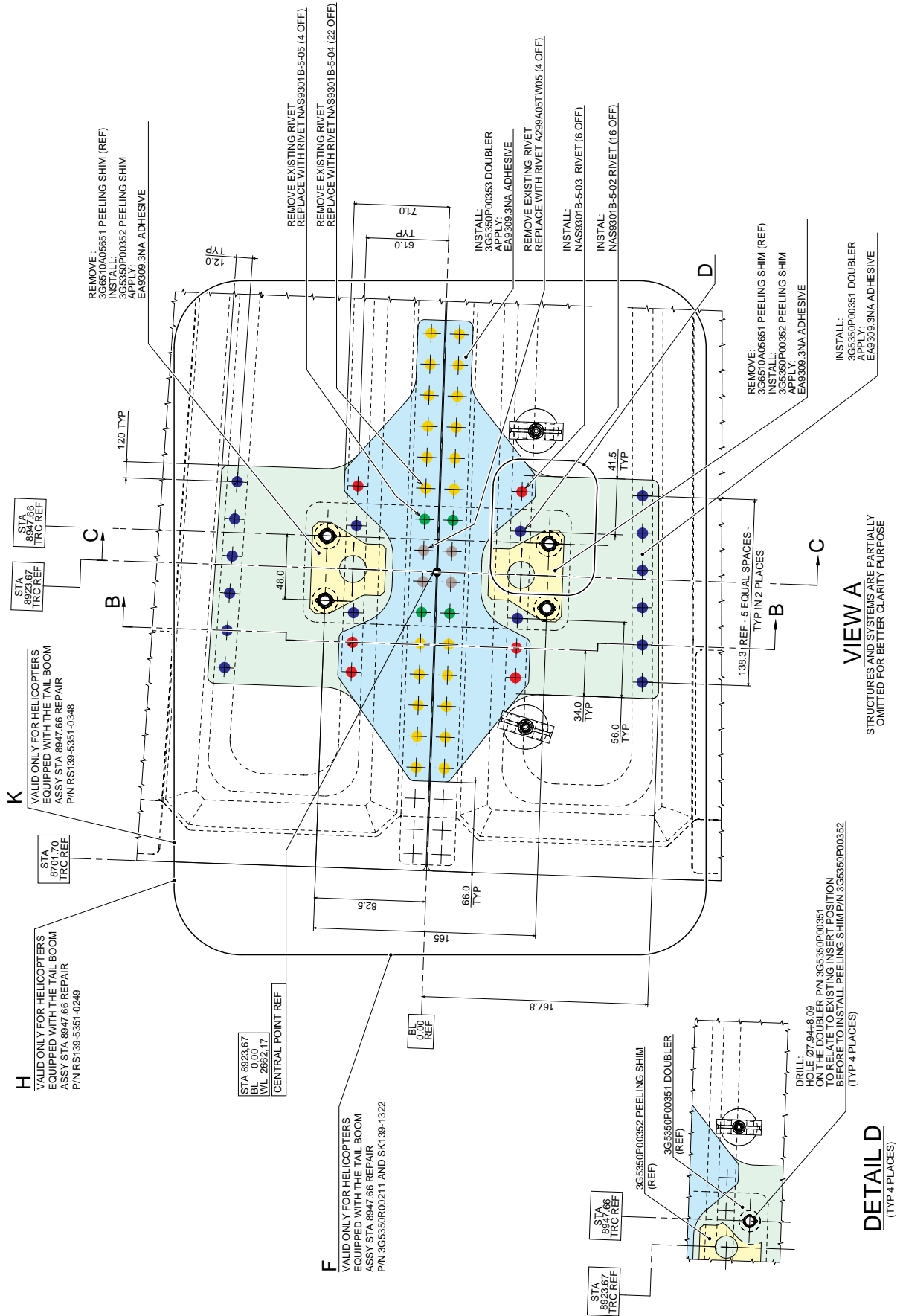
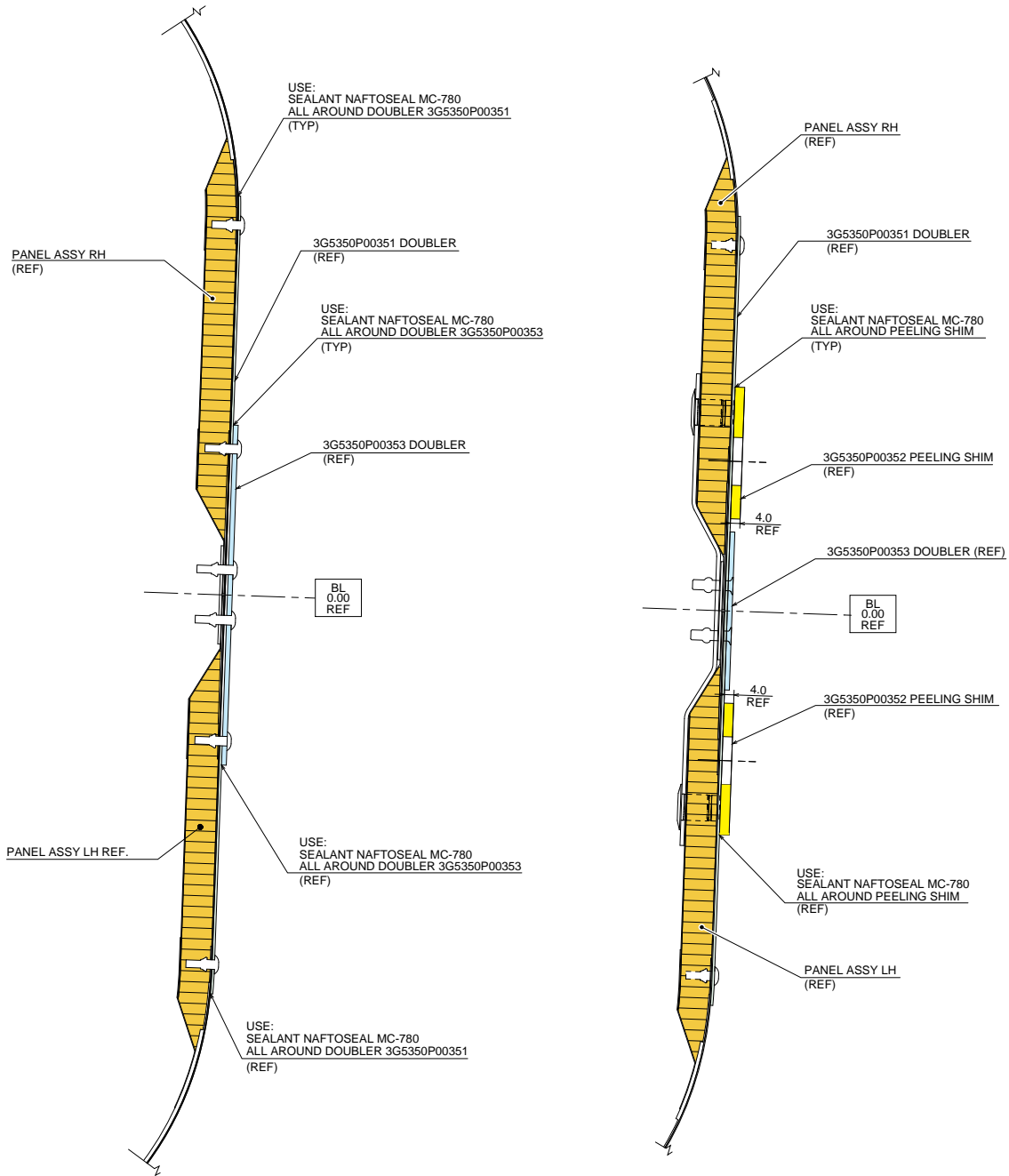


Figure 4



SECTION B-B

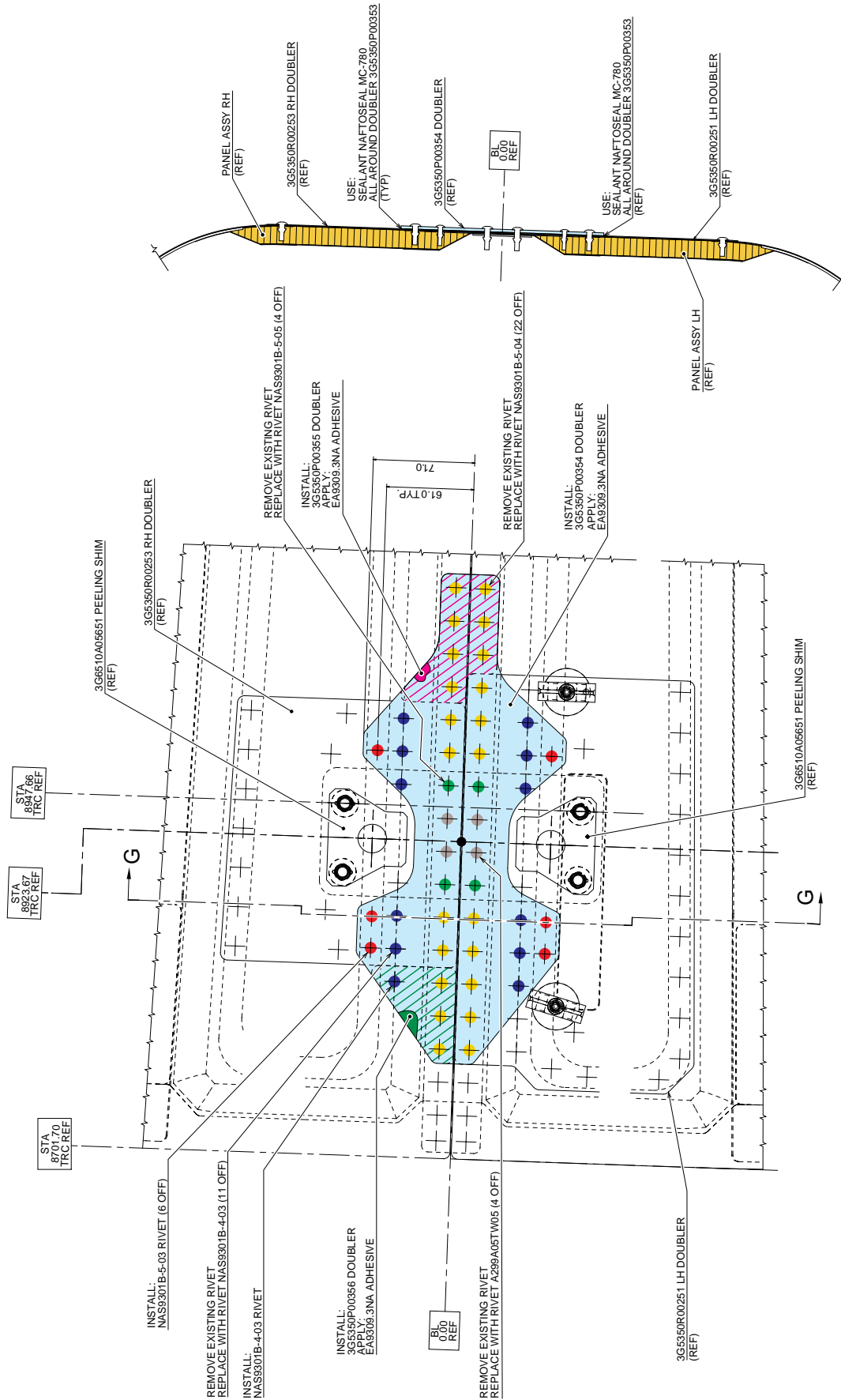
STRUCTURES AND SYSTEMS ARE PARTIALLY
OMITTED FOR BETTER CLARITY PURPOSE

SECTION C-C

STRUCTURES AND SYSTEMS ARE PARTIALLY
OMITTED FOR BETTER CLARITY PURPOSE

Figure 5

S.B. N°139-539
DATE: January 26, 2022
REVISION: /



SECTION G-G
STRUCTURES AND SYSTEMS ARE PARTIALLY OMITTED FOR BETTER CLARITY PURPOSE

DETAIL F
VALID ONLY FOR HELICOPTERS EQUIPPED WITH THE TAIL BOOM ASSY STA 8947.66 REPAIR PIN 3G5350R00211 AND SK139-1322

Figure 6

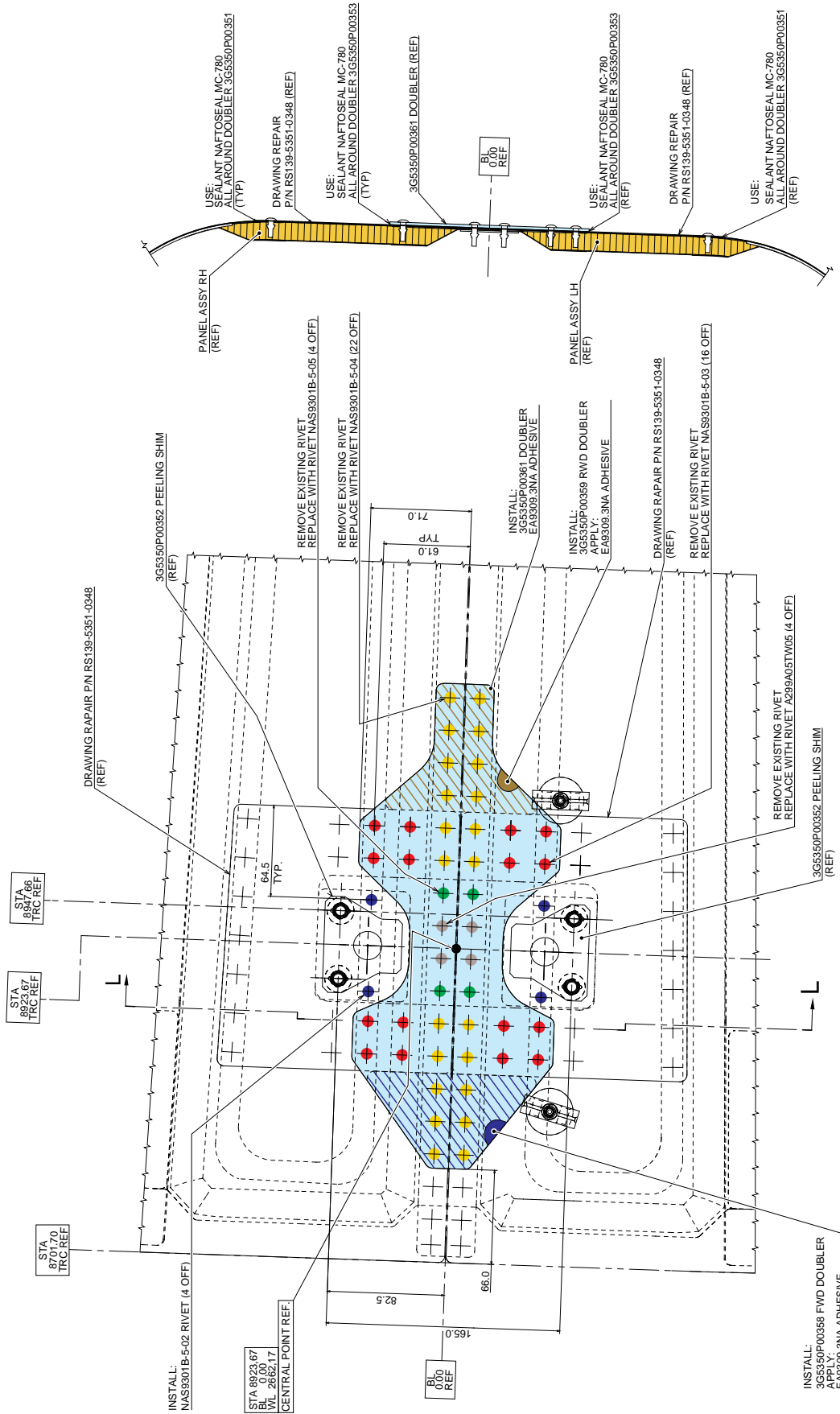


Figure 8

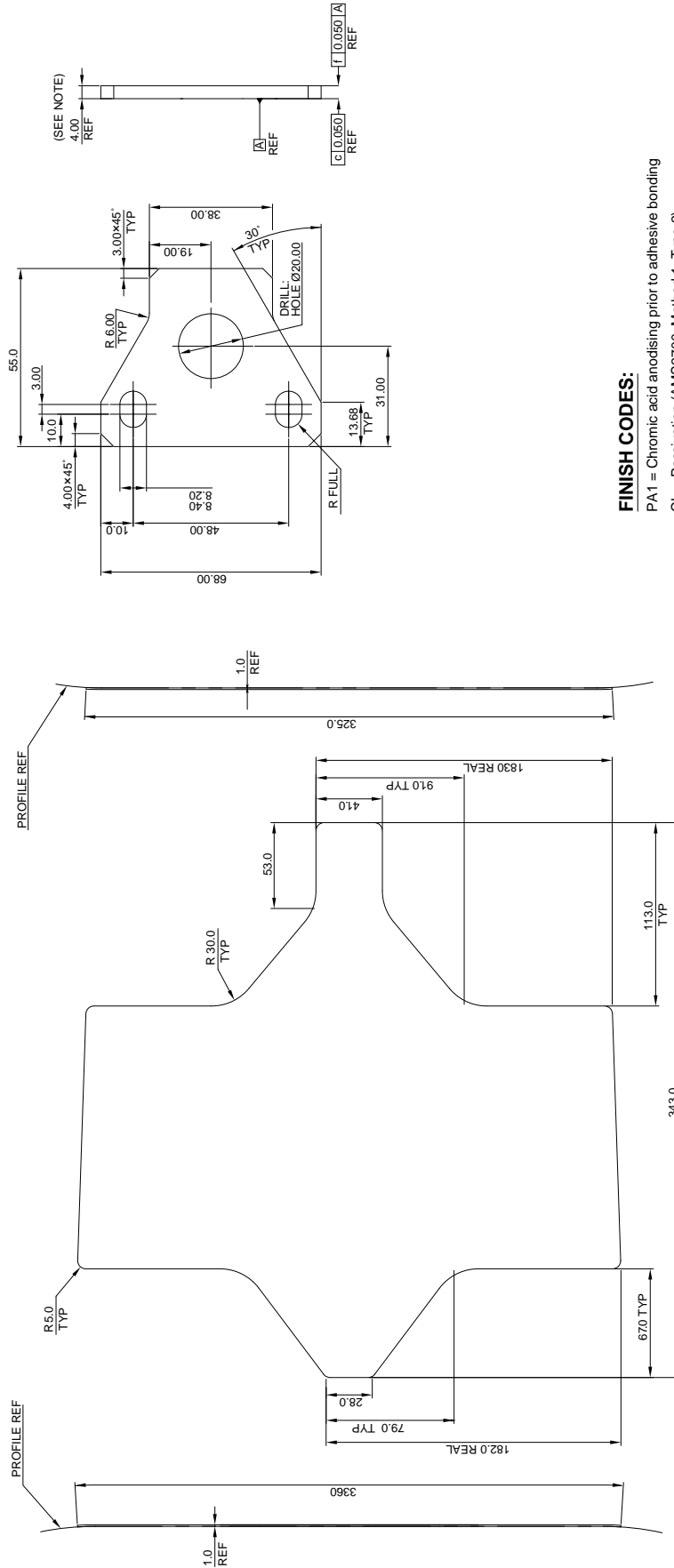
S.B. N°139-539
DATE: January 26, 2022
REVISION: /

3G5350P00351 DOUBLER

MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/4, TH 1.00, PA1

3G5350P00352 PEELING SHIM

PART TO BE OBTAINED REWORKING THE
PEELING SHIMS P/N 3G6510A05651 AS SHOWN



FINISH CODES:

PA1 = Chromic acid anodising prior to adhesive bonding
CL = Passivation (AMS2700, Method 1, Type 2)

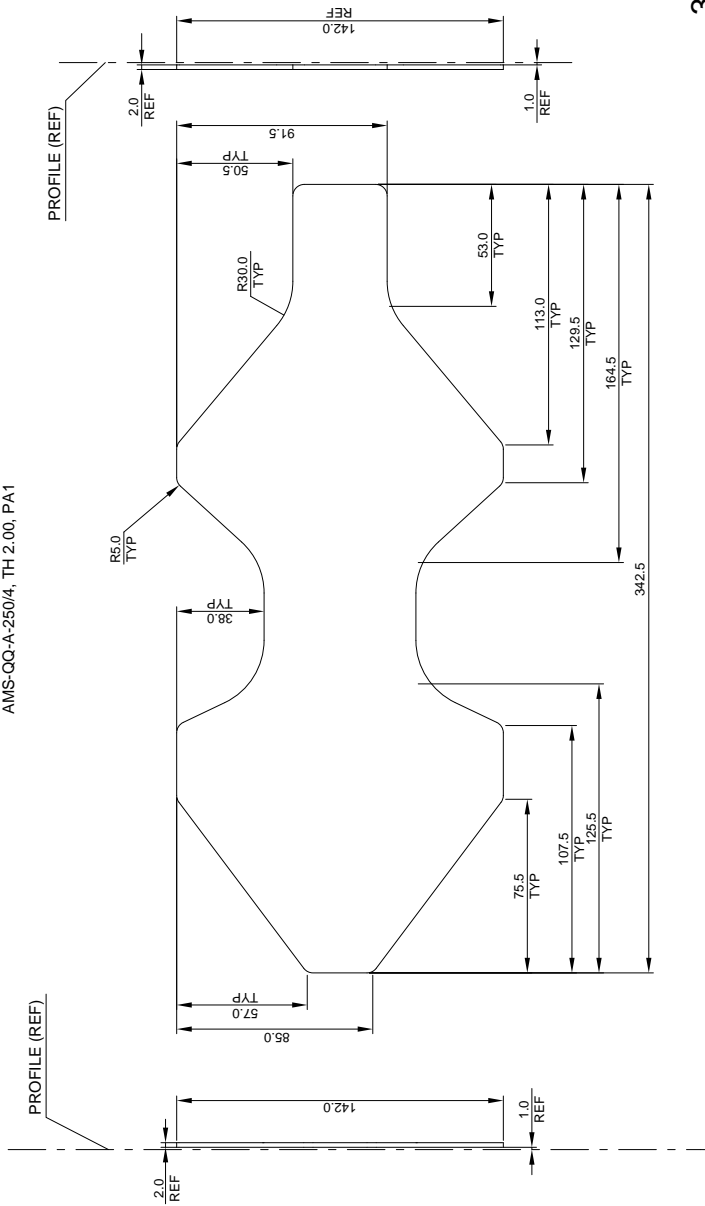
NOTE:

4.00 IS A NOMINAL DIMENSION. PEEL THE SHIM ACCORDING TO THE THICKNESS OF THE ADDED DOUBLER.

Figure 9

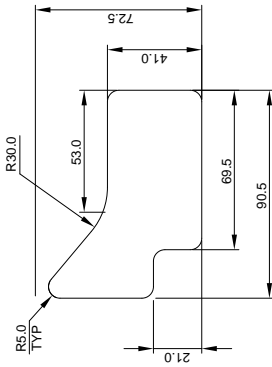
3G5350P00353 DOUBLER

MATERIAL CRES 1/4 HARD T3
AMS-QQ-A-250/4, TH 2.00, PA1



3G5350P00355 DOUBLER

MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL
(SEE NOTE)



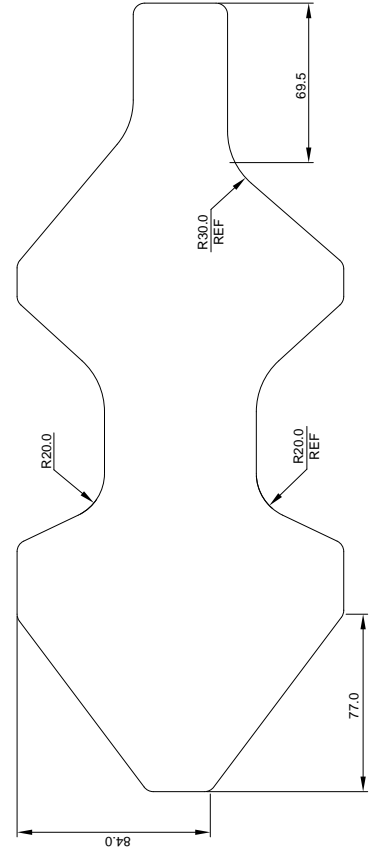
NOTE:

FOR AW139 HELICOPTERS EQUIPPED WITH THE TAIL BOOM ASSY REPAIR SK139-1322, IT IS ALLOWED TO TRIM THE CONTOUR OF THE DOUBLER P/N 3G5350P00355 TO FIT WITH THE EXISTING DOUBLER.

3G5350P00354 DOUBLER

SAME TO 3G5350P00353 EXCEPT AS SHOWN

MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/4, TH 2.00, PA1



3G5350P00356 DOUBLER

MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL

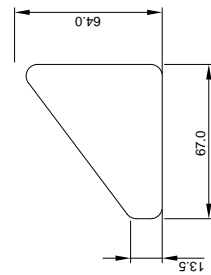
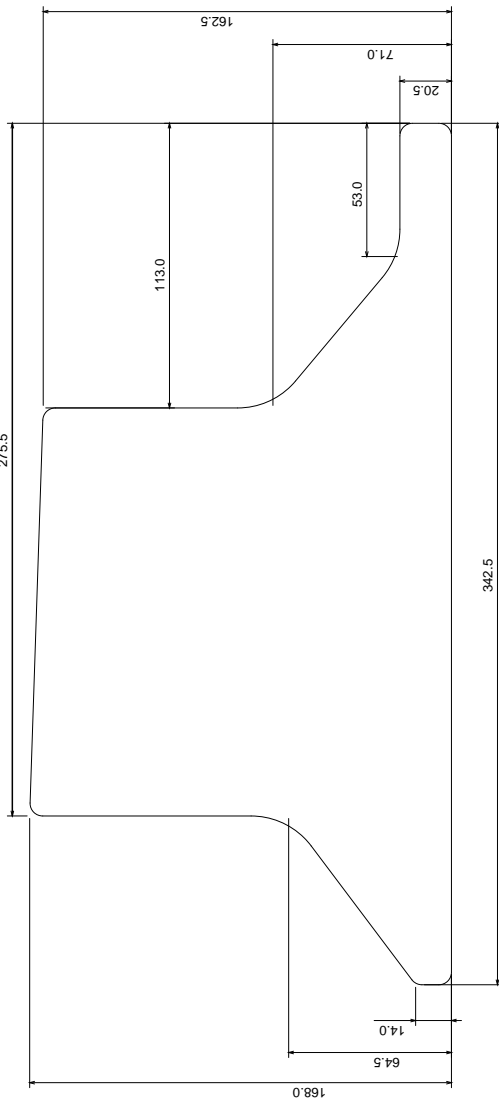


Figure 10

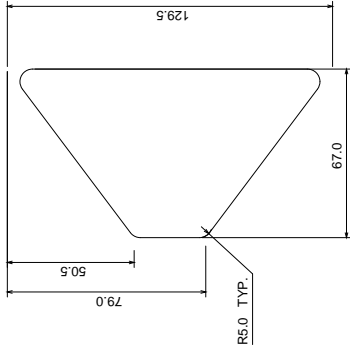
3G5350P00357 DOUBLER

MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/4, TH 1.02, PA1



3G5350P00358 DOUBLER

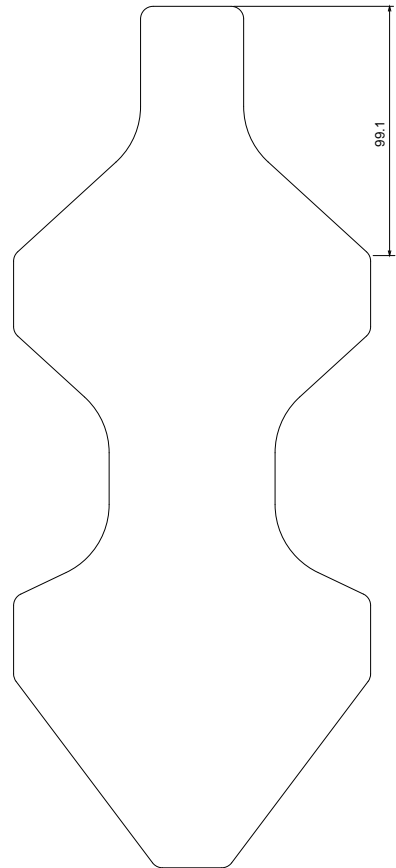
MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL



3G5350P00361 DOUBLER

SAME TO 3G5350P00353 EXCEPT AS SHOWN

MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/4, TH 2.00, PA1



3G5350P00359 DOUBLER

MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL

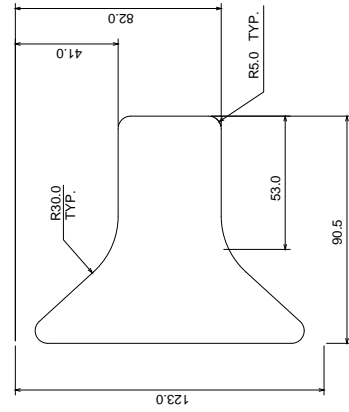


Figure 11

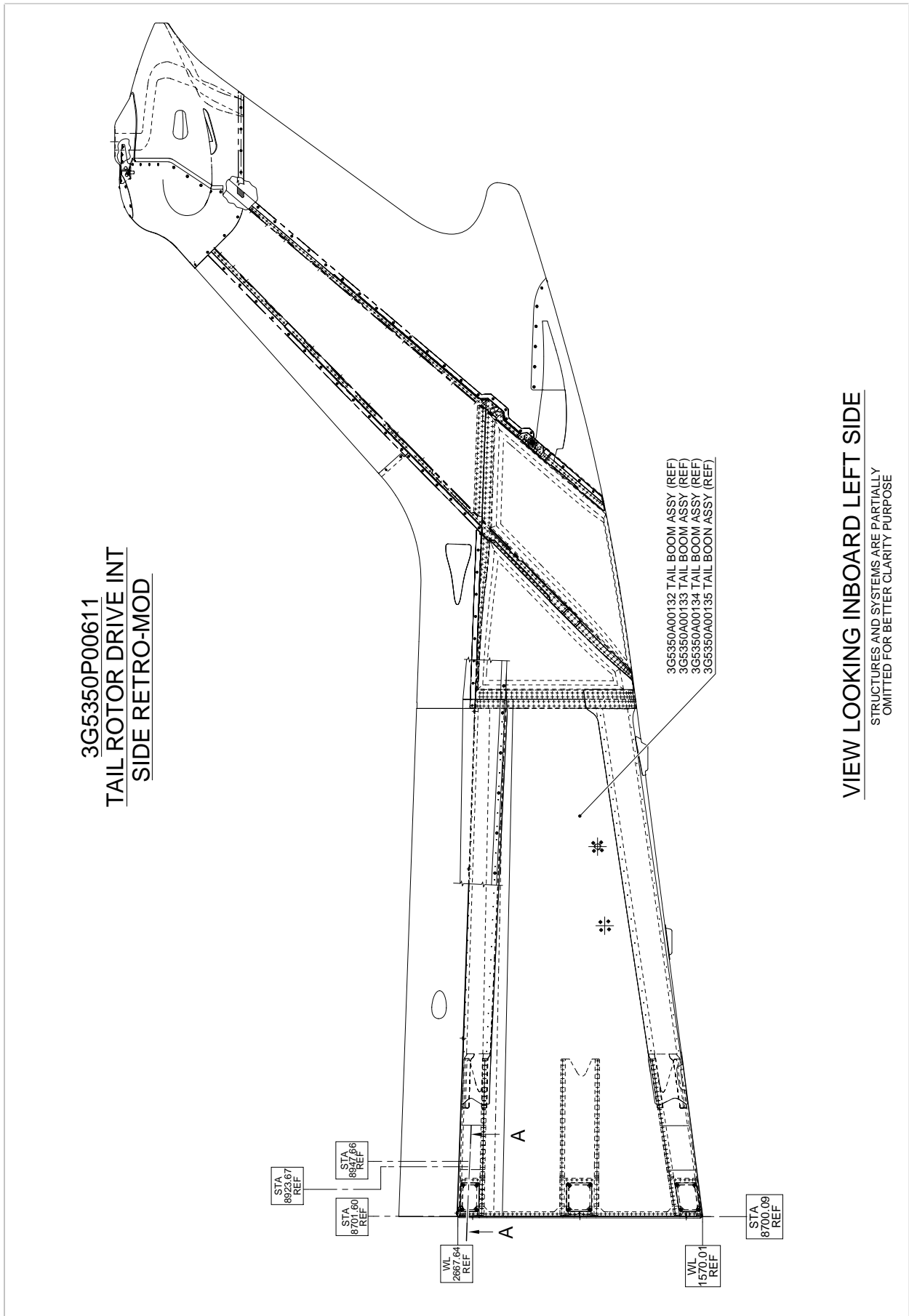


Figure 12

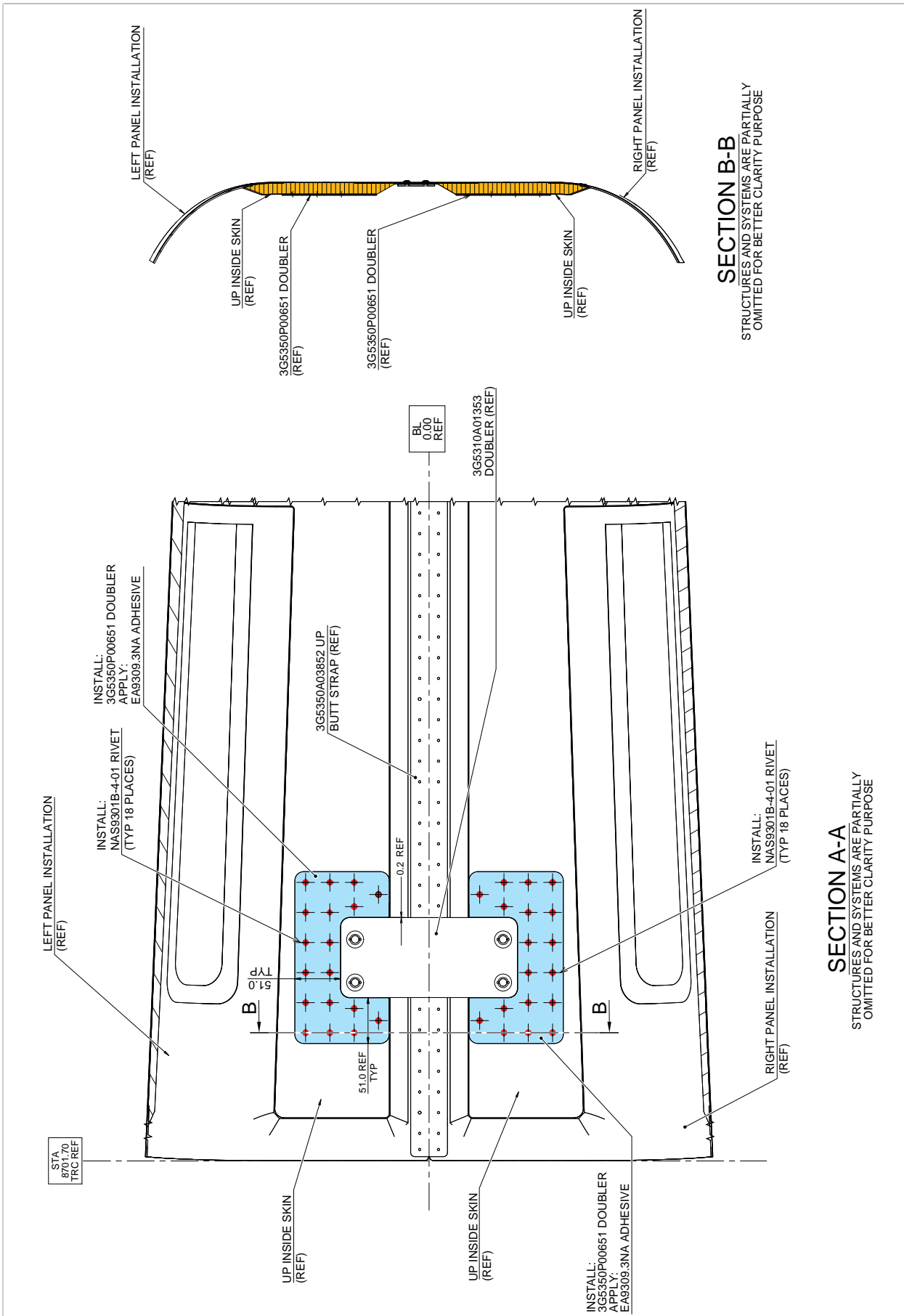
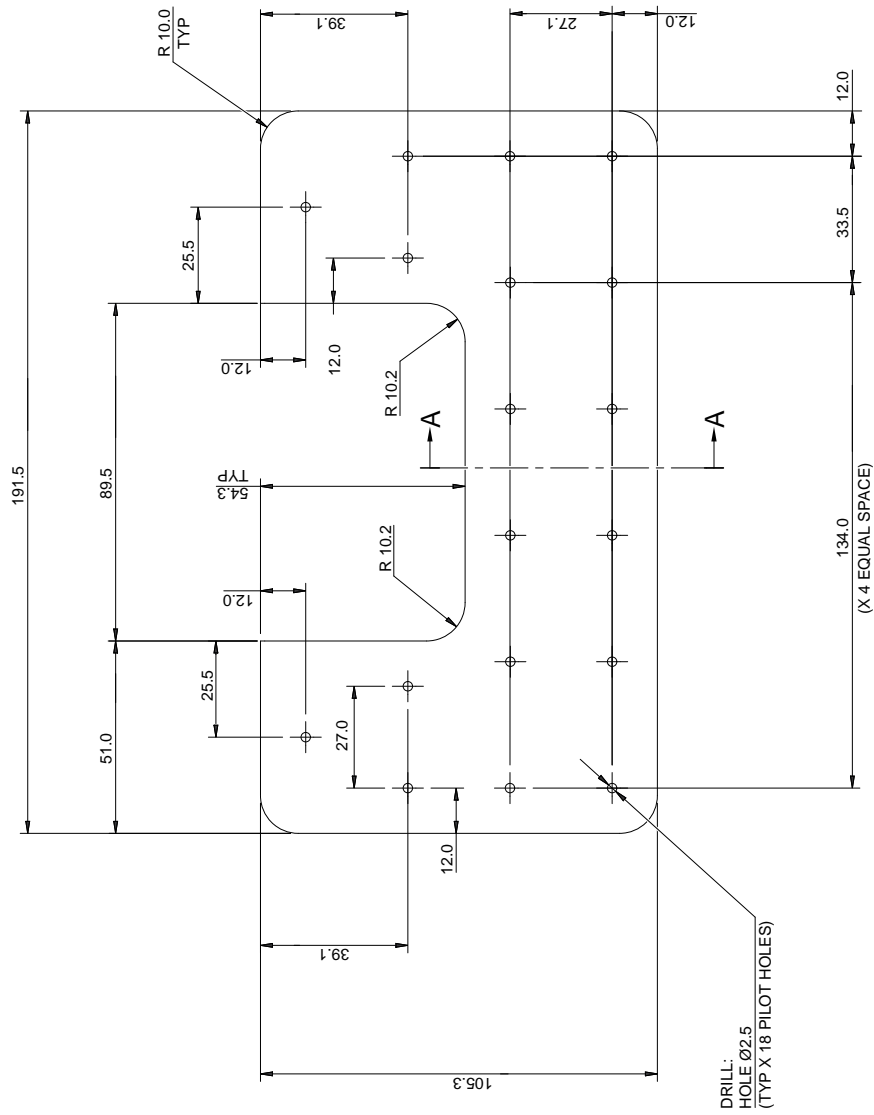


Figure 13

3G5350P00651 DOUBLER

MATERIAL AL-ALY 2024 T3
AMIS-QQ-A-250/4, TH 1.0
PA1, XPFW/1



FRONT VIEW

FINISH CODES:
PA1 = Chromic acid anodising prior to adhesive bonding
XPFW/1 = One coat of epoxy primer (C596)

Figure 14

ANNEX A

TRDL LIMITED DIRECT ALIGNMENT CHECK

This alignment procedure, hereafter described, must be repeated two times: before and after the replacement/rework of the floor panel.

Tool P/N PEC-139-009-01 (shown in Figure A4) or tools P/N 139H6300D002A651D and P/N TALL0000M1A686A (shown in Annex B) may be used to comply with this procedure.

1. SET OF MEASURES NO.1 – BEFORE THE REPLACEMENT/REWORK OF THE FUSELAGE FLOOR PANEL

- 1.1 With reference to Figures A1 and A2, install the the direct alignment tools on the bearing support coupling (C).
- 1.2 Rotate the tail drive line until the protruding part of the tool is contained in the Y-Plane (vertical), upwards with respect to the coupling, and set the dial gauge to zero.
- 1.3 Rotate the tail drive line of 180 [deg] until the protruding part of the tool is contained again in the Y-Plane (vertical), but this time downwards with respect to the coupling and record the displacement measure (positive value for elongation; negative value for contraction)
- 1.4 Repeat steps 1.2 and 1.3 for the X-plane (horizontal) setting the dial gauge to zero on the left side position of the flexible coupling.
- 1.5 Record the measure on Y-plane in Δ_{C1V} box and the measure on X-plane in Δ_{C1H} box of the frozen working sheet (table in Figure A5).
- 1.6 Remove the direct alignment tool from the bearing support coupling (C).

2. SET OF MEASURES NO.2 – AFTER THE REPLACEMENT/REWORK OF THE FUSELAGE FLOOR PANEL

- 2.1 Perform the steps 1.1 thru 1.4 after the replacement/rework of the fuselage floor panel.
- 2.2 Record the new measures (set of measures No.2) in Δ_{C2V} , Δ_{C2H} boxes of the frozen working sheet (table in Figure A5).

3. ALIGNMENT CHECK

- 3.1 If the production alignment check has been carried out with the linear gauge, recover the measures on the MGB output (Δ_A) and IGB input (Δ_B) couplings recorded in Table 1.
- 3.2 If the production alignment check has been carried out with the optical device, with reference to Figure A3, convert the registered measurements X_A , Y_A , X_B , Y_B , recorded in Table 1, using the following formulation:

$$P_A = \sqrt{(X_A)^2 + (Y_A)^2} \leq 9.25 \text{ mm}$$

$$P_B = \sqrt{(X_B)^2 + (Y_B)^2} \leq 9.45 \text{ mm}$$

$$\Delta_A = \frac{P_A}{D_{CA}} \cdot (2 \cdot R_{LG}) + \frac{0.79}{3} = \frac{P_A}{3176.4} \cdot (2 \cdot 91) + \frac{0.79}{3} \cong \boxed{0.0573 \cdot P_A + 0.263 \leq 0.79 \text{ mm}}$$

$$\Delta_B = \frac{P_B}{D_{BC}} \cdot (2 \cdot R_{LG}) + \frac{0.79}{3} = \frac{P_B}{3218.0} \cdot (2 \cdot 91) + \frac{0.79}{3} \cong \boxed{0.0565 \cdot P_B + 0.263 \leq 0.79 \text{ mm}}$$

being R_{LG} the Control Radius of the linear gauge.

If one of the above requirements is not satisfied, contact Product Support Engineering (engineering.support.lhd@leonardocompany.com)

- 3.3 Extract the displacement margin, using the following formulation:

$$\Delta_m = 2 \cdot (0.79 - \max(\Delta_A; \Delta_B)) \geq 0$$

- 3.4 Calculate the vectorial composition of the measures of the central bearing support coupling (C) on X-plane (horizontal, H) and Y-plane (vertical, V), after the replacement/rework of the fuselage floor panel (set of measures No.2), and make sure that it is contained inside the tolerance of 0.79 mm (15 minutes of flexible coupling misalignment angle).

$$\Delta_{C2} = \sqrt{(\Delta_{C2V})^2 + (\Delta_{C2H})^2} \leq 0.79 \text{ mm}$$

- 3.5 Calculate the vectorial composition of the difference between the correspondent values of the two set of measures (before and after the replacement/rework of the floor panel) and make sure that it is contained inside the following tolerance.

$$\sqrt{(\Delta_{C1V} - \Delta_{C2V})^2 + (\Delta_{C1H} - \Delta_{C2H})^2} \leq \Delta_m$$

- 3.6 If one of the requirements per steps 3.3, 3.4, 3.5 is not satisfied, perform the alignment procedure according to Annex C.

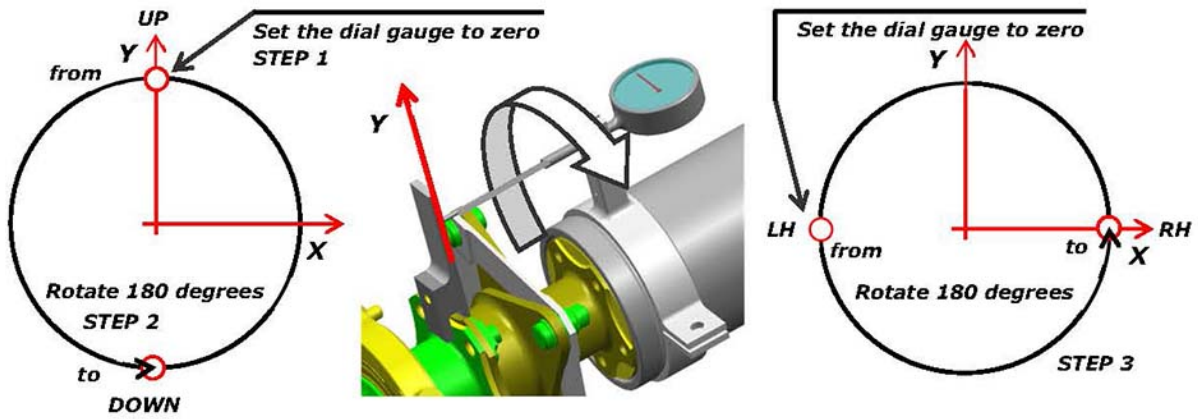


Figure A1 – Direct alignment check

		TAIL DRIVE SHAFTS DIRECT ALIGNMENT CHECK (Ref. ALIGNMENT PROCEDURE 139G6300D002)			
DEPT. :		COORDINATOR :			
ORIGIN COMPANY :		Material P/N :			
TDS <input type="checkbox"/>	INSTALLATION	HARD <input type="checkbox"/>	LANDING	ABNORMAL VIBRATIONS <input type="checkbox"/>	PERIODIC CHECK <input type="checkbox"/>
AIRCRAFT S/N :					
COUPLING POSITION	MEASURED VALUES ONLY FOR P/N 4G6500A00211 /12			ALLOWABLE LINEAR DISPLACEMENT [mm]	
MGB Output (A)	Δ_A			≤ 0.79	
IGB Input (B)	Δ_B			≤ 0.79	
Central Bearing Support (C)				≤ 0.79	
ORIGINATOR Name: _____ Date: _____		APPROVED / QUALITY Name: _____ Date: _____		DISTRIBUTION AGUSTAWESTLAND (TSD&D)	

Figure A2 – Direct alignment check with linear gauge

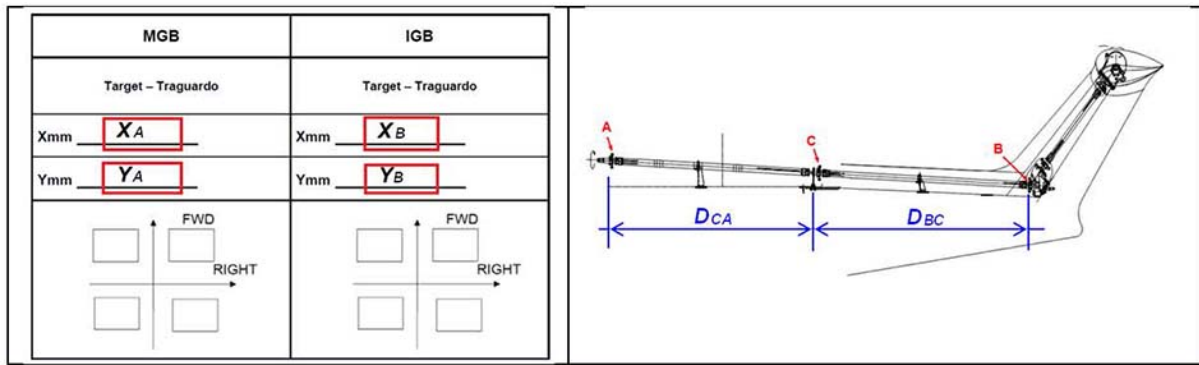


Figure A3 – Example of alignment check with optical device

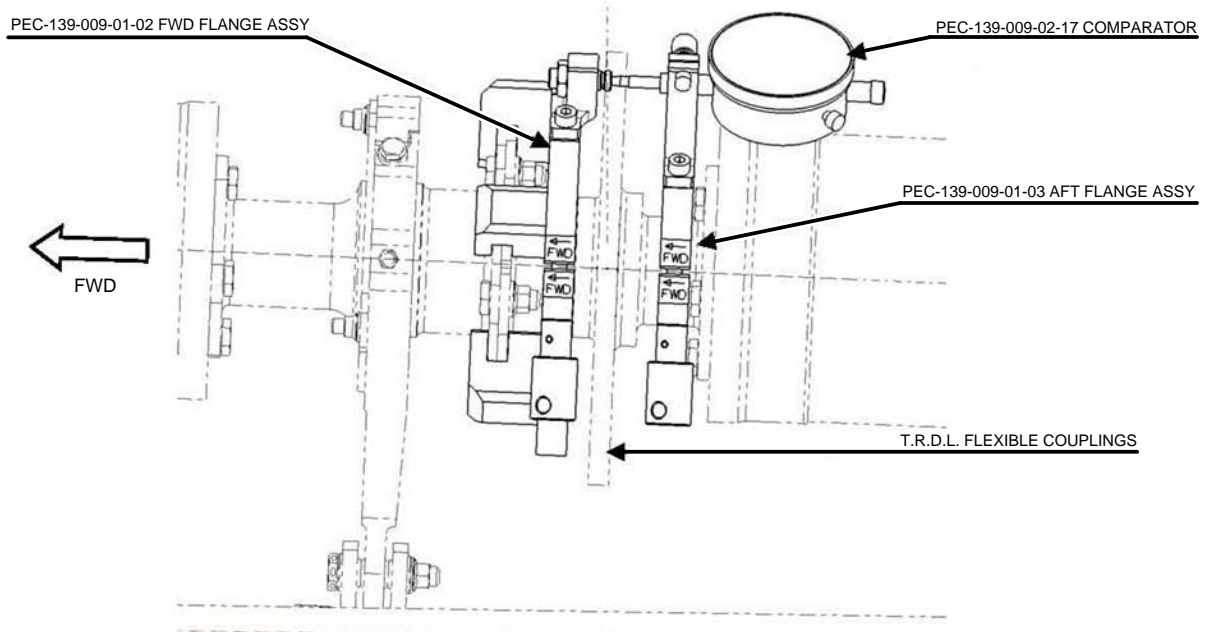


Figure A4 – TOOL ASSY P/N PEC-139-009-01 installation on the flexible coupling (Area C)

TABLE A

		TAIL DRIVE SHAFTS DIRECT ALIGNMENT CHECK SUPPLEMENTARY PROCEDURE ONLY FOR P/N 4G6500A00212 Ref: TSD&D 139-N-17-08													
DEPT. :		COORDINATOR :													
ORIGIN COMPANY :		Material P/N :													
AIRCRAFT S/N :															
ORIGINAL ALIGNMENT DATA		Δ_A _____ (1)		Δ_B _____ (1)											
COUPLING POSITION	LINEAR DISPLACEMENT [mm]														
	BEFORE FLOOR PANEL SUBSTITUTION		AFTER FLOOR PANEL SUBSTITUTION		DIFFERENCE										
(C)	Vertical plane Δ_{C1V}	Horizontal plane Δ_{C1H}	Vertical plane Δ_{C2V}	Horizontal plane Δ_{C2H}	Vertical plane $\Delta_{C1V} - \Delta_{C2V}$										
Central Bearing Support	_____ (1)	_____ (1)	_____ (1)	_____ (1)	Vertical plane $\Delta_{C1H} - \Delta_{C2H}$										
Alignment Requirements Verification:															
Formulas			Results		OK / Not OK										
$P_A = \sqrt{(X_A)^2 + (Y_A)^2} \leq 9.25mm$ $P_B = \sqrt{(X_B)^2 + (Y_B)^2} \leq 9.45mm$ $\Delta_A = 0.0573 \cdot P_A + 0.263 \leq 0.79mm$ $\Delta_B = 0.0565 \cdot P_B + 0.263 \leq 0.79mm$			_____ (1)(2) _____ (1)(2) _____ (1)(2) _____ (1)(2)		_____ (1) _____ (1) _____ (1) _____ (1)										
$\Delta_m = 2 \cdot (0.79 - \max(\Delta_A; \Delta_B)) \geq 0$ $\Delta_{C2} = \sqrt{(\Delta_{C2V})^2 + (\Delta_{C2H})^2} \leq 0.79mm$ $\sqrt{(\Delta_{C1V} - \Delta_{C2V})^2 + (\Delta_{C1H} - \Delta_{C2H})^2} \leq \Delta_m$			_____ (1) _____ (1) _____ (1)		_____ (1) _____ (1) _____ (1)										
Note: (1) field to be fulfilled by the operator (2) to be calculated if the available measurements derive from the alignment check based on optical device															
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">MGB</td> <td style="width: 50%; text-align: center;">IGB</td> </tr> <tr> <td style="text-align: center;">Target – Traguardo</td> <td style="text-align: center;">Target – Traguardo</td> </tr> <tr> <td style="text-align: center;">Xmm X_A</td> <td style="text-align: center;">Xmm X_B</td> </tr> <tr> <td style="text-align: center;">Ymm Y_A</td> <td style="text-align: center;">Ymm Y_B</td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> </tr> </table>		MGB	IGB	Target – Traguardo	Target – Traguardo	Xmm X_A	Xmm X_B	Ymm Y_A	Ymm Y_B						
MGB	IGB														
Target – Traguardo	Target – Traguardo														
Xmm X_A	Xmm X_B														
Ymm Y_A	Ymm Y_B														
ORIGINATOR Name: _____ Date : _____		APPROVED / QUALITY Name: _____ Date : _____		DISTRIBUTION Leonardo HD (TS D&D)											

Figure A5

ANNEX B

TAIL ROTOR DRIVE LINE FINAL ALIGNMENT CHECK

1. GENERAL DESCRIPTION

The tail rotor drive final alignment procedure allows to check the angular misalignments of the Tail Rotor Drive Line (TRDL).

2. REQUIRED TOOLS

The tools necessary to do the tail rotor drive final alignment check are listed in Table B1. See Figure B1 and Figure B2.

Table B1 – Required Tools.

REF	P/N	DESCRIPTION
Fig. B1	139H6300D002A651D	LINEAR GAUGE SUPPORT
Fig. B2	TALL0000M1A686A	LINEAR GAUGE BENCH

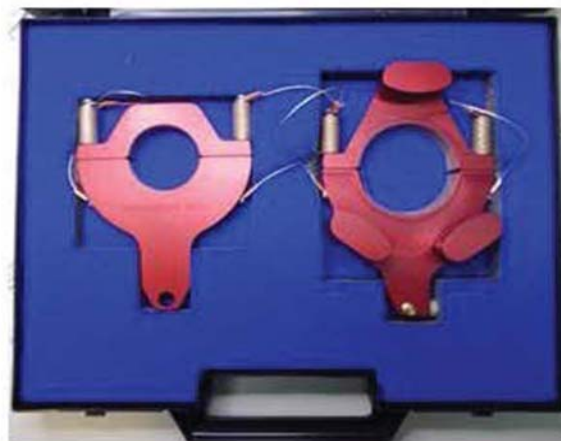


Figure B1 - Linear Gauge Support

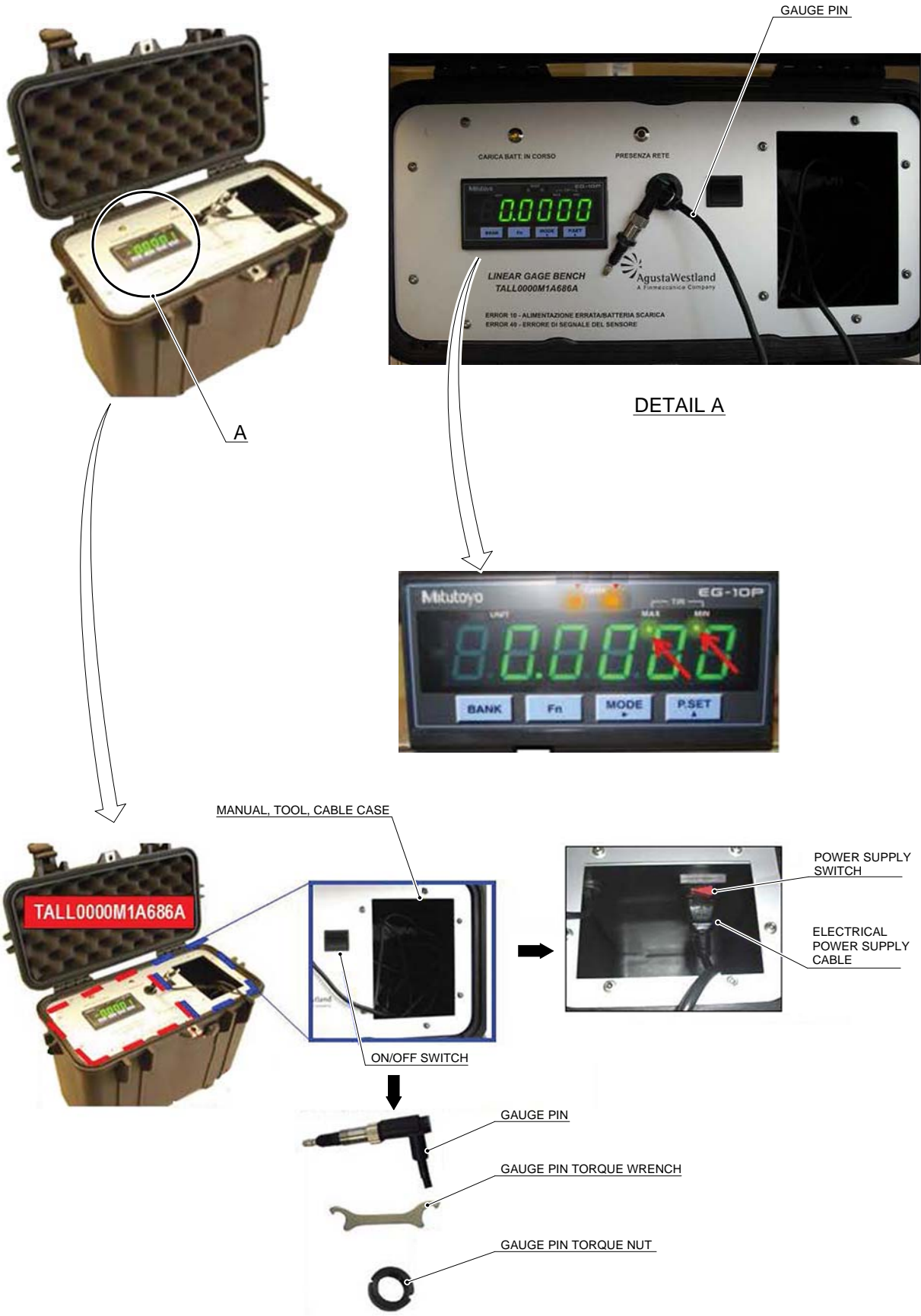


Figure B2 - Linear Gauge Bench

3. ALIGNMENT PROCEDURE DESCRIPTION

3.1 LOCAL COORDINATE SYSTEM

The local/relative coordinate system is the coordinate system x, y, z which is used with the optical device unit and targets to check the alignment. It is defined as follows:

- x : lateral axis on the sight (matches to the BL helicopter coordinate)
- y : vertical axis on the sight (matches to the WL helicopter coordinate)
- z : axis of sight (matches to the STA helicopter coordinate).

3.2 TAIL DRIVE LINE (TDL) COUPLING ANGULAR MISALIGNMENT

With reference to Figure B3, the angular misalignment at a specific point of a shafting line (typically at a flexible coupling position) is made up of two components on two normal planes:

- α_y is the “vertical” component (WL);
- α_x is the “horizontal” component (BL).

The resulting misalignment is given by:

$$\alpha = \sqrt{(\alpha_x^2 + \alpha_y^2)}.$$

All the criteria and the permitted values given in this procedure are referred to the resulting misalignment α .

The permitted installation misalignment is defined as:

- PERMITTED ANGULAR MISALIGNMENT AT TDL FLEXIBLE COUPLING AT INSTALLATION $\alpha \leq \pm 15'$.

With reference to Figure B4:

$$\alpha = \alpha_{G1} = \alpha_{G2} = \alpha_{G3} = \alpha_{G4} = \alpha_{G5}.$$

All TDRL flexible couplings are designed to operate with an Endurance Limit angular misalignment equal to 2.0°. This misalignment value includes the installation and operational (structural and thermal) effects that follow:

- | | |
|---|---------------|
| — Operational structural effects | ≤ 47' (0.79°) |
| — Operational thermal effects estimated value | 12' (0.20°) |
| — Uncertainty factor (1.5) | 31' (0.52°) |
| — Load variability factor | 15' (0.24°). |

The angular misalignment at flexible couplings due to the operational effects is 1.75°.

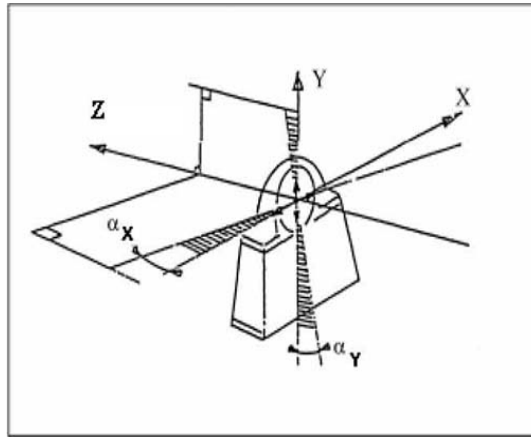


Figure B3 - Angular misalignment components

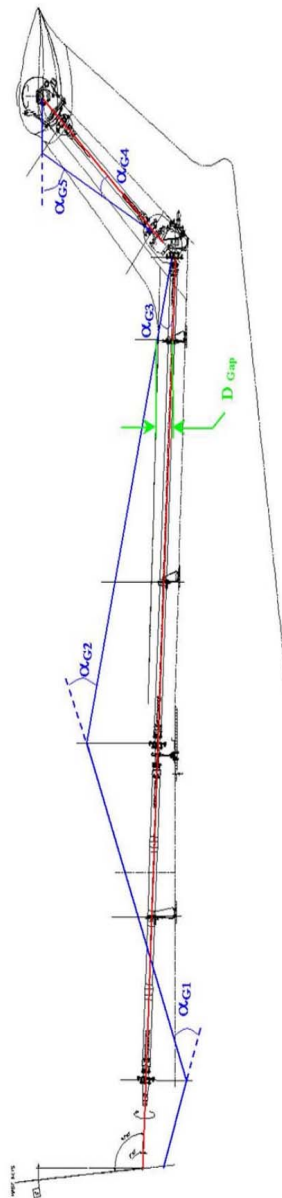


Figure B4

4. TAIL ROTOR DRIVE LINE FINAL ALIGNMENT CHECK PROCEDURE

NOTE

Use the 30V DC power supply only if the helicopter is not connected to the electrical power source.

- 4.1 If the rotor brake caliper is set in the fully UP position, set the rotor brake caliper to the down position according to AMP DM 39-A-63-51-05-00A-100B-A.

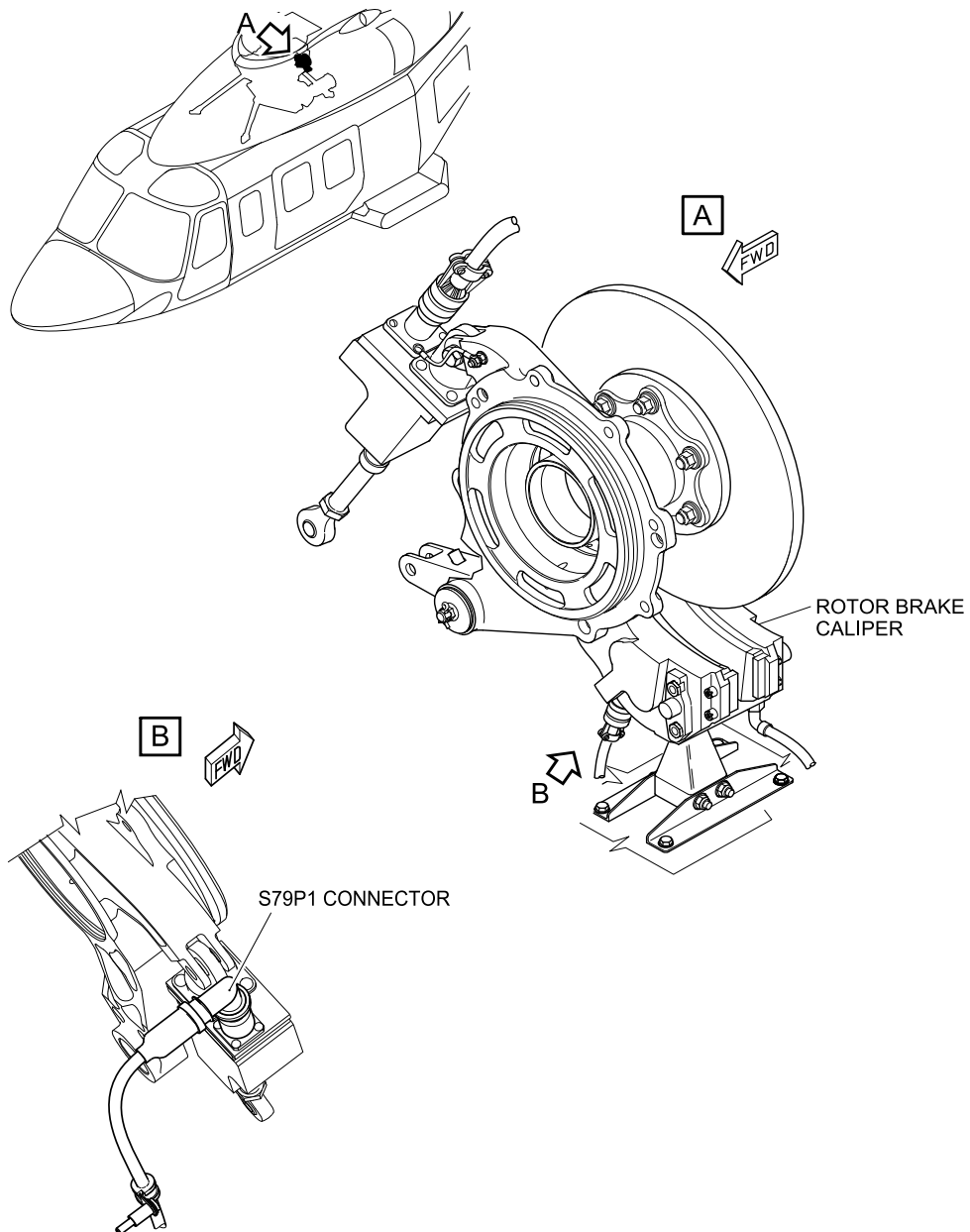


Figure B5

- 4.2 With reference to Figure B6 and Figure B7, install the adapter P/N 139H6300D002A651D on the flexible coupling on the MGB output (Position A). Attach the adapter to the two flexible coupling flanges as shown in Figure B7.

NOTE

The adapter P/N 139H6300D002A651D has two flanges that must be attached to the coupling.

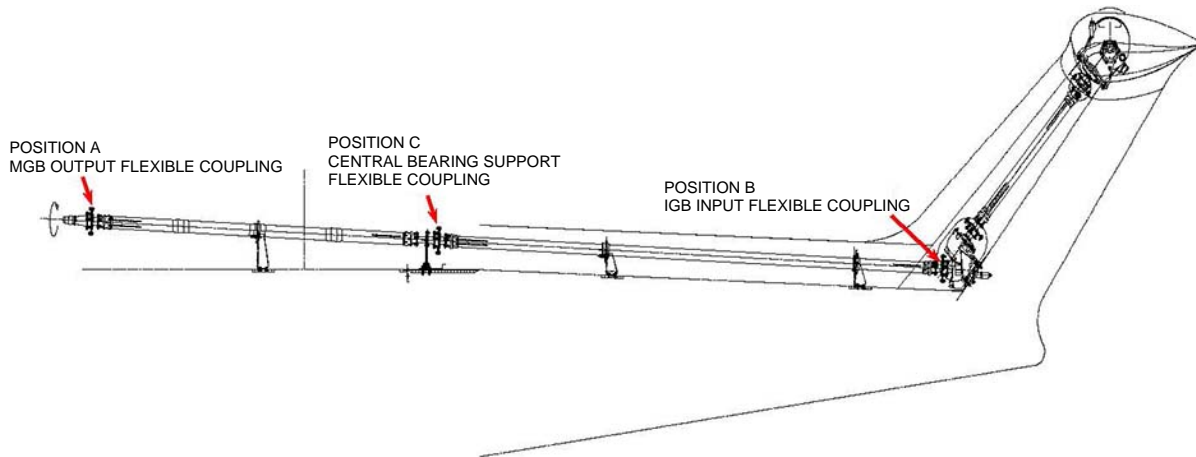


Figure B6

CAUTION

INSTALL THE LINEAR GAUGE PIN ON THE ADAPTER AFTER THE ADAPTER HAS BEEN INSTALLED ON THE FLEXIBLE COUPLING. BE CAREFUL WHEN YOU INSTALL THE LINEAR GAUGE PIN TO THE ADAPTER. IT CAN BE EASILY DAMAGED.

- 4.3 With reference to Figure B7, Install the linear gauge pin (part of P/N TALL0000M1A686A) on the adapter P/N 139H6300D002A651D.
- 4.4 With reference to Figure B2, set the ON/OFF switch to ON to energize the linear gauge bench.

NOTE

If the batteries of the linear test bench are discharged, connect the test bench through the power supply cable to a 220V receptacle.

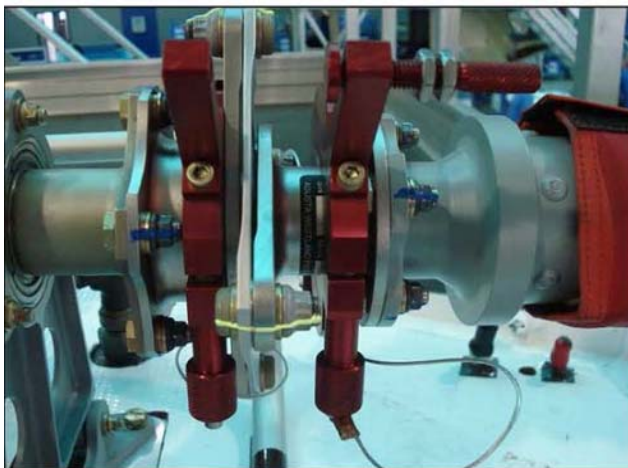
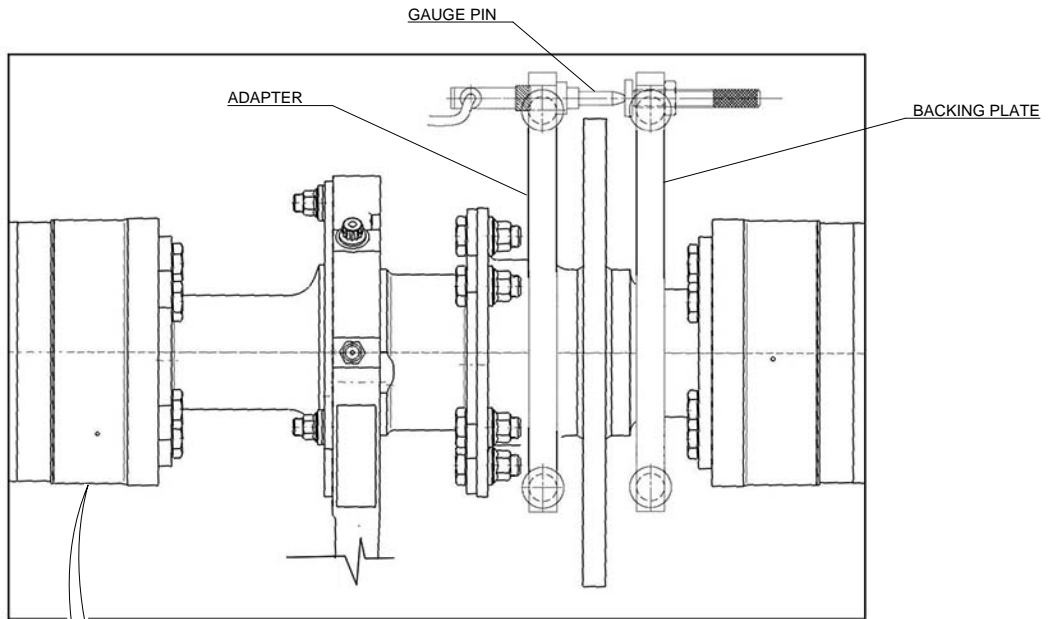


Figure B7

- 4.5 With reference to Figure B8, make sure that, on the test bench, no function (MAX, MIN, TIR or BANK) is active. If one of the LED function indicators is on (the function is active) operate the keys "MODE" and "BANK" until all LED function indicators go off (all function not active).

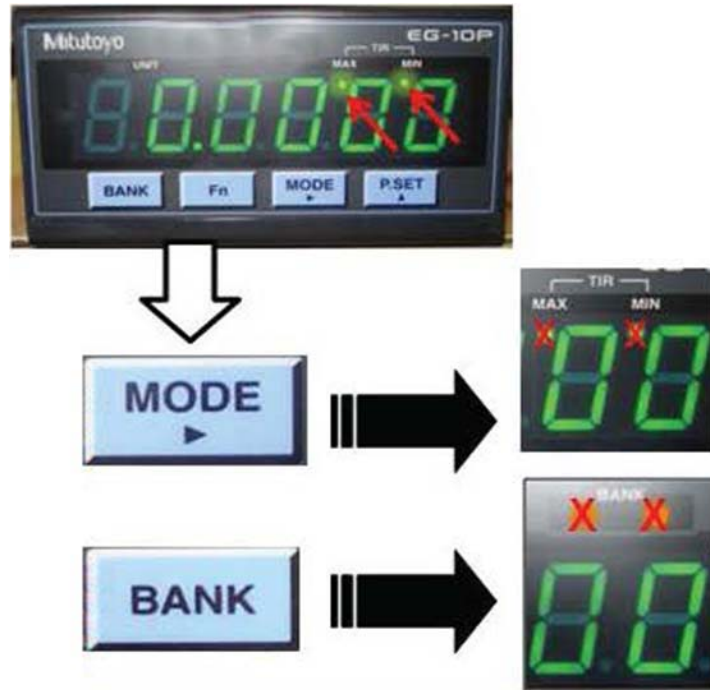


Figure B8

- 4.6 With reference to Figure B7, adjust the position of backing plate (part of P/N TALL0000M1A686A) until, on the display of linear gauge bench P/N TALL0000M1A686A, the value of 2.500 comes in view (50% of the gauge pin stroke).

NOTE

The gauge stroke is 5.000 mm. Adjust the position to have the measure value that is far from the full scale (it must not be exactly 2.500 mm). This is to make sure that the measure value does not reach the full scale during the alignment check procedure.

- 4.7 With reference to Figure B9, push three times the "MODE" key until the LED indicators above MAX, MIN and TIR are on.

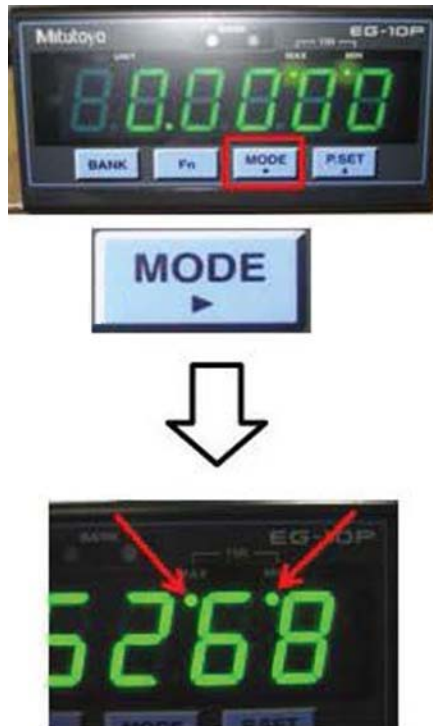


Figure B9

- 4.8 With reference to figure B10, push the "P.SET" key to set the TIR value to 0.



Figure B10

NOTE

The TIR value is the result of the difference between the MAX and the MIN values measured after each zeroing (reset).

CAUTION

With reference to Figure B6, when the tail drive line rotates, make sure that the linear gauge pin, installed on the Position A (MGB flexible coupling), do not touch the engine firewall.

CAUTION

When the tail drive line rotates, make sure the linear gauge pin is not stressed or pinched.

- 4.9 With reference to Figure B11, rotate the tail drive line of 360° minimum, and record the maximum TIR value.

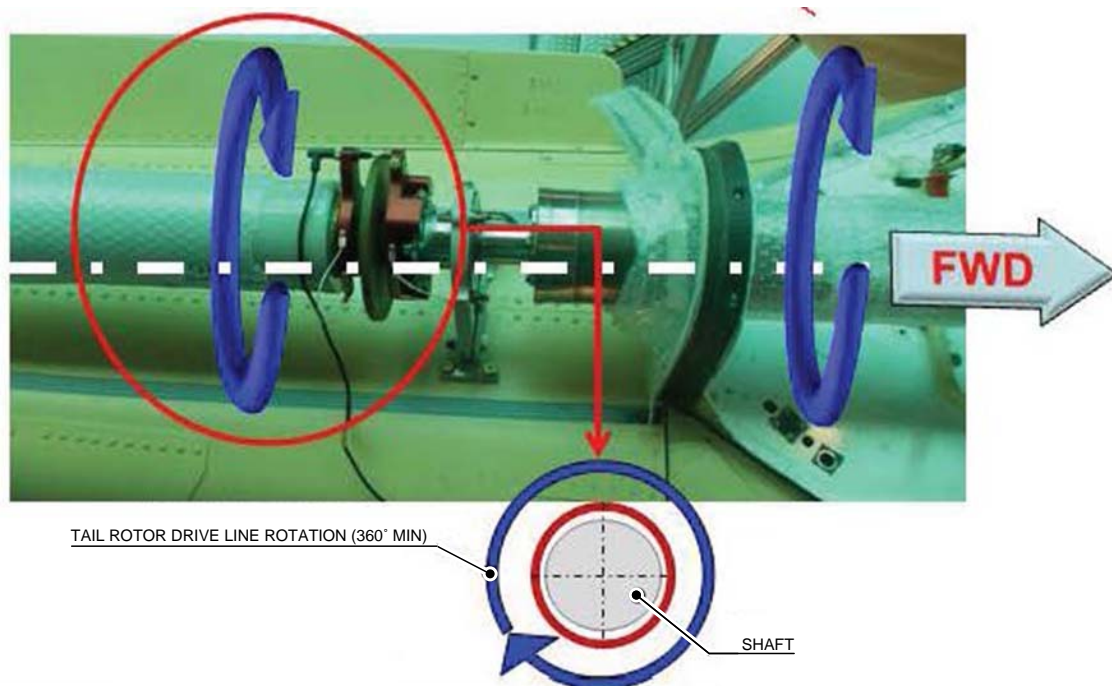


Figure B11

- 4.10 Record the maximum TIR value (rounded to the second decimal place) in the related column of Table B2.

Table B2

COUPLING POSITION (see Figure B6)	MEASURED VALUES mm	PERMITTED LINEAR DISPLACEMENT mm
A MGB output		≤ 0.79
B IGB input		≤ 0.79
C Central bearing support		≤ 0.79

NOTE

The displacement limit values are computed accounting for the maximum angular misalignment of 15'.

- 4.11 With reference to Figure B2, push in sequence the "P.SET" key and the "MODE" key to reset the linear gauge bench. Set the ON/OFF switch to OFF to de-energize the linear gauge bench.
- 4.12 With reference to Figure B7, remove the linear gauge pin (part of linear gauge bench P/N TALL0000M1A686A) from the adapter P/N 139H6300D002A651D, then remove the adapter from the MGB flexible coupling.
- 4.13 With reference to Figure B6, install the adapter P/N 139H6300D002A651D on the IGB flexible couplings. Refer to Figure B6, Position B.
- 4.14 With reference to Figure B7, install the linear gauge pin (part of linear gauge bench P/N TALL0000M1A686A) on the adapter.
- 4.15 Repeat steps 4.4 thru 4.12, to do the alignment check on the IGB.
- 4.16 With reference to Figure B7, remove the linear gauge pin (part of linear gauge bench P/N TALL0000M1A686A) from the adapter P/N 139H6300D002A651D, then remove the adapter from the IGB flexible coupling.
- 4.17 With reference to Figure B6, install the adapter P/N 139H6300D002A651D on the central bearing support (Position C) and the linear gauge pin (part of linear gauge bench P/N TALL0000M1A686A) on the adapter.
- 4.18 Repeat steps 4.4 thru 4.12, to do the alignment check on the central bearing support.
- 4.19 Remove all the tools and the other items from the work area. Make sure that the work area is clean.

ANNEX C

TAIL ALIGNMENT PROCEDURE

1. REQUIRED TOOLS

The tools necessary to perform the tail alignment procedure are listed in Table C1.

Table C1 – Required Tools.

P/N	DESCRIPTION
TECO6-147	Optical device (Telescope Keuffel & Esser or equivalent)
TECO6-148	Target glass (Telescope Keuffel & Esser or equivalent)
3G6510H05232A651A	Central support
3G5350H00131A651A	Tail module sustaining strut
3G6500H00211A651A	IGB target adapter
3G6500H00311A651A	Telescope support kit (TGB)
3G6510A01531A651A	Damper adapter (STA 10587.80)
N.A.	AIES139 Software [Rel. 1.3] for Windows PC

2. ALIGNMENT PROCEDURE DESCRIPTION

2.1 HELICOPTER CONFIGURATION

The Tail assy must be removed in accordance with AMP DM n° 39-A-53-40-00-00A-520A-A or DM n° 39-A-53-40-00-00A-520B-A.

2.2 LOCAL COORDINATE SYSTEM

The local/relative coordinate system is the coordinate system x,y,z which is used when adopting an optical sight unit and targets to check the alignment and it is defined as follows:

- x : lateral axis on the sight (corresponds to the BL helicopter coordinate)
- y : vertical axis on the sight (corresponds to the WL helicopter coordinate)
- z : axis of sight (corresponds to the STA helicopter coordinate).

2.3 ANGULAR MISALIGNMENT PERMITTED

The angular misalignment at a specific point of a shafting line (typically at a flexible coupling location) is made up of two components on two normal planes (see Figure B4 in Annex B):

- α_y is the “vertical” component (WL)
- α_x is the “horizontal” component (BL)
- The resulting misalignment is given by:

$$\alpha = \sqrt{(\alpha_x^2 + \alpha_y^2)}$$

All the criteria and permitted values given in this procedure are referred to the resulting misalignment.

The permitted installation misalignment is defined as:

— Permitted Angular Misalignment $\alpha \leq \pm 10'$.

2.4 CABIN AND TAIL ALIGNMENT PROCEDURE DESCRIPTION

The optical device shall be installed on the related support and fixed by means of bolts.

The support has two target glass positions: forward and aft position. The forward position on the support is used for the position check, the aft position is used for the angular check.

The forward position glass shall be pointed with the optical device with X, Y axis at the 0.0, 0.0 starting condition.

The focus knob, on the optical device, must be operated until the target glass and the reference axes are clearly visible.

The total X and Y distance between the axis origin and the target glass zero position must be calculated moving the X and Y axis knobs until both axes are tangent to one of the target glass circles (it is not necessary to use the same circle for the two axis).

With reference to Figure C1, the values read on the alignment check chart shall be integrated with the values to be read on the X and Y axes positions adjust knobs.

Values sign (“+” or “-”) is determined by alignment check chart shown in Figure C1.

The measured values (with \pm sign) must be used for the final calculation.

The adjustment of the peeling shim thickness is necessary if the permitted limits of misalignment are not matched.

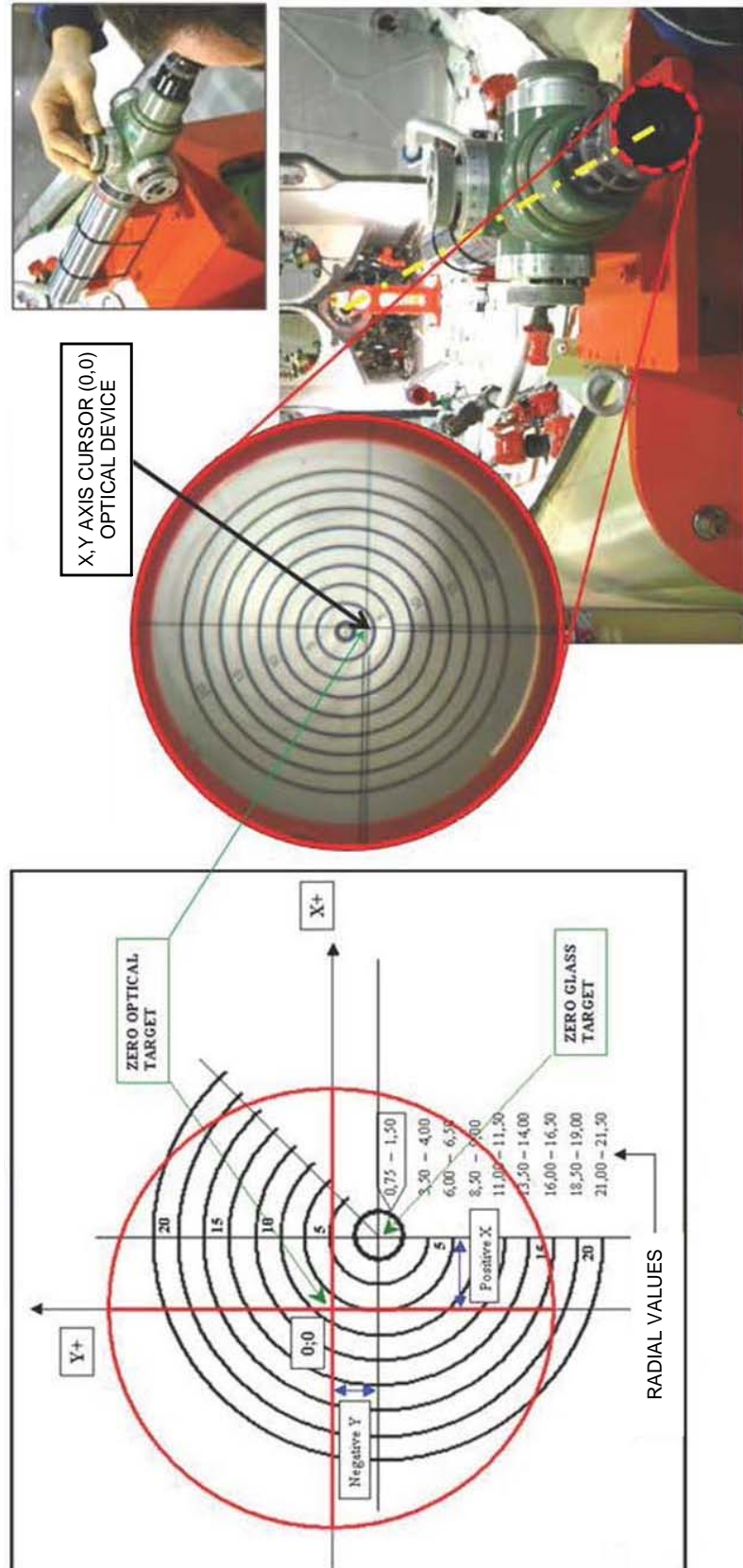


Figure C1 –Target glass axis definition/ Alignment check chart
Target glass and optical device positions in the picture are for reference only

3. TAIL ALIGNMENT PROCEDURE

- 3.1 Install the tail module upon the specific sustaining strut P/N 3G5350H00131A651A and fix it by means of special tooling bolts, as shown in Figure C3. Torque the bolts to 23.75-26.25 Nm.
- 3.2 Perform the IGB positional check as described in the procedure that follows:
 - 3.2.1 Install the optical device (TECO6-147 or equivalent) upon the specific support at the Tail clipping section.
 - 3.2.2 Install the target glass (TECO6-148 or equivalent) upon the specific support P/N 3G6500H00211A651A, located in correspondence of the theoretical IGB input (position 1 in Figure C3).
 - 3.2.3 Target the forward positional glass using the telescope (with X,Y axis at 0,0 at the starting condition).
 - 3.2.4 Record the measured values.
 - 3.2.5 The measured value must be in a 19 mm diameter (9.5 mm radius) circle with respect to the origin position (0, 0).
- 3.3 Perform the IGB angular check as described in the procedure that follows:
 - 3.3.1 Point the optical device (TECO6-147 or equivalent) to the angular glass target located on the IGB input specific support (P/N 3G6500H00211A651A) at a distance of 100 mm backwards with respect to the positional target previously removed (position 2 in Figure C3).
 - 3.3.2 Record the measured values.
 - 3.3.3 The measured value must be in a 0.58 mm diameter (0.29 mm radius) circle with respect to the value previously recorded (position 1 in Figure C3).
- 3.4 Perform the TGB positional check as described in the procedure that follows:
 - 3.4.1 Install the optical device (TECO6-147 or equivalent) upon the specific support P/N 3G6500H00311A651A at the TGB input section.
 - 3.4.2 Install the target glass (TECO6-148 or equivalent) upon the specific support P/N 3G6500H00211A651A, located in correspondence of the theoretical IGB output (position 3 in Figure C3).
 - 3.4.3 Target the positional glass (fitted in the most distant seat with respect to the optical device).
 - 3.4.4 Record the measured values.
 - 3.4.5 The measured value must be in a 6 mm diameter (3 mm radius) circle with respect to the origin position (0,0).

- 3.5 Perform the TGB angular check as described in the procedure that follows:
 - 3.5.1 Point the optical device to the angular glass target located on the IGB output specific support (P/N 3G6500H00211A651A) and fitted in the closest seat with respect to the telescope (position 4 in Figure C3).
 - 3.5.2 Record the measured values.
 - 3.5.3 The measured value must be in a 0.58 mm diameter (0.29 mm radius) circle with respect to the value previously recorded (position 3 in Figure C3).
- 3.6 Perform the Central Bearing Support positional check (STA 8936.42) as described in the procedure that follows:
 - 3.6.1 Calculate the theoretical point coordinates multiplying the coordinates of IGB position (position 4 in Figure C3) for 0.068.
 - 3.6.2 Install the optical device (TECO6-147 or equivalent) upon the specific support at the Tail clipping section.
 - 3.6.3 Install the central support 3G6510H05232A651A at STA 8936.42 and fixed by means of special tooling bolts.
 - 3.6.4 Check the position of the positional target (forward glass target) (position 9 in Figure C3).
 - 3.6.5 Record the measured values.
 - 3.6.6 The measured value must be in a 1.4 mm diameter (0.7 mm radius) circle with respect to the theoretical point determined at step 3.6.1.
- 3.7 Perform the Central Bearing Support angular check (STA 8936.42) as described in the procedure that follows:
 - 3.7.1 Install the angular target glass upon the central bearing adapter P/N 3T6510H05232A651A, 100 mm backwards with respect to the positional glass (position 10 in Figure C3).
 - 3.7.2 Record the measured values.
 - 3.7.3 The measured value must be in a 0.58 mm diameter (0.29 mm radius) circle with respect to the value previously recorded (position 9 in Figure C3).
- 3.8 Perform the Damper positional check (STA 10587.80) as described in the procedure that follows:
 - 3.8.1 Obtain the theoretical point coordinates multiplying the coordinates of IGB position (position 11 in Figure C3) for 0.543.
 - 3.8.2 Install the optical device (TECO6-147 or equivalent) upon the specific support at the Tail clipping section.

- 3.8.3 Install the damper adapter P/N 3G6510A01531A651A at STA 10587.80 and fix it by means of special tooling bolts.
- 3.8.4 Target the positional glass (forward glass target) adopting the telescope (position 11 in Figure C3).
- 3.8.5 Record the measured values.
- 3.8.6 The measured value must be in a 4 mm diameter (2 mm radius) circle with respect to the theoretical point determined at step 3.8.1.
- 3.9 Perform the Damper angular check (STA 10587.80) as described in the procedure that follows:
 - 3.9.1 Install the angular target glass upon the central bearing adapter P/N 3G6510A01531A651A, 100 mm backwards with respect to the positional glass (position 11 in Figure C3).
 - 3.9.2 Record the measured values.
 - 3.9.3 The measured value must be in a 1.7 mm diameter (0.85 mm radius) circle with respect to the value previously recorded (position 11 in Figure C3).

NOTE: The difference of thickness with respect to the nominal shims is automatically computed, for bearing and damper supports, by AIES139 software through an optimisation process. Perform following step 3.10 if AIES139 software is available.
- 3.10 Check the required shimming using AIES139 software.
- 3.11 If required, perform the alignment shimming as described in the procedure that follows:

NOTE: The maximum shim thickness range (with respect to the nominal shims = 5 mm) is equal to $-5 \div +1.5$ mm.

 - 3.11.1 If the tolerances, in terms of angular misalignment and radial gap, between damper ring and wear sleeve, are not satisfied, add or remove shims as per drawing requirements with respect to the nominal shims (6.35 mm).
 - 3.11.2 Make sure that you obey the following rules:
 - The adjustment/correction that have to be performed on damper/bearing supports, to correct their position along the vertical coordinate (Y axis of local coordinate system), shall be carried out by means of left and right shims with same thickness.

- The adjustment/correction that have to be performed on damper/bearing supports, to correct their position along the horizontal coordinate (X axis of local coordinate system), shall be carried out using left and right shims with different thickness.
- The adjustment/correction that have to be performed on bearing support, to correct its angle on Y-plane (vertical), shall be carried out using front and rear shims with different thickness.
- The planarity tolerance of the damper/bearing, is 0.1 mm according to Figure C4.
- This value (0.1 mm) can be assured whether the difference between the Left and Right shim's thickness is within 0.5 mm and Front and Rear is within 0.2 mm.
- If instead, the difference between the shims LH and RH is major than 0.5 mm (or 0.2 mm for Front and Rear shims), the shims shall be reworked to guarantee the planarity tolerance.
- The reworking procedure is defined to achieve slanting shim like a wedge. This could be obtained removing only a portion of a single foil from the internal or external side of the support.

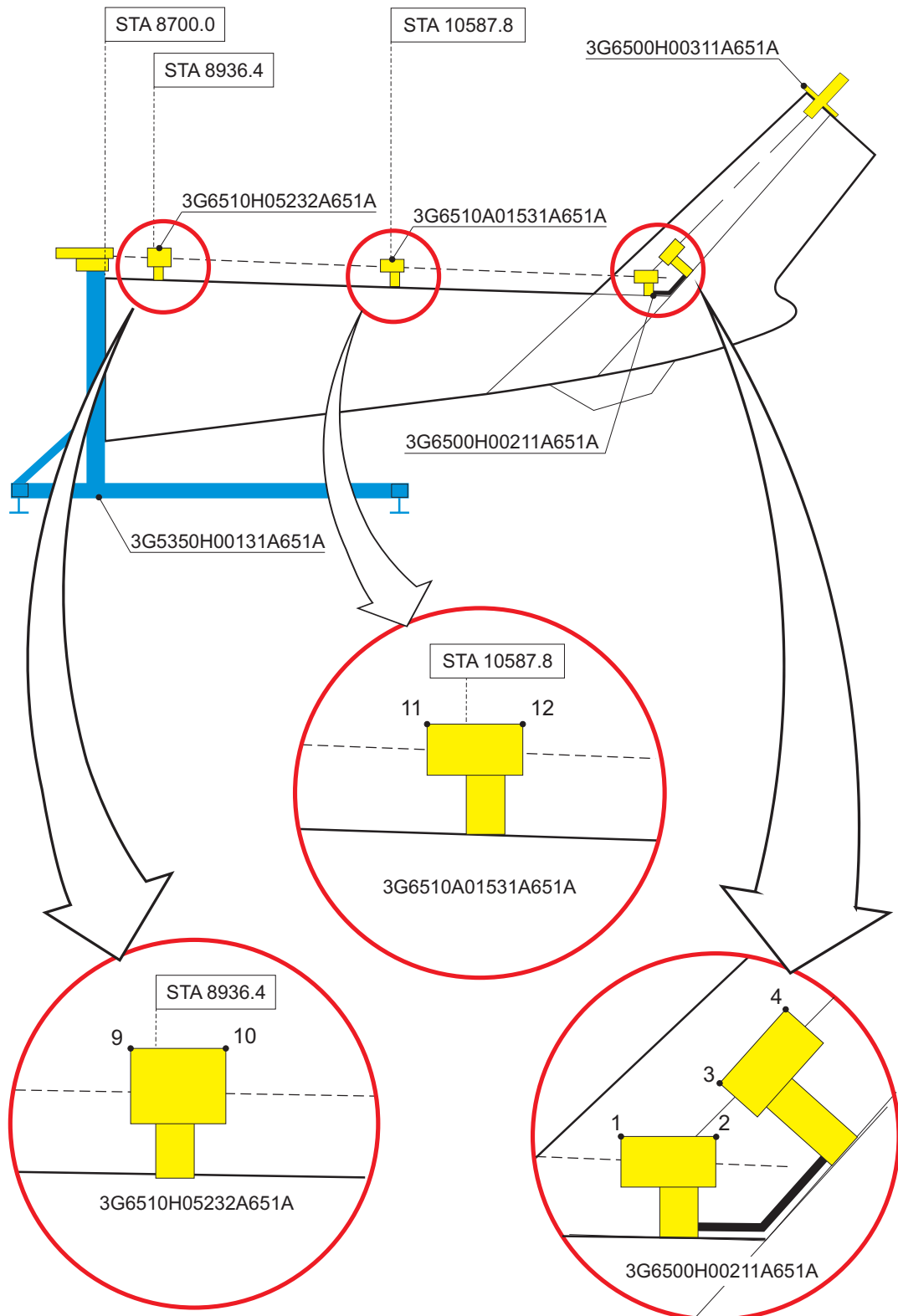


Figure C3 – Tail alignment check

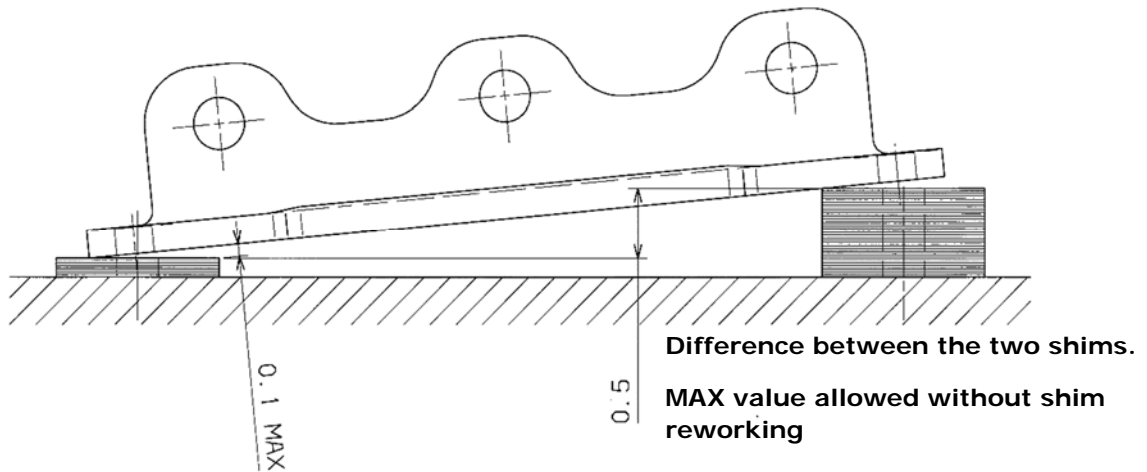


Figure C4 – Tail alignment check

- 3.12 In case of shim adjustment, it is necessary to repeat the alignment procedure from step 3.2 to step 3.9 with the modified configuration of shims.
- 3.13 Attach the final alignment report to the tailboom logcard.
- 3.14 Remove all the tools and other items from the work area.
- 3.15 Make sure that the work area is clean.
- 3.16 Install Tail Assy in accordance with AMP DM n° 39-A-53-40-00-00A-720A-A or DM n° 39-A-53-40-00-00A-720B-A.

ANNEX D

TAIL BOOM ASSY REPAIRS

1. GENERAL DESCRIPTION

This Annex D includes the repair procedures for damage on the left and right tail boom panels.

2. REQUIRED CONDITIONS

In accordance to CSRP DM CSRP-A-51-21-05-00A-028A-D, the repair area shall be cleaned before repair execution.

In accordance to CSRP DM CSRP-A-51-70-00-00A-010A-D, for deviations from the indicated repair design refer to guidelines for standard repairs or contact Product Support Engineering (engineering.support.lhd@leonardocompany.com).

In accordance to CSRP DM CSRP-A-51-21-00-00A-028A-D, paint and primer shall be removed from the repair area.

3. GENERAL NOTES

During the following repair procedures:

- Refer to CSRP for all the processes described;
- Adapt manufactured items during installation on existing structure;
- Protect bare aluminium surfaces (manufactured items, sanded areas and cut edges) with conversion coating (C237);
- Protect all manufactured items with primer;
- Round out manufactured parts/cut lines corners with 5 mm radius typ;
- During cutting/sanding operations take care not to damage surrounding items;
- Break sharp edges with radius 0.13 thru 0.38 mm;
- Deburr new fastener holes;
- Select actual fastener grip at installation;
- Dip the shank of fasteners into sealant (C465) before installation;
- Rivet as indicated, if holes conditions are not suitable use oversize rivets.

4. TAIL BOOM ASSY REPAIR 3G5350R00211

NOTE

For the identification of the applicable damages of this procedure refer to Figure D2.

The position and size of the cut-out and relative filler may change depending on the damaged area.

- 4.1 With reference to Figure D8, manufacture the applicable components and rework the peeling shims P/N 3G6510A05651 as required.

- 4.2 With reference to Figure D6 View A, remove the rivets that attach the panels to the structure as required.
- 4.3 With reference to Figure D6 View A and Figure D7 Section C-C, drill on the panels the holes for the new rivets.
- 4.4 With reference to Figure D6 View A, countermark holes position on the doublers and on the filler according to the existing holes on the panel.
- 4.5 With reference to Figure D6 View A, drill on the doublers and on the filler the holes on the previously countermarked positions.
- 4.6 With reference to Figure D6 Detail B, do the cut out of the skin of the panel.
- 4.7 With reference to Figure D6 View A, bond in its correct position the filler by means of adhesive EA934NA (C057).
- 4.8 With reference to Figure D6 View A, apply adhesive EA9309.3NA (C021) on the mating surfaces between the doublers and the panels.
- 4.9 With reference to Figure D6 View A, put and secure the doublers in their correct positions on the panels.

NOTE

Performing following step 4.10, check the rivets required for doublers installation according to Figure 6 of this Service Bulletin.

- 4.10 With reference to Figure D6 View A and Figure D7 Section C-C, install the rivets that attach the doublers P/N 3G5350R00251 and P/N 3G5350R00253 to the panels as required.
- 4.11 With reference to Figure D7 Section C-C, prepare on the panel the holes for the n°7 rivets P/N NAS9304B-5-10 as follows:
 - 4.11.1 Drill the doublers and the external skin of the panels.
 - 4.11.2 Remove the honeycomb core.
 - 4.11.3 Fill the honeycomb cleaned area with adhesive EA934NA (C057).
 - 4.11.4 When the adhesive is cured, drill the rivets holes on these parts:
 - The doublers;
 - The external skin of the panels;
 - The adhesive;
 - The internal skin of the panels.
- 4.12 With reference to Figure D6 View A and Figure D7 Section C-C, install n°7 rivets P/N NAS9304B-5-10 and n°7 washers P/N 999-0065-06-45 that attach the doublers to the panels.

- 4.13 With reference to Figure D6 View A, seal the doublers with the sealant MC-780 B-2 (C465).
- 4.14 Continue to step 8 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.

5. TAIL BOOM ASSY REPAIR SK139-1322

NOTE

For the identification of the applicable damages of this procedure refer to Figure D3.

The position and size of the cut-out and relative filler may change depending on the damaged area.

- 5.1 With reference to Figure D14, manufacture the applicable components.
- 5.2 Rework the peeling shims P/N 3G6510A05651 according to Figure D8.
- 5.3 With reference to Figure D10 View A, remove the rivets that attach the panels to the structure as required.
- 5.4 With reference to Figures D10 thru D13, drill on the panel the holes for the new rivets.
- 5.5 With reference to Figures D10 thru D13, countermark holes position on the doublers and on the filler according to the existing holes on the panel.
- 5.6 With reference to Figures D10 thru D13, drill on the doublers and on the filler the holes on the previously countermarked positions.
- 5.7 With reference to Figure D11 Detail B, do the cut out of the skin of the panel.
- 5.8 With reference to Figure D12 Detail C, bond in its correct position the filler by means of adhesive EA934NA (C057).
- 5.9 With reference to Figure D12 Detail C, apply adhesive EA9309.3NA (C021) on the mating surfaces between the doublers and the panels.
- 5.10 With reference to Figure D12 Detail C, put and secure the doublers in their correct positions on the panels.

NOTE

Performing following step 5.11, check the rivets required for doublers installation according to Figure 6 of this Service Bulletin.

- 5.11 With reference to Figures D10, D12 and D13, install the rivets that attach the doubler P/N 3G5350R00253 and the LH doubler to the panels as required.
- 5.12 With reference to Figures D10, D12 and D13, prepare on the panel the holes for the n°7 rivets P/N NAS9304B-5-10 and rivet P/N NAS9301B-5-10 as follows:

- 5.12.1 Drill the doublers and the external skin of the panels.
- 5.12.2 Remove the honeycomb core.
- 5.12.3 Fill the honeycomb cleaned area with adhesive EA934NA (C057).
- 5.12.4 When the adhesive is cured, drill the rivets holes on these parts:
 - The doublers;
 - The external skin of the panels;
 - The adhesive;
 - The internal skin of the panels.
- 5.13 With reference to Figures D10, D12 and D13, install n°7 rivets P/N NAS9304B-5-10, rivet P/N NAS9301B-5-10 and n°8 washers P/N 999-0065-06-45 that attach the doublers to the panels.
- 5.14 With reference to Figure D12, seal the doublers with the sealant MC-780 B-2 (C465).
- 5.15 Continue to step 8 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.

6. TAIL BOOM ASSY REPAIR RS139-5351-0348

NOTE

For the identification of the applicable damages of this procedure refer to Figure D4.

The position and size of the cut-out and relative filler may change depending on the damaged area.

- 6.1 With reference to Figure D17, manufacture the applicable components and rework the peeling shims P/N 3G6510A05651 as required.
- 6.2 With reference to Figure D15 View A, remove the rivets that attach the panels to the structure as required.
- 6.3 With reference to Figure D15 View A, drill on the panel the holes for the new rivets.
- 6.4 With reference to Figure D15 View A, countermark holes position on the doublers and on the fillers according to the existing holes on the panel.
- 6.5 With reference to Figure D15 View A, drill on the doublers and on the fillers the holes in the previously countermarked positions.
- 6.6 With reference to Figure D16 Detail B, do the cut outs of the skin of the panels.
- 6.7 With reference to Figure D15 View A, bond in its correct position the fillers by means of adhesive EA934NA (C057).

- 6.8 With reference to Figure D15 View A, apply adhesive EA9309.3NA (C021) on the mating surfaces between the doublers and the panels.
- 6.9 With reference to Figure D15 View A, put and secure the doublers in their correct positions on the panels.

NOTE

Performing following step 6.10, check the rivets required for doublers installation according to Figure 8 of this Service Bulletin.

- 6.10 With reference to Figure D15 View A, install the rivets that attach the doublers to the panels as required.
- 6.11 With reference to Figure D15 View A, seal the doublers with the sealant MC-780 B-2 (C465).
- 6.12 Continue to step 10 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.

7. TAIL BOOM ASSY REPAIR RS139-5351-0249

NOTE

For the identification of the applicable damages of this procedure refer to Figure D5.
The position and size of the cut-out and relative filler may change depending on the damaged area.

- 7.1 With reference to Figure D21, manufacture the applicable components and rework the peeling shim P/N 3G6510A05651 as required.
- 7.2 With reference to Figure D18 View A, remove the rivets that attach the panel to the structure as required.
- 7.3 With reference to Figure D18 View A, drill on the panel the holes for the new rivets.
- 7.4 With reference to Figure D18 View A, countermark with the existing holes of the panel on the doubler and on the filler.
- 7.5 With reference to Figure D18 View A, drill on the doubler and on the filler the holes on the previously countermarked positions.
- 7.6 With reference to Figure D19 Detail B, do the cut out of the skin of the panel.
- 7.7 With reference to Figure D18 View A, bond in its correct position the filler by means of adhesive EA934NA (C057).
- 7.8 With reference to Figure D18 View A, apply adhesive EA9309.3NA (C021) on the mating surfaces between the doubler and the panel.

- 7.9 With reference to Figure D18 View A, put and secure the doubler in its correct position on the panel.
- 7.10 With reference to Figure D18 View A, apply adhesive EA9309.3NA (C021) on the mating surfaces between the tapered shim and the panel.
- 7.11 With reference to Figure D18 View A, put and secure the tapered shim in its correct position on the panel.

NOTE

Performing following step 7.12, check the rivets required for doublers installation according to Figure 7 of this Service Bulletin.

- 7.12 With reference to Figure D18 View A, install the rivets that attach the doubler to the panel as required.
- 7.13 With reference to Figure D18 View A, seal the doubler and the tapered shim with the sealant MC-780 B-2 (C465).
- 7.14 Continue to step 9 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.

8. TAIL BOOM ASSY REPAIR RS139-5351-0714

NOTE

For the identification of the applicable damages of this procedure refer to Figure D23.

The position and size of the cut-out and relative filler may change depending on the damaged area.

NOTE

Make sure to record the inserts position before applying the following step 8.1.

- 8.1 With reference to Figure D25, remove inserts P/N AW007TE and lower doubler P/N 3G5310A01353. Use a template to record the inserts position. and to reinstall the inserts in original position.
- 8.2 Install inserts in accordance with CSRP DM CSRP-A-51-42-00-00A-028A-D.
- 8.3 Drill \varnothing 1.8÷2.0 mm stop-crack holes in accordance with CSRP DM CSRP-A-51-24-02-00A-663A-D.
- 8.4 With reference to Figure D26, if required, manufacture doubler P/N RS139-5351-0714-101 and shims P/N RS139-5351-0714-103 and P/N RS139-5351-0714-105, using al-aly 2024 T3 AMS-QQ-A-250/5 sheets, thickness 0.64 mm.

NOTE

Performing the following steps, make sure to obey the rules that follow:

- Protect bare aluminium surfaces in accordance with CSRP DM CSRP-A-51-21-06-00A-644A-D.
- Use adhesives in accordance with CSRP DM CSRP-A-51-22-00-00A-028A-D.
- Install rivets in accordance with CSRP DM CSRP-A-51-41-00-00A-663A-D. Install rivets with sealant MC-780 B-2.

- 8.5 With reference to Figures D24 and D25, install doubler P/N RS139-5351-0714-101 and shims P/N RS139-5351-0714-103 and P/N RS139-5351-0714-105, using adhesive EA9309.3NA (C021) and rivets P/N NAS9301B-4-01.
- 8.6 Install lower doubler P/N 3G5310A01353 previously removed, using adhesive EA934NA (C057). Seal around the contour using sealant MC-780 B-2.
- 8.7 Continue to step 7, 8, 9, or 10 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.

9. TAIL BOOM ASSY REPAIR SK139-1510

NOTE

For the identification of the applicable damage of this procedure refer to Figure D22.

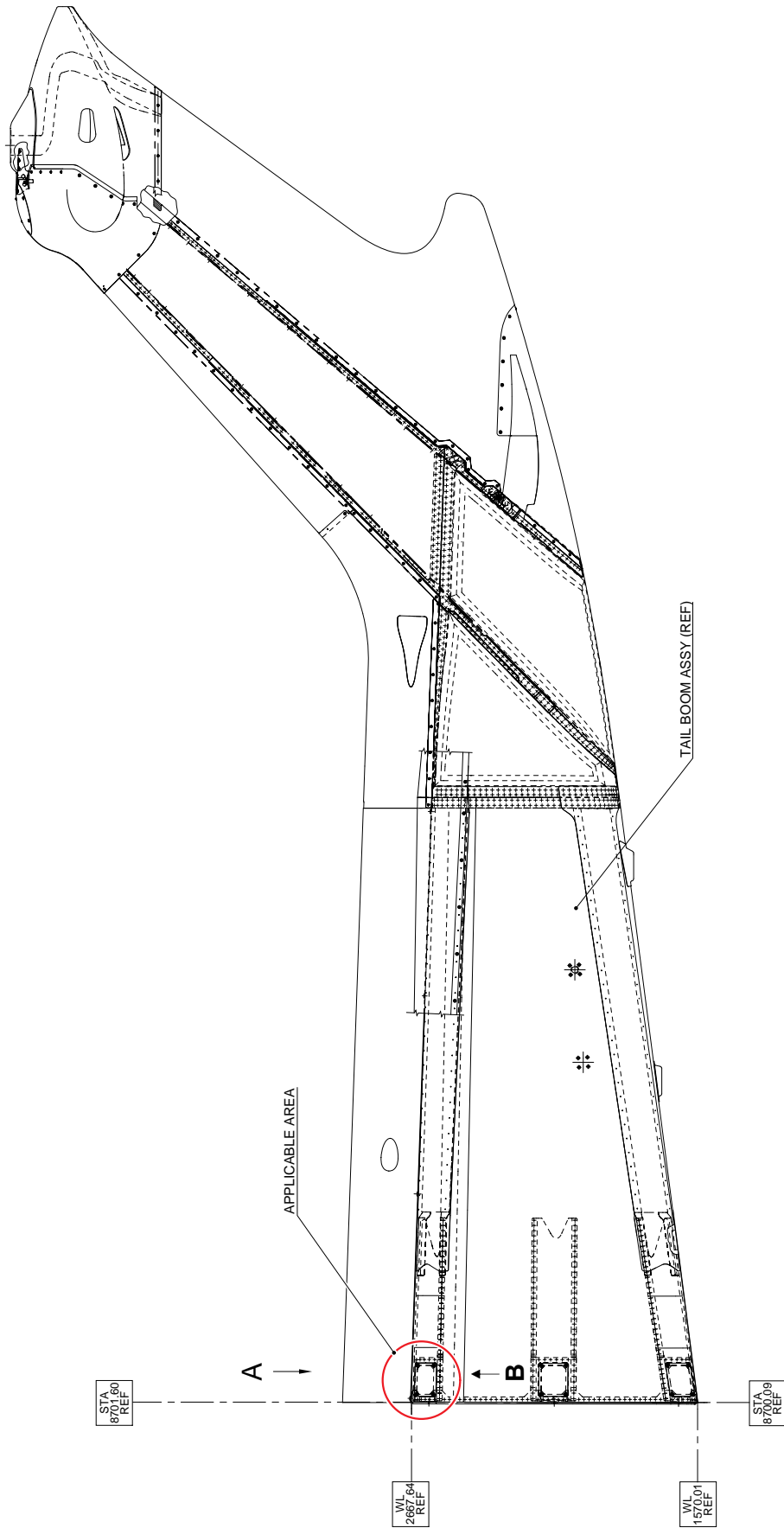
The position and size of the cut-out and relative filler may change depending on the damaged area.

NOTE

Tail boom assy repair SK139-1510 may have been performed in the past according to ASRP DM 39-A-53-51-01-01E-664A-D.

This DM is no more present in the IETP (40th Issue) and is herein attached as Annex E.

- 9.1 Perform tail boom assy repair SK139-1510, according to Annex E.
- 9.2 Continue to step 7, 8, 9, or 10 of Part III of this Service Bulletin to complete retromod P/N 3G5350P00311 installation, and perform following applicable steps as required.



VIEW LOOKING INBOARD LEFT SIDE
STRUCTURES AND SYSTEMS ARE PARTIALLY OMITTED FOR BETTER CLARITY PURPOSE

Figure D1

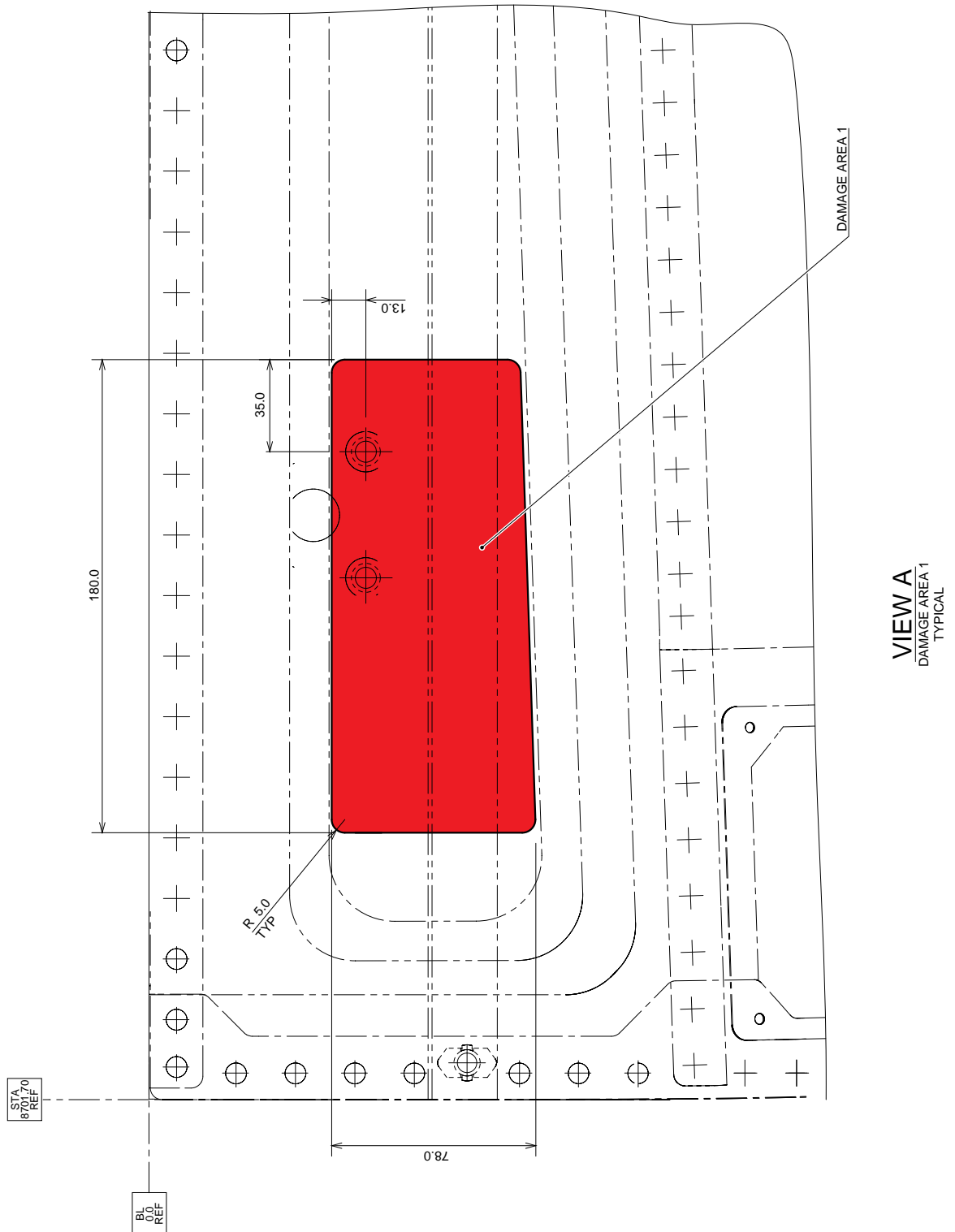


Figure D2

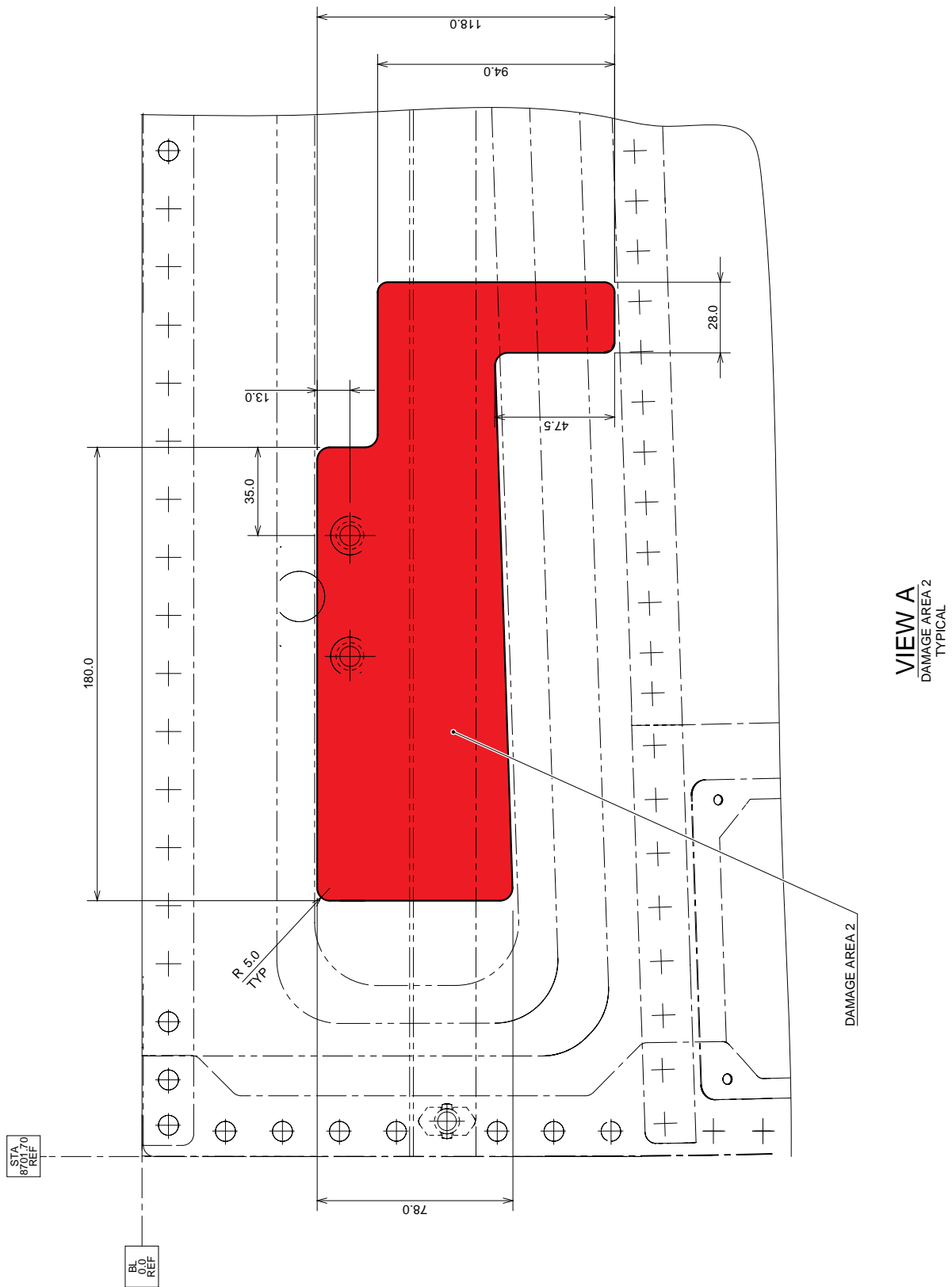
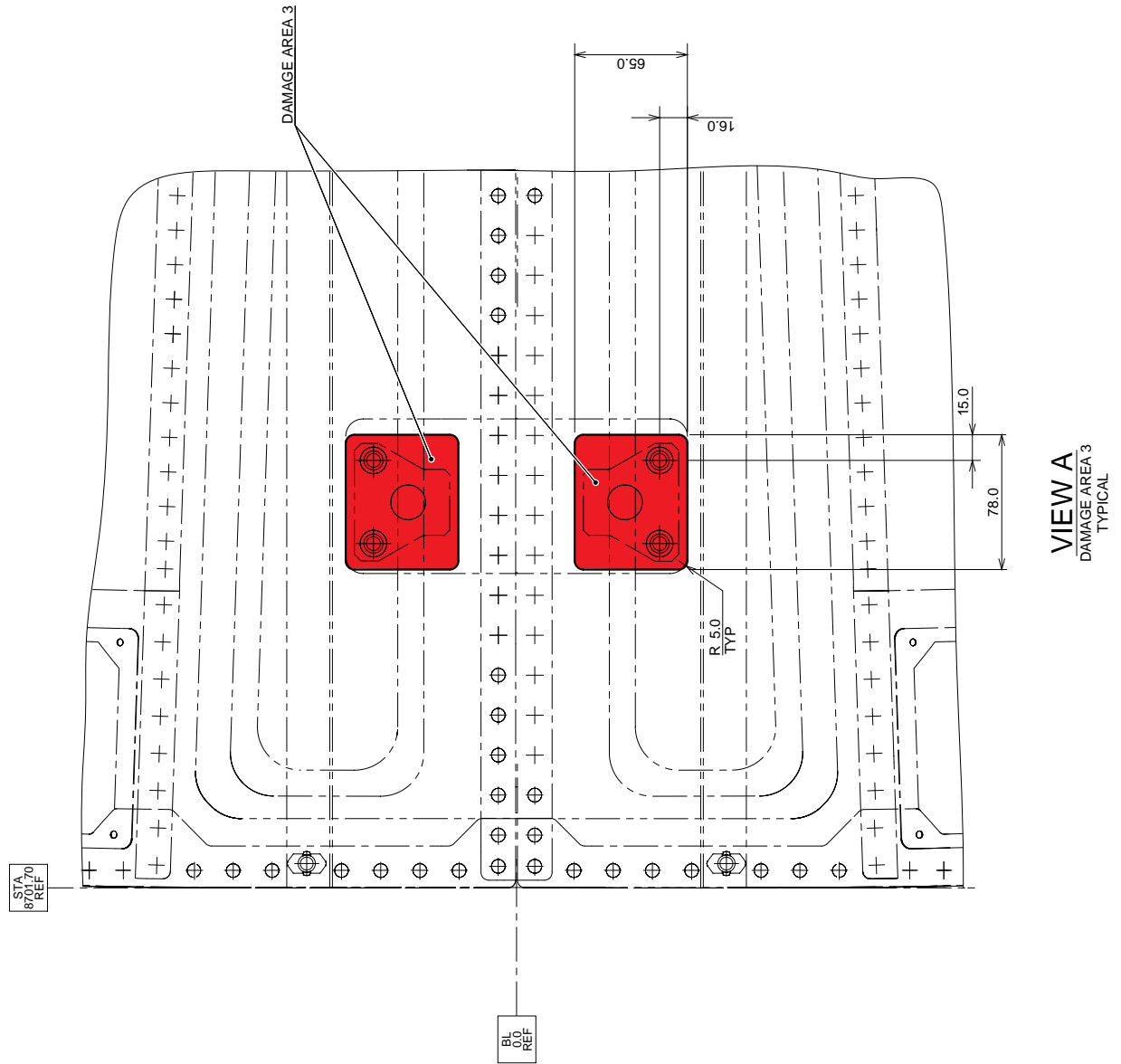


Figure D3



VIEW A
DAMAGE AREA 3
TYPICAL

Figure D4

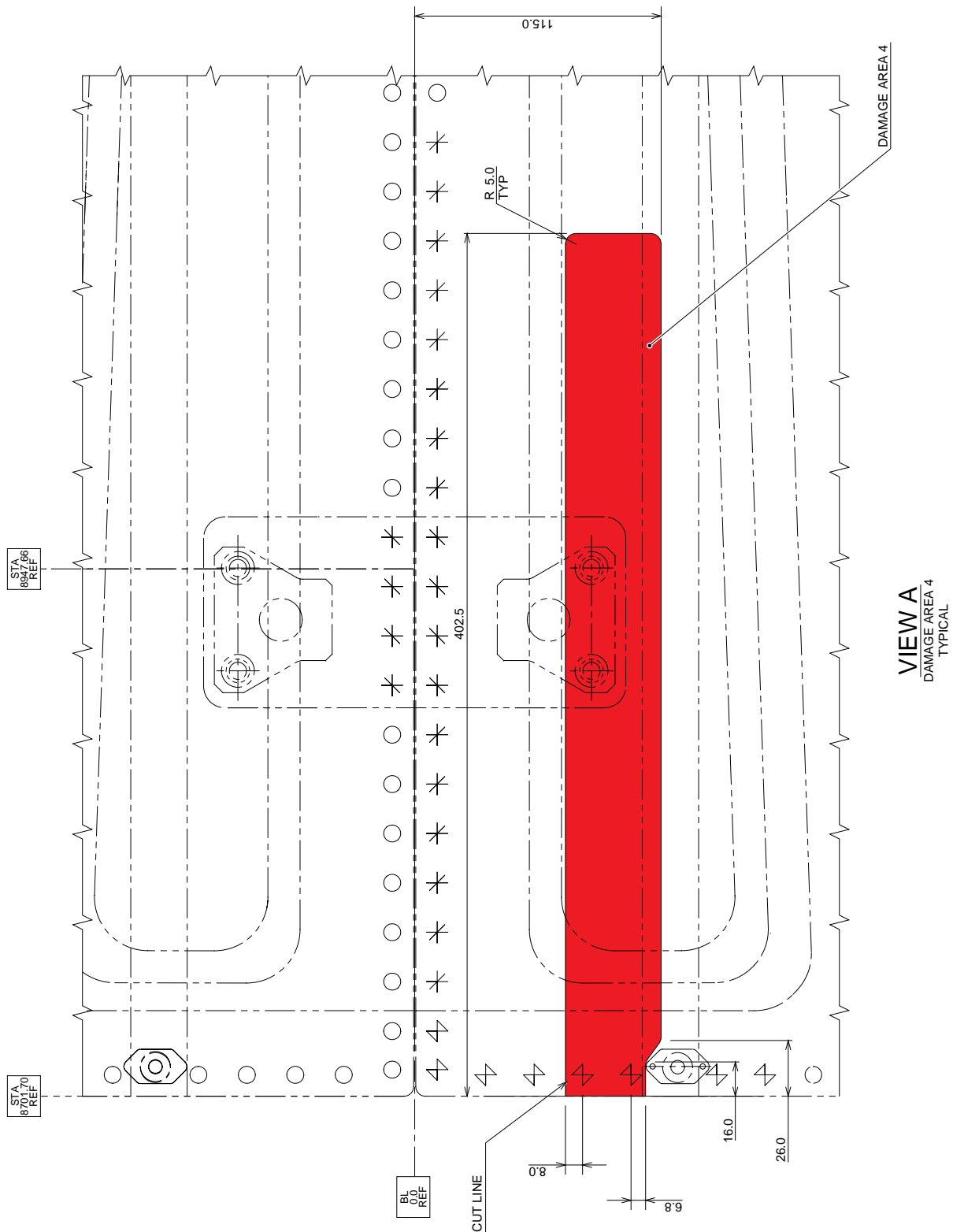


Figure D5

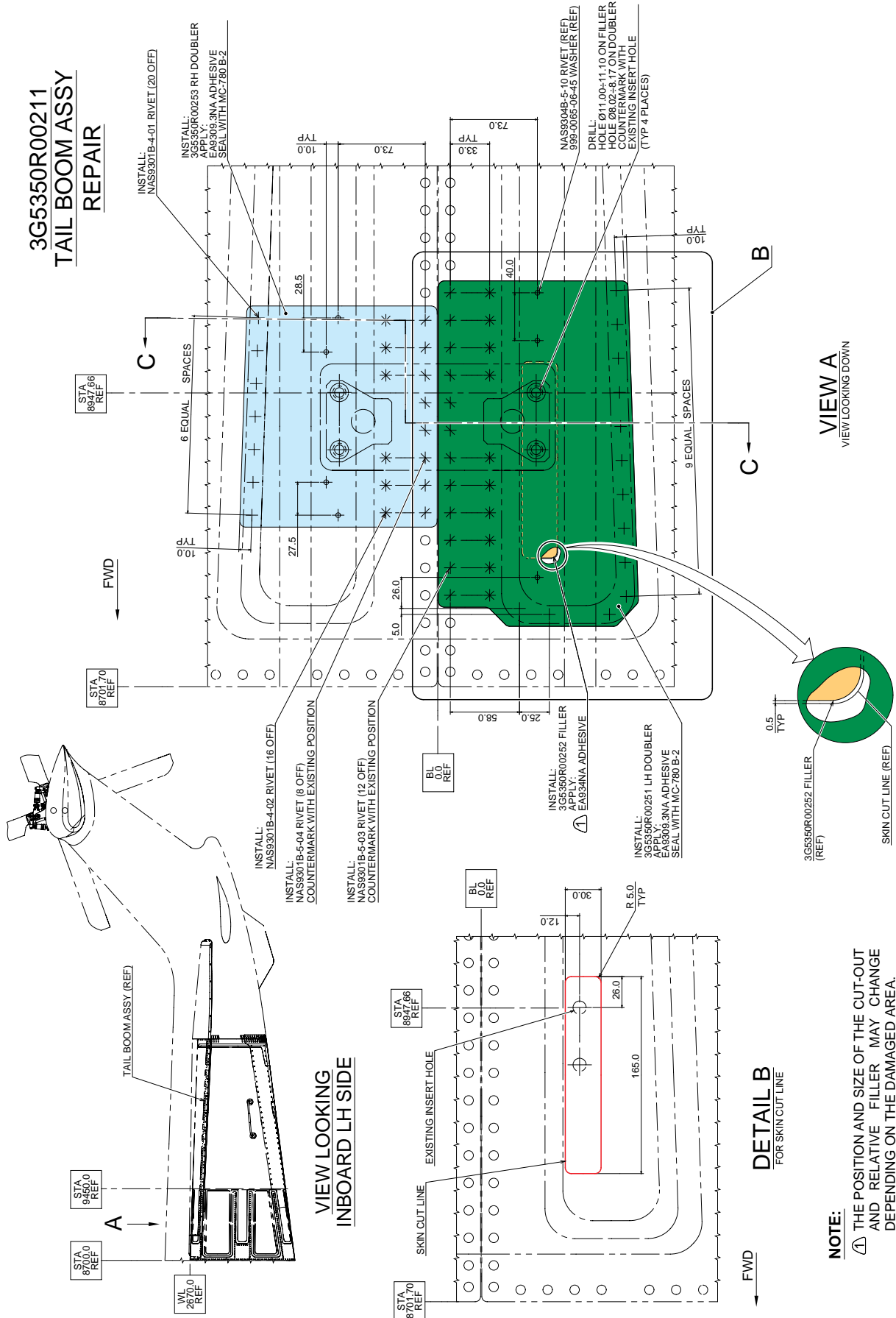


Figure D6

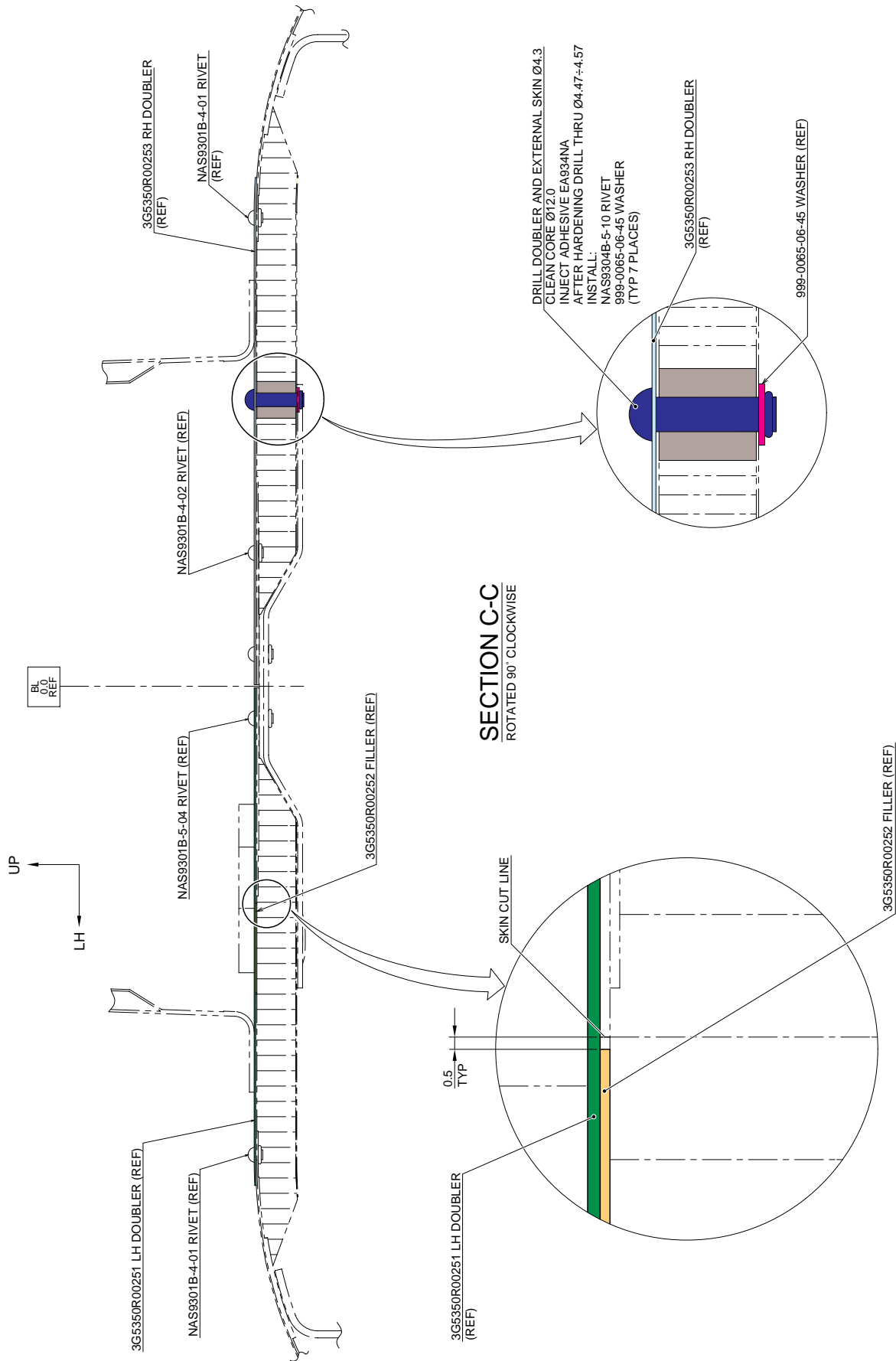
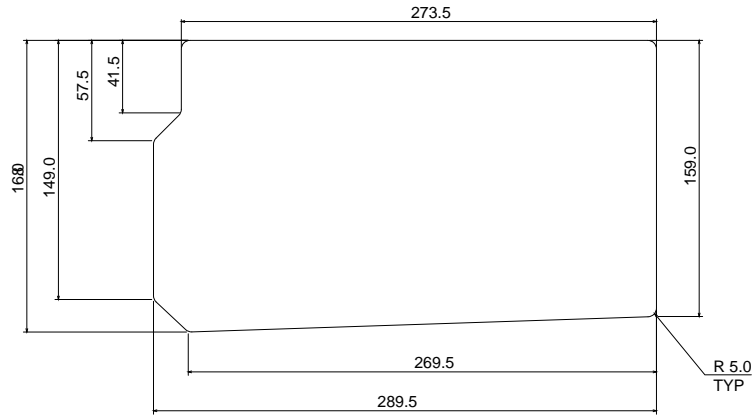
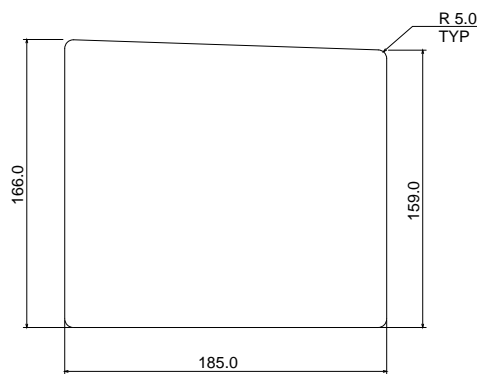


Figure D7



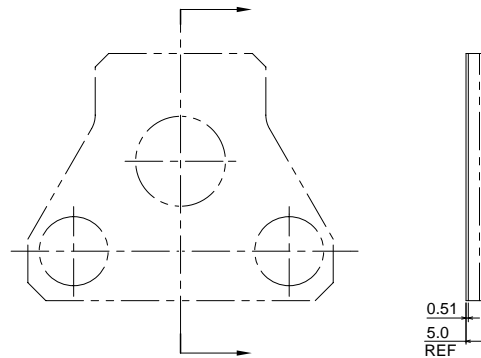
3G5350R00251 LH DOUBLER

MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL



3G5350R00253 RH DOUBLER

MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51, CL



3G6510A05651 PEELING SHIM

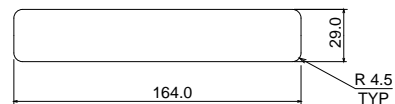
REWORK SCHEME
(TYP 2 POSITIONS)

FINISH CODES:

PA1 = Chromic acid anodising prior to adhesive bonding
XPFW1 = One coat of epoxy primer (C596)

NOTE:

⚠ THE POSITION AND SIZE OF THE CUT-OUT AND RELATIVE FILLER MAY CHANGE DEPENDING ON THE DAMAGED AREA.

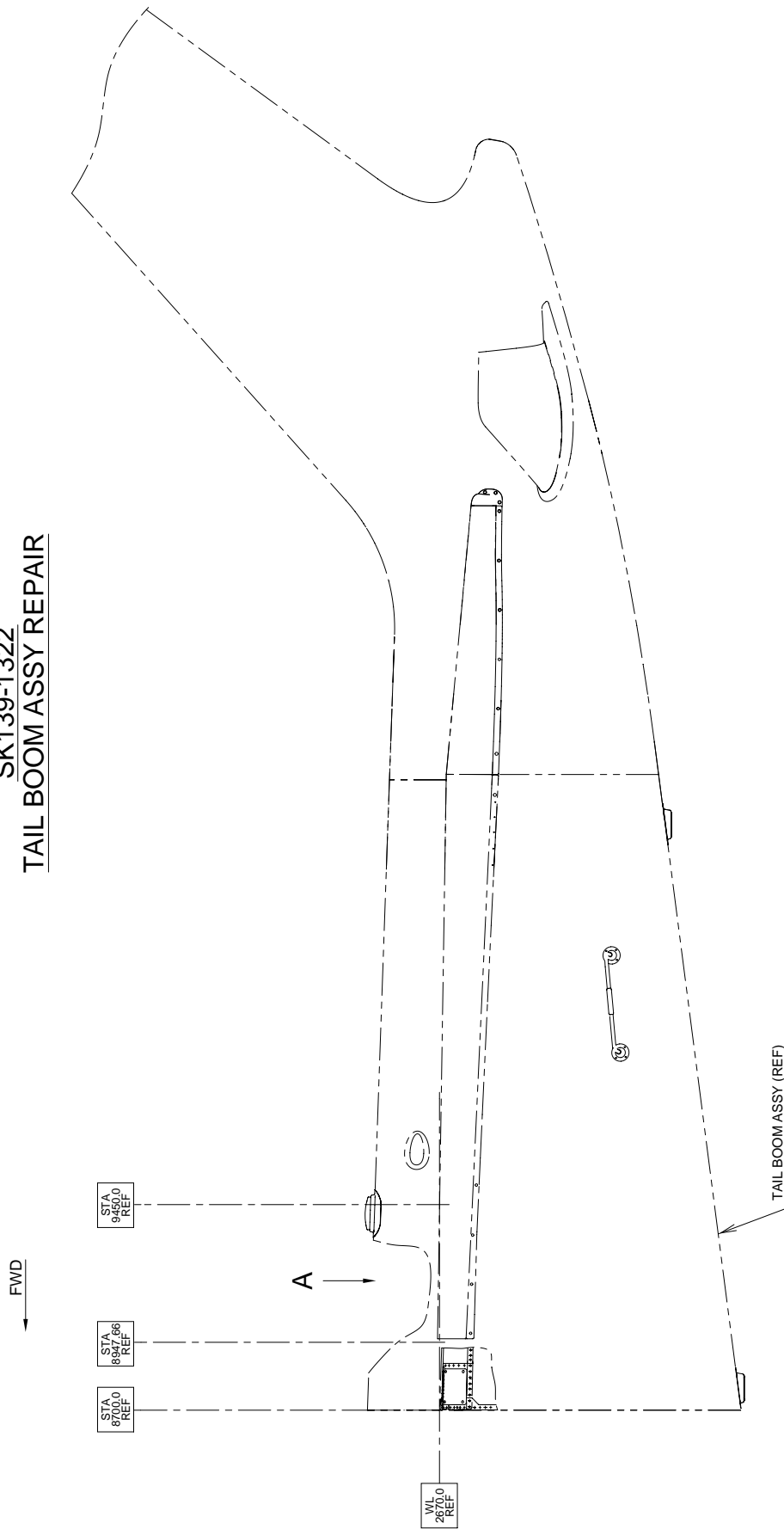


⚠ **3G5350R00252 FILLER**

MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/5, TH 0.3, K+XPD1

Figure D8

SK139-1322
TAIL BOOM ASSY REPAIR



VIEW LOOKING INBOARD LEFT SIDE
STRUCTURES AND SYSTEMS ARE PARTIALLY
OMITTED FOR BETTER CLARITY PURPOSE

Figure D9

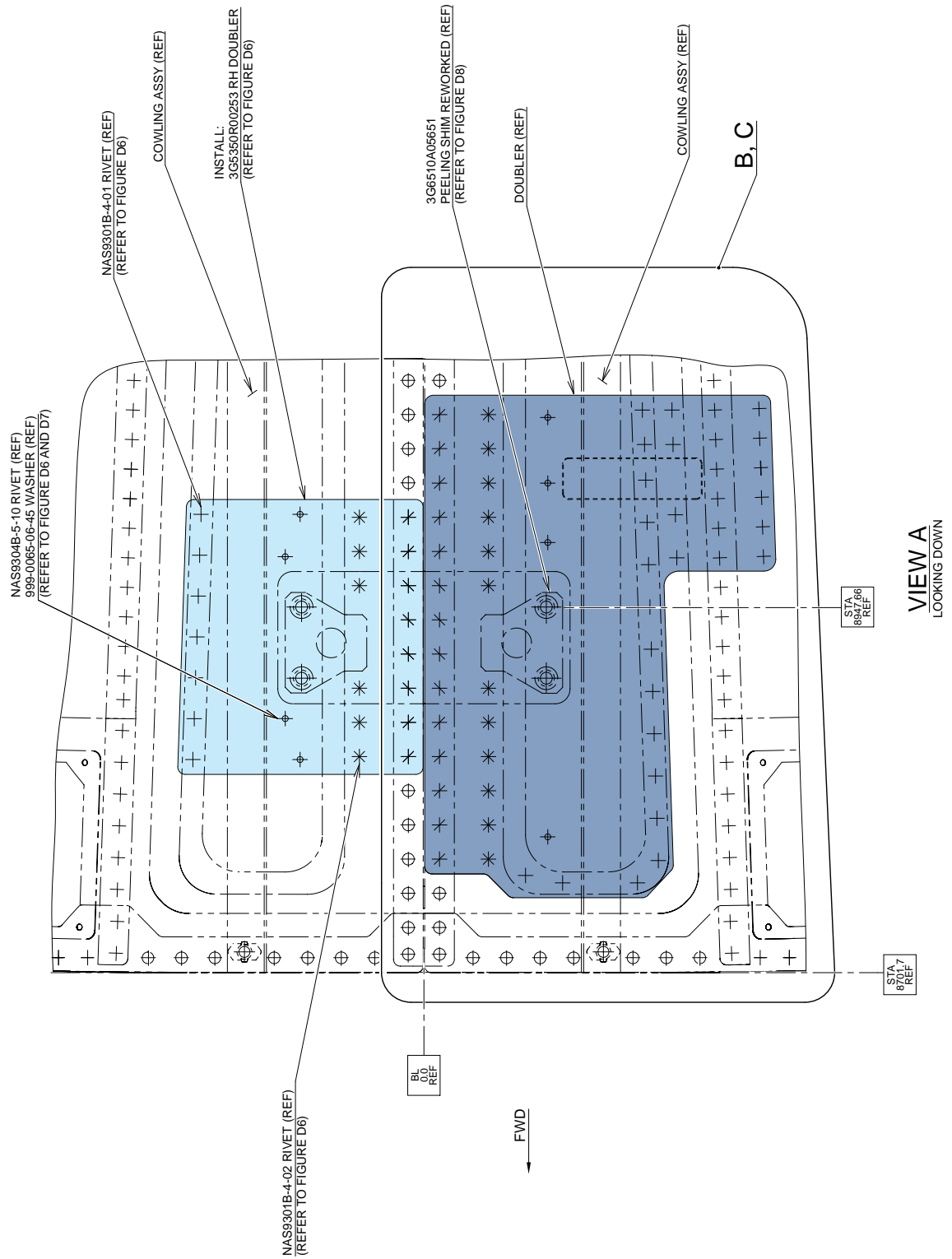
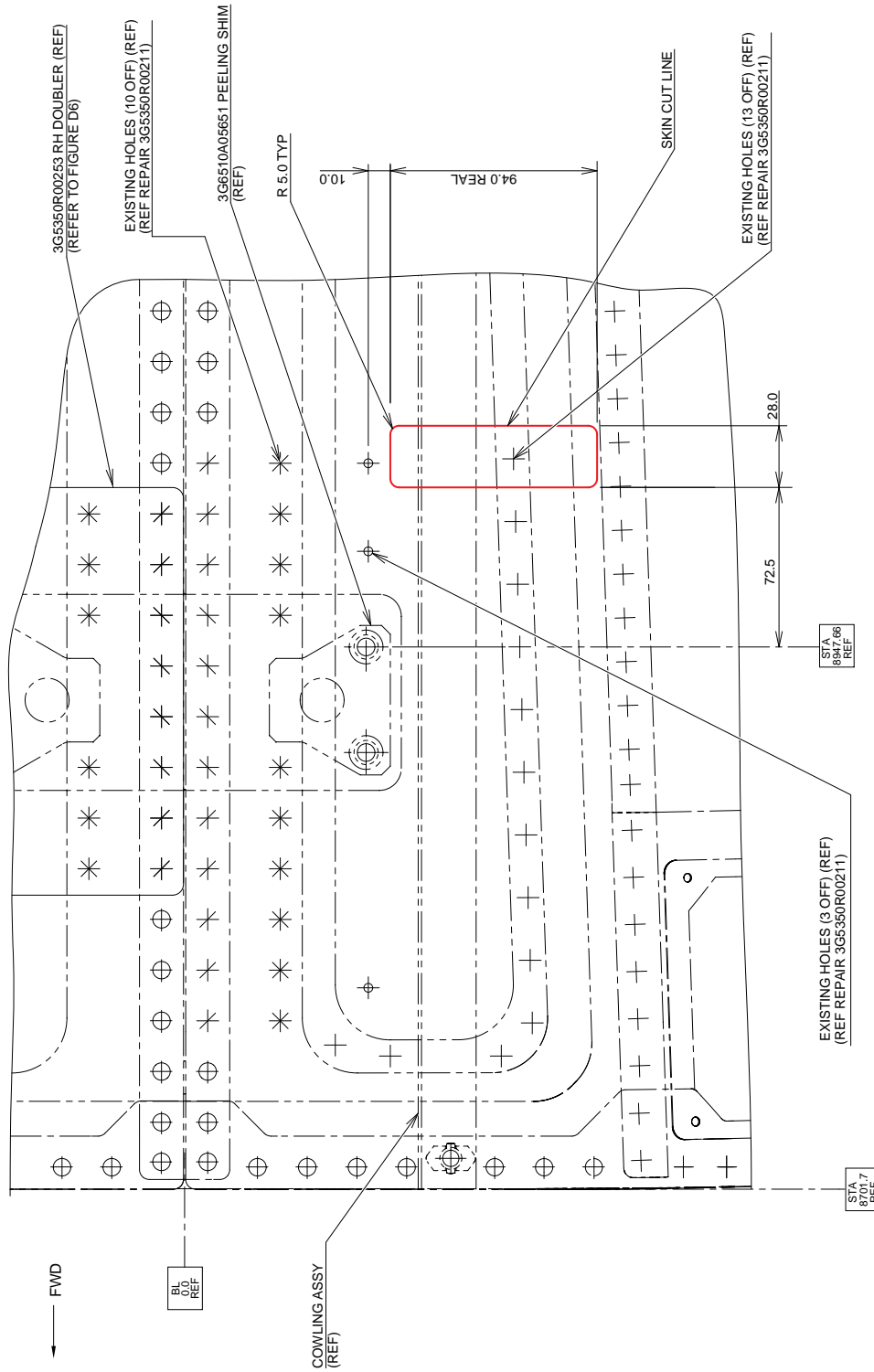


Figure D10



NOTE:
⚠ THE POSITION AND SIZE OF THE CUT-OUT AND RELATIVE FILLER MAY CHANGE DEPENDING ON THE DAMAGED AREA.

⚠ **DETAIL B**
FOR SKIN CUT LINE

Figure D11

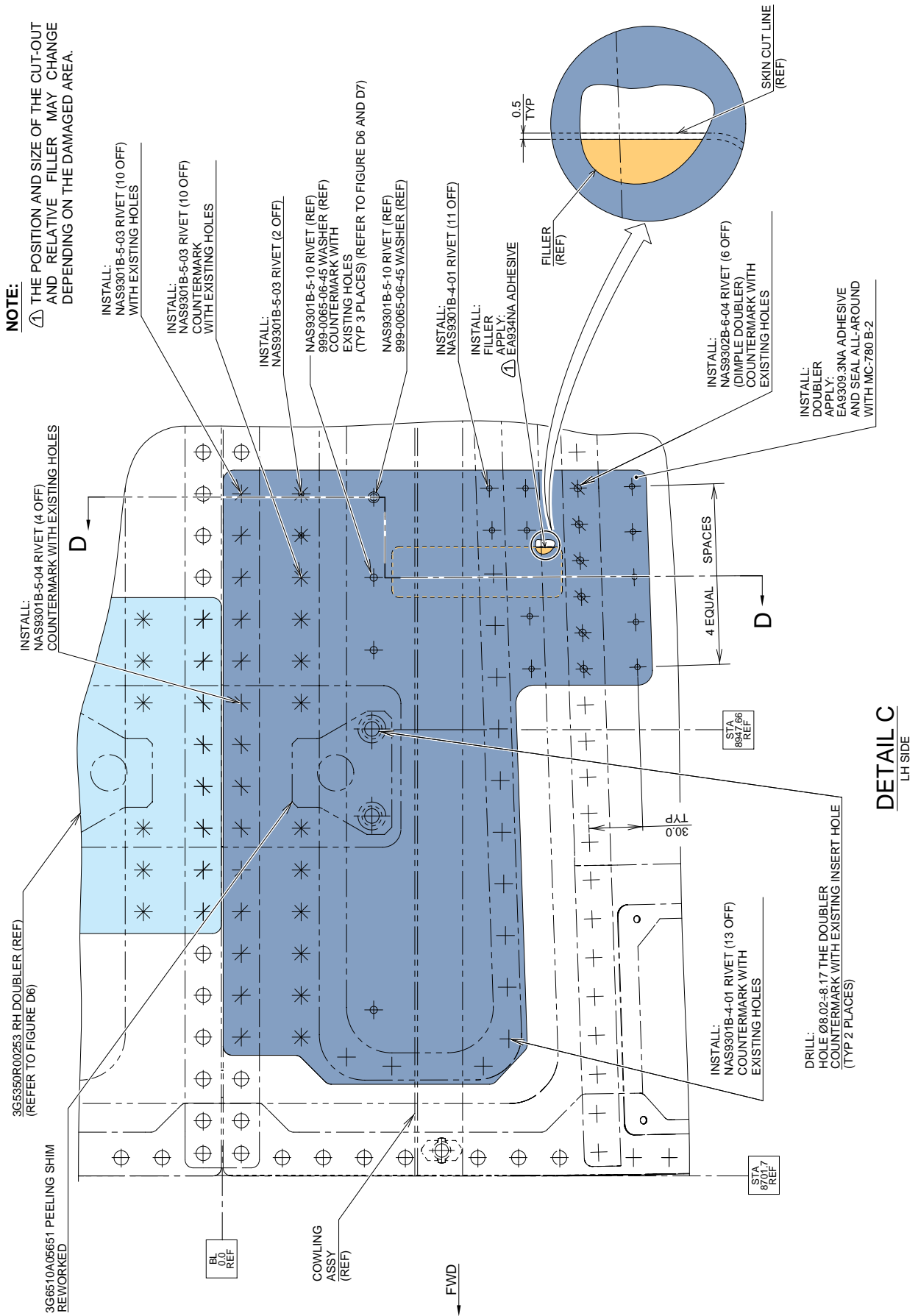


Figure D12

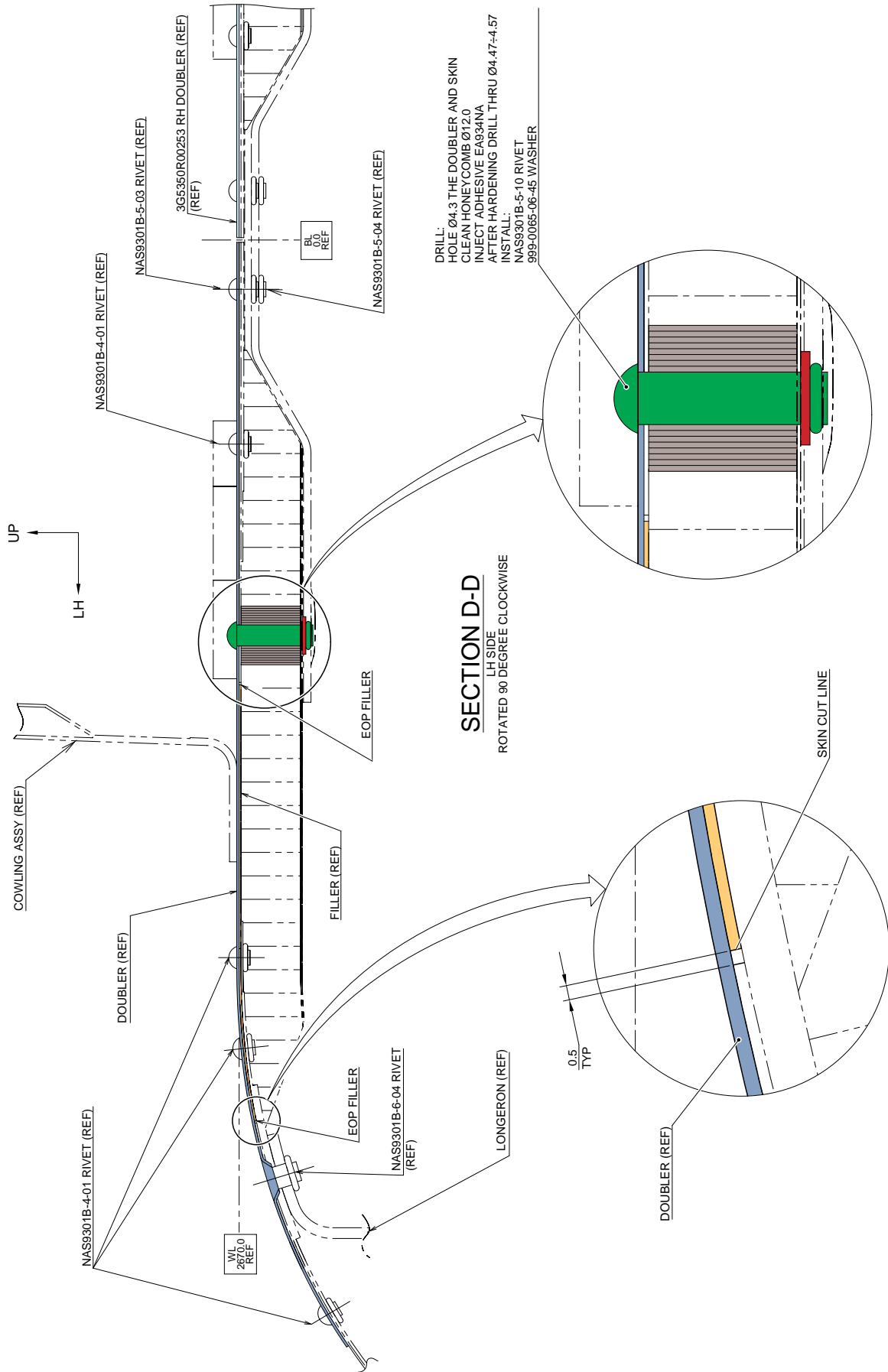


Figure D13

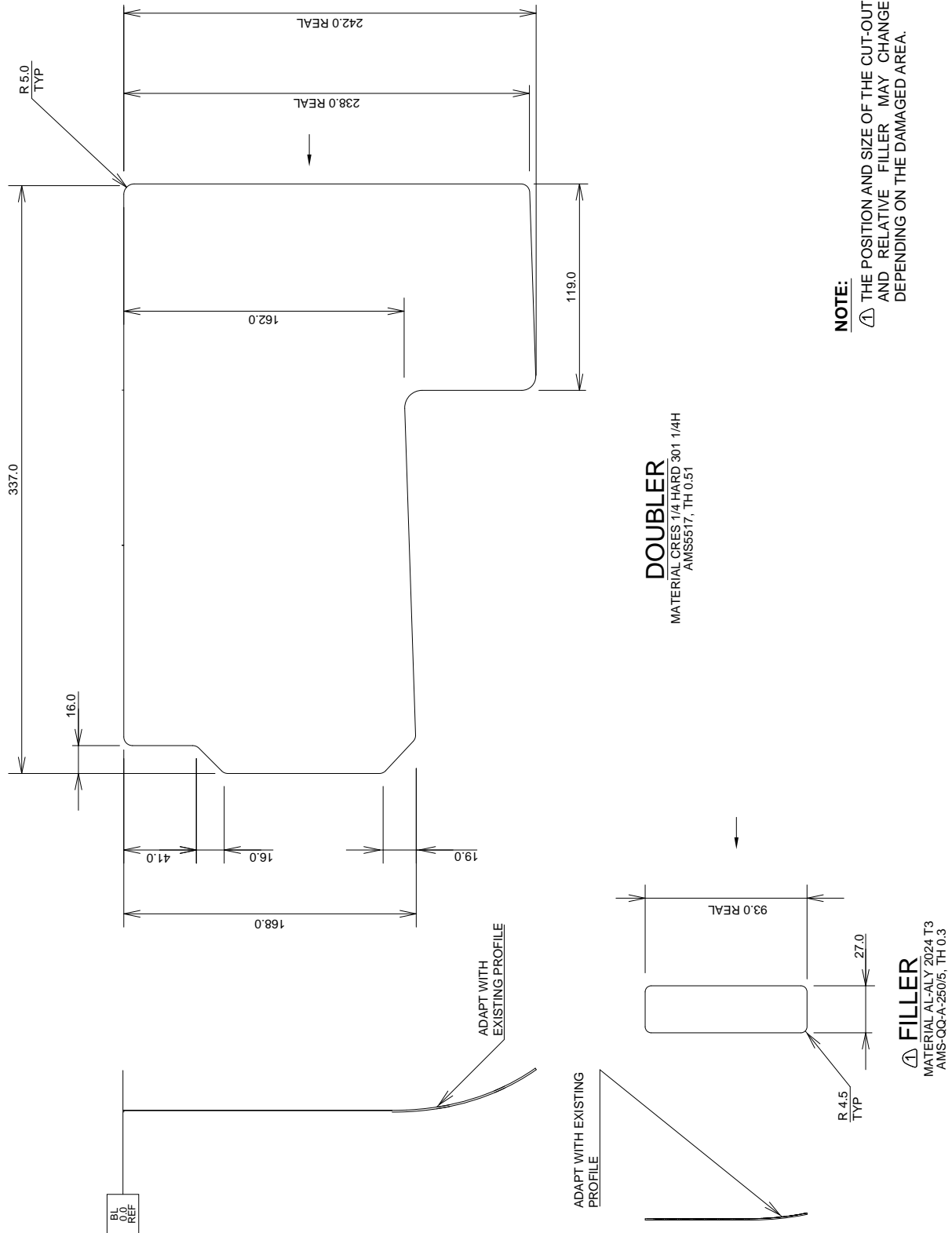


Figure D14

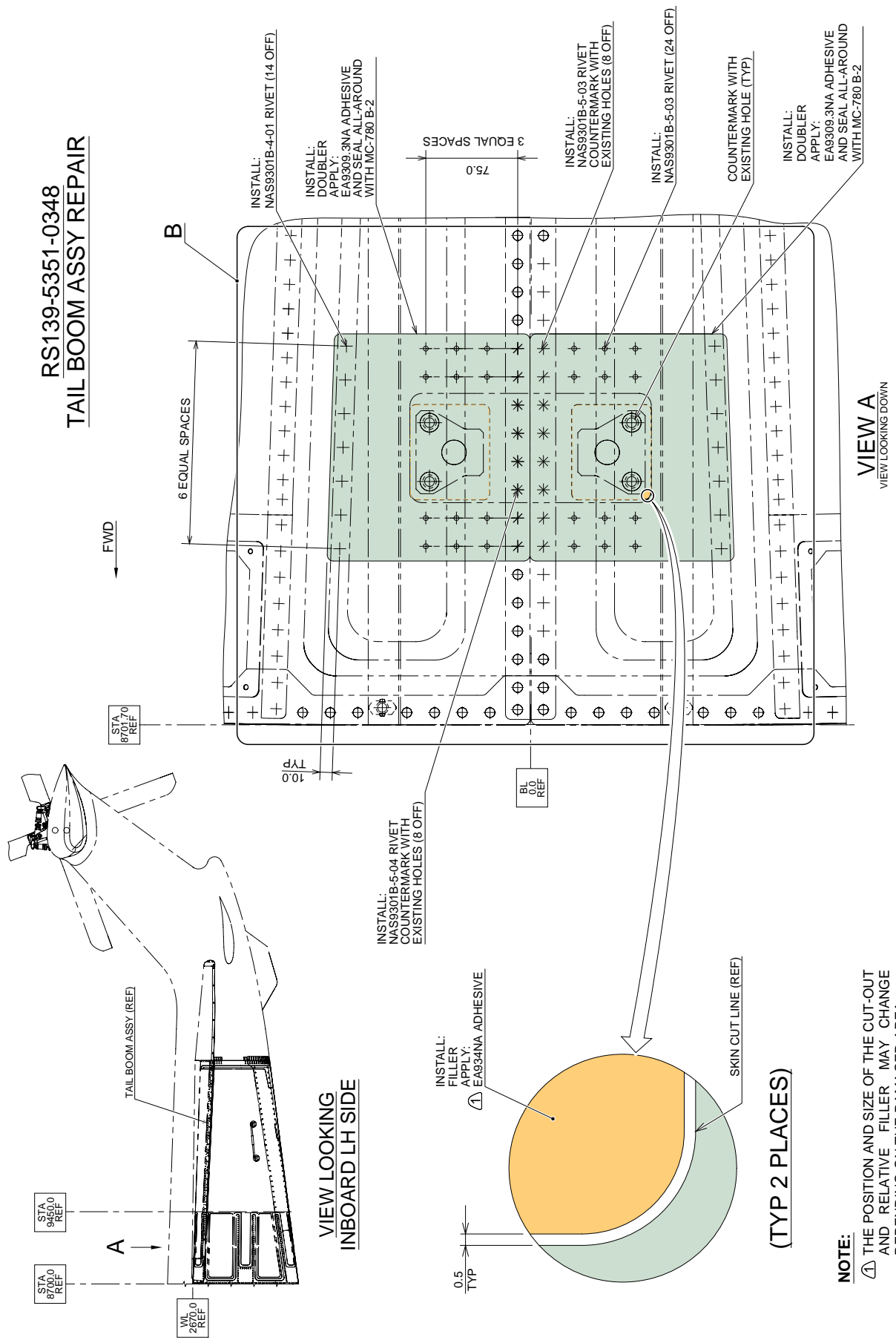


Figure D15

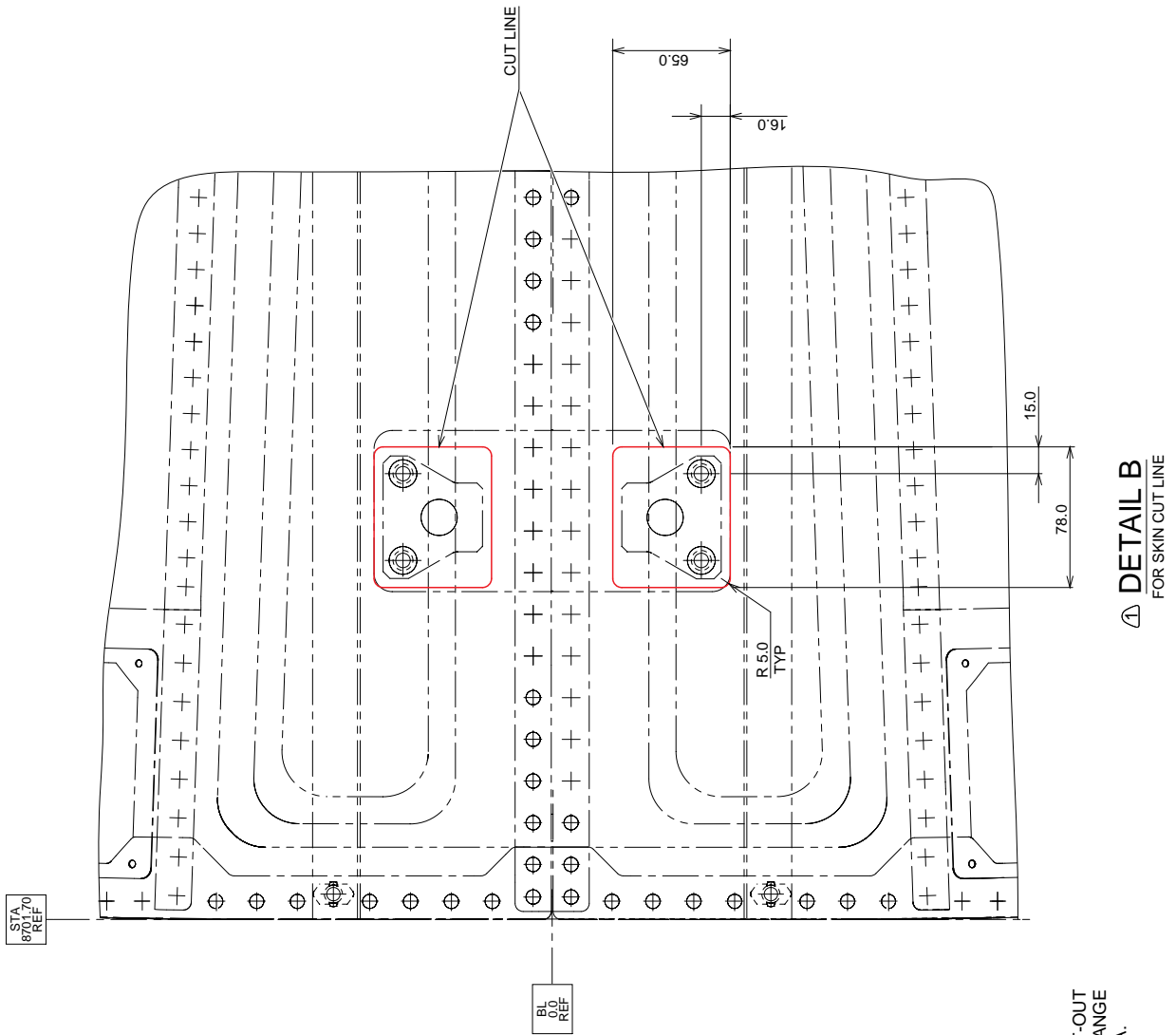
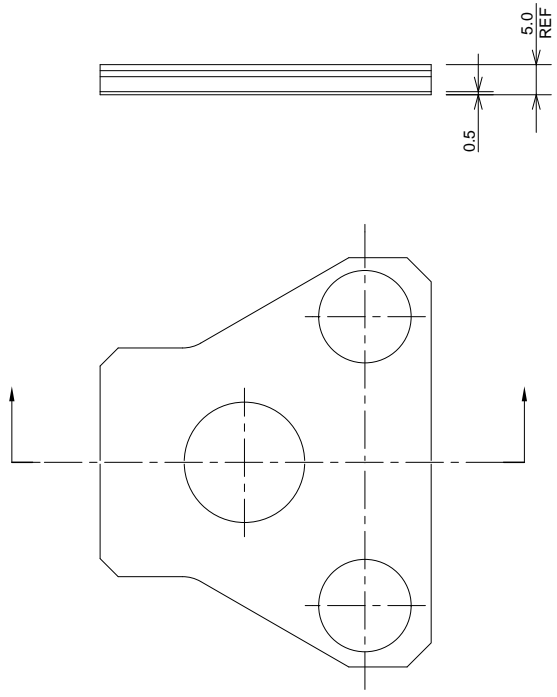
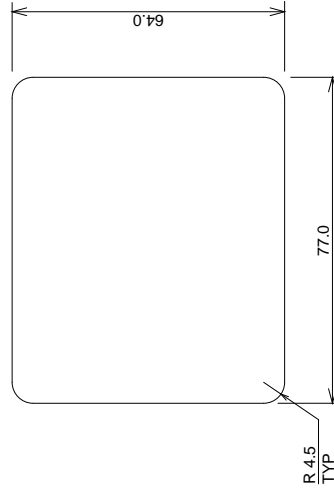


Figure D16



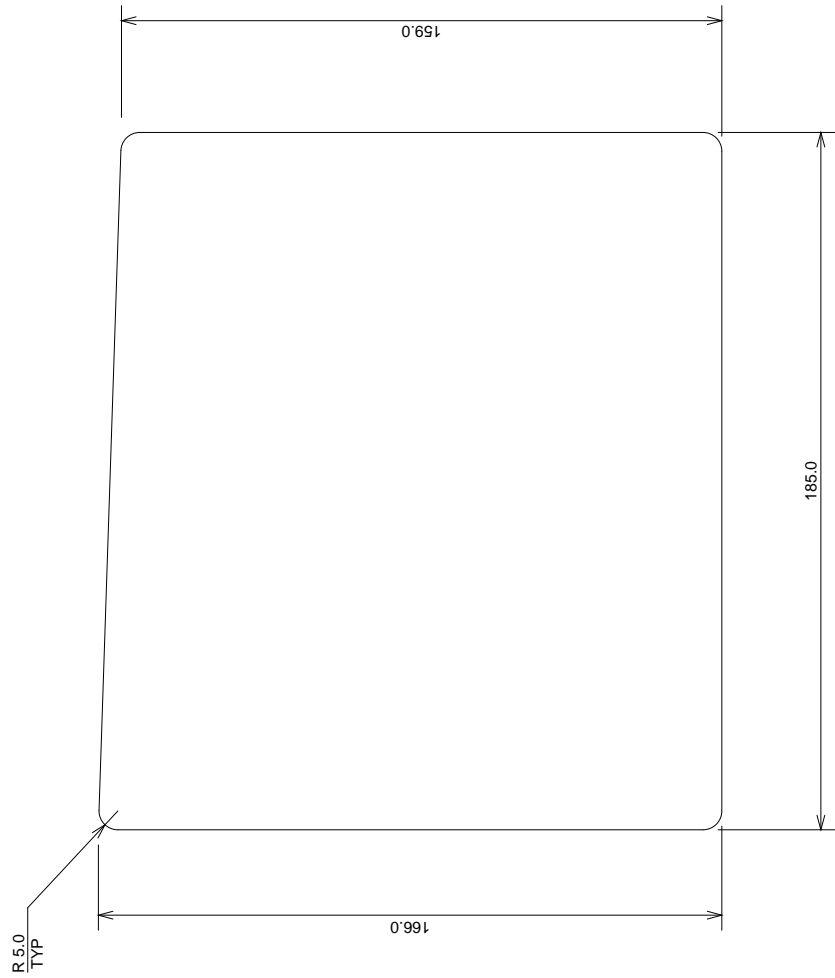
3G6510A05651 PEELING SHIM

REWORK SCHEME
(TYP 2 PLACES)



FILLER

2 PIECES
MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/5, TH 0.356



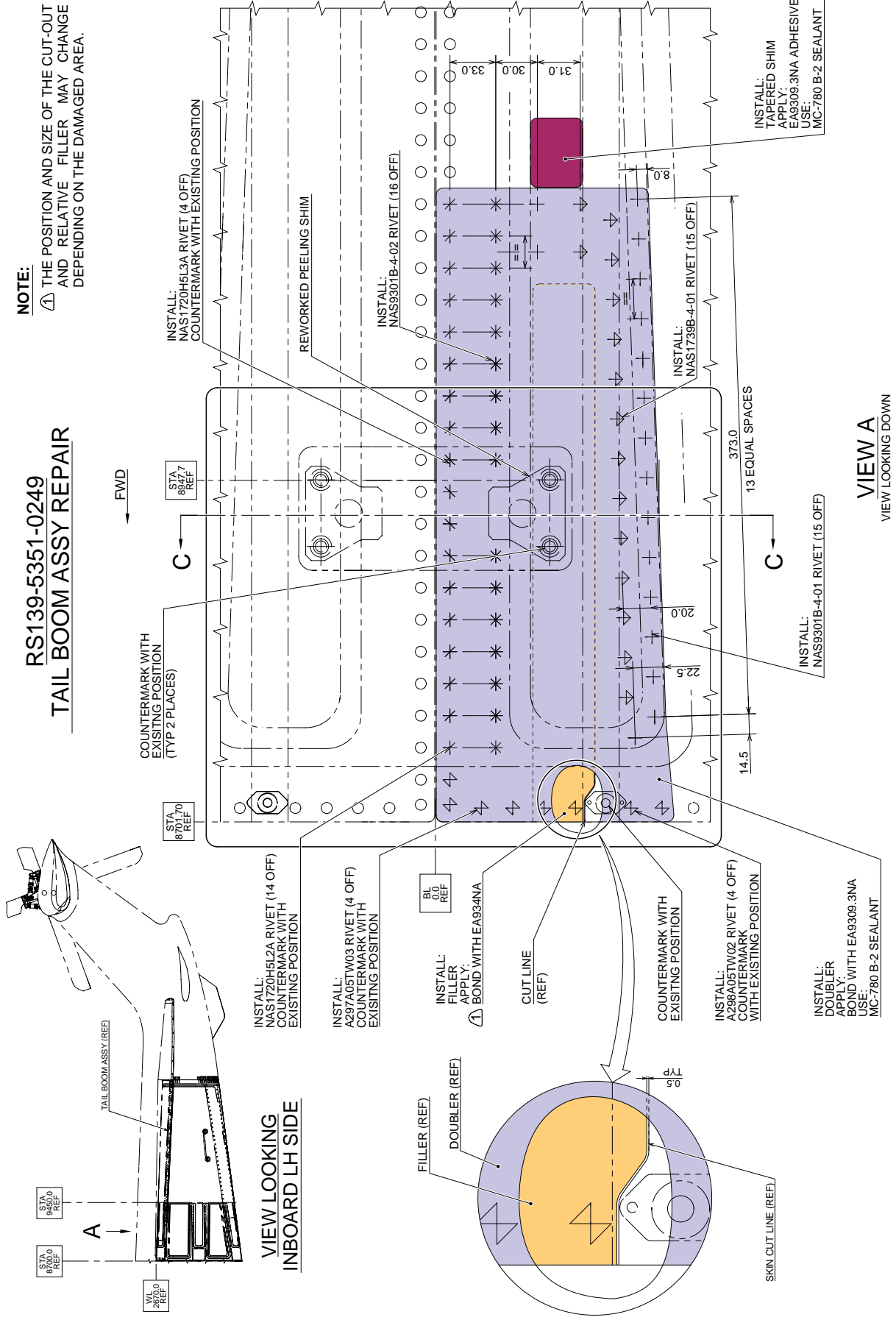
DOUBLER

2 PIECES
MATERIAL CRES 1/4 HARD 301 1/4H
AMS5517, TH 0.51

NOTE:

⚠ THE POSITION AND SIZE OF THE CUT-OUT AND RELATIVE FILLER MAY CHANGE DEPENDING ON THE DAMAGED AREA.

Figure D17



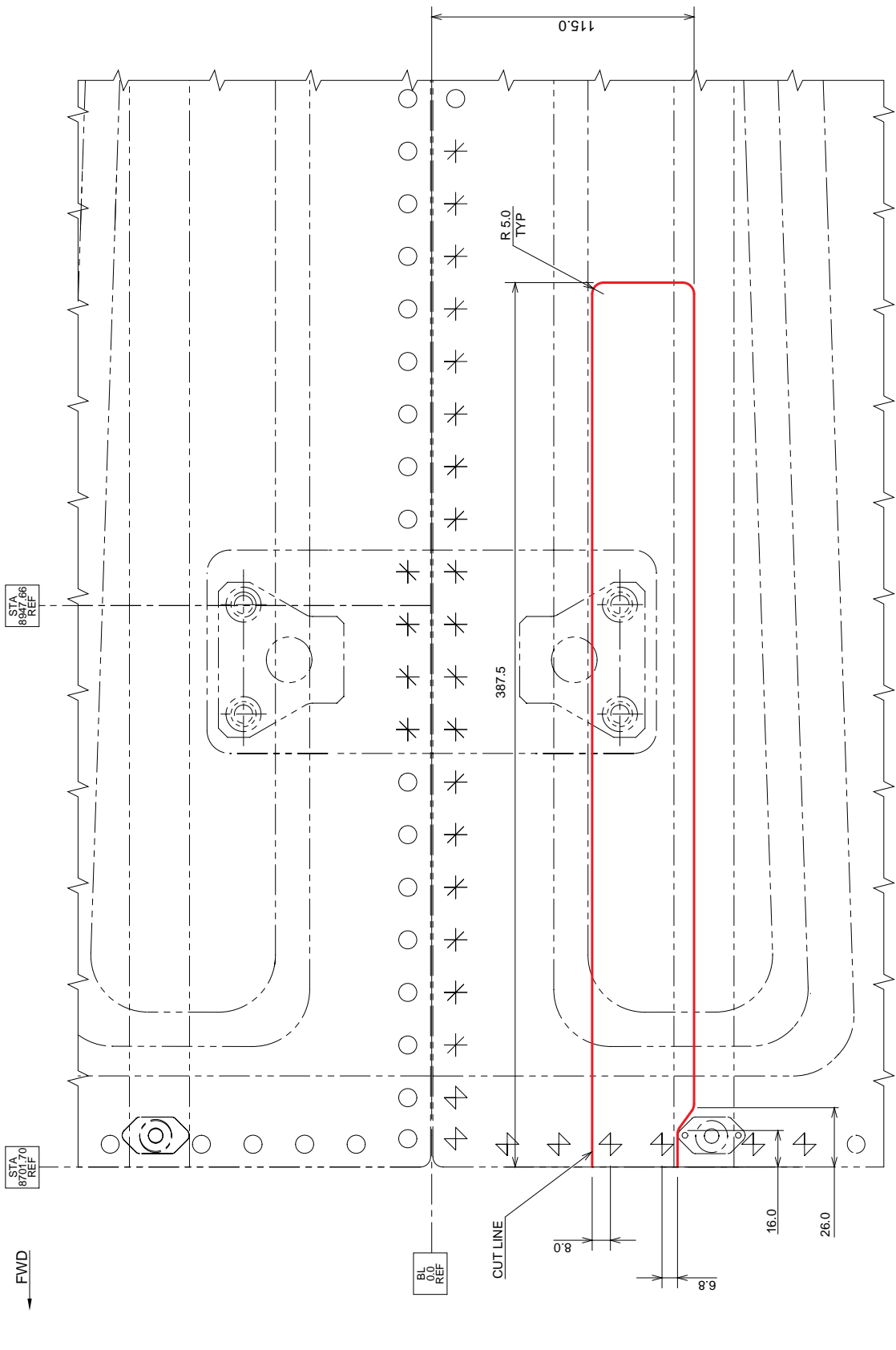


Figure D19

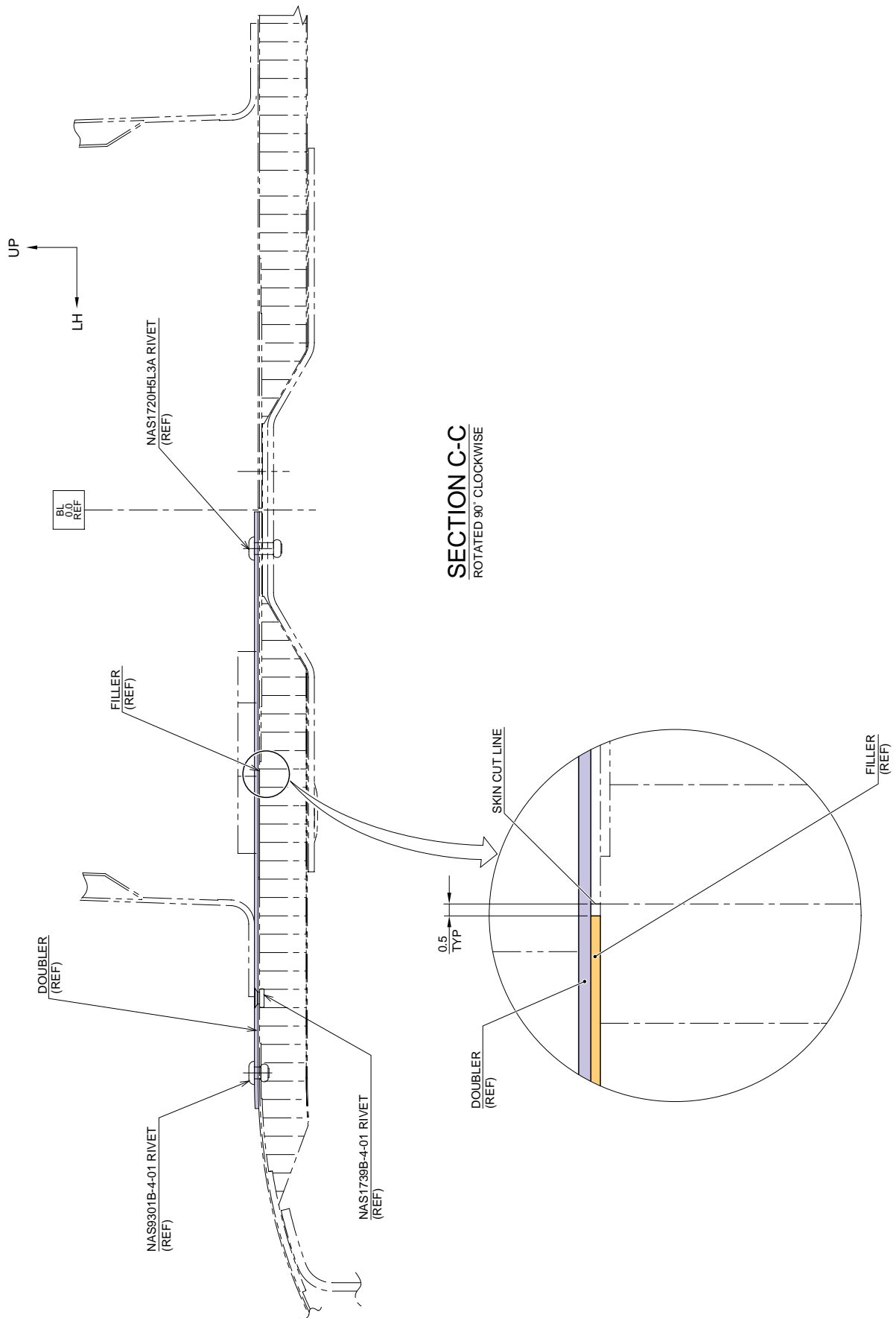
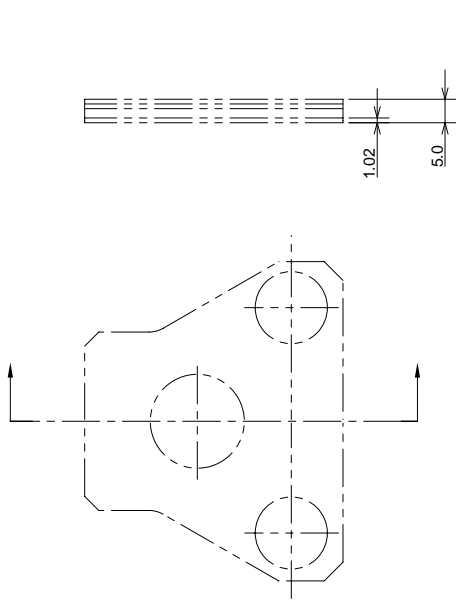
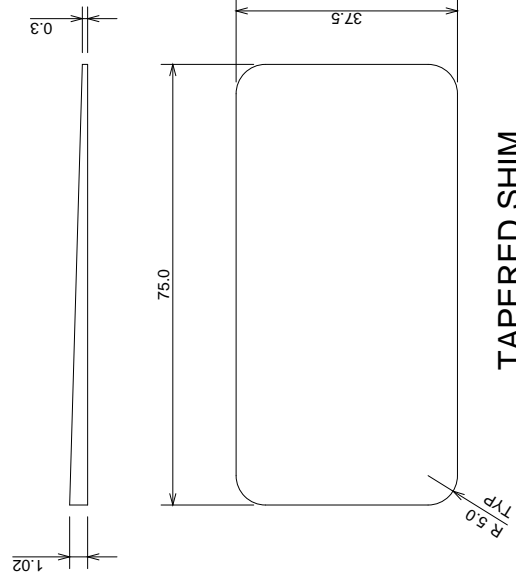


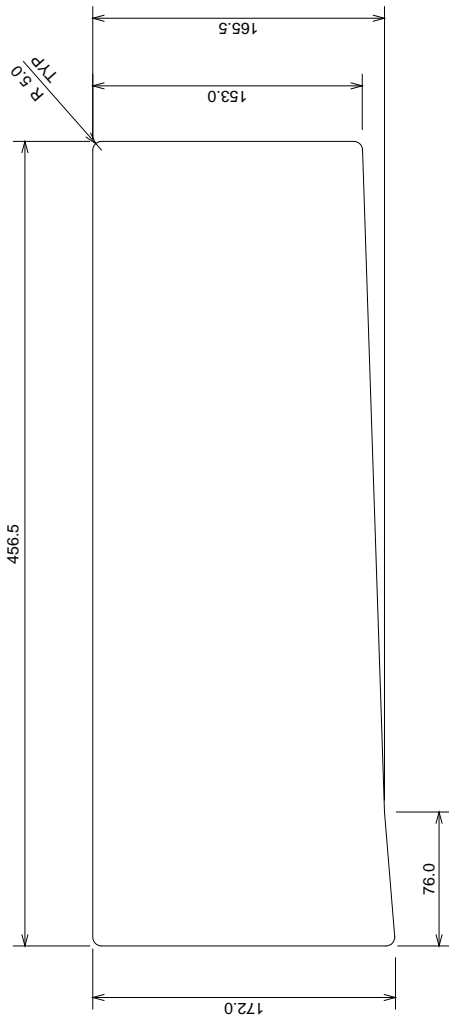
Figure D20



3G6510A05651 REWORKED PEELING SHIM



TAPERED SHIM
MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/5, TH 1.02



DOUBLER
MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/5, TH 1.02

NOTE:
⚠ THE POSITION AND SIZE OF THE CUT-OUT AND RELATIVE FILLER MAY CHANGE DEPENDING ON THE DAMAGED AREA.



FILLER
MATERIAL AL-ALY 2024 T3
AMS-QQ-A-250/5, TH 0.356

Figure D21

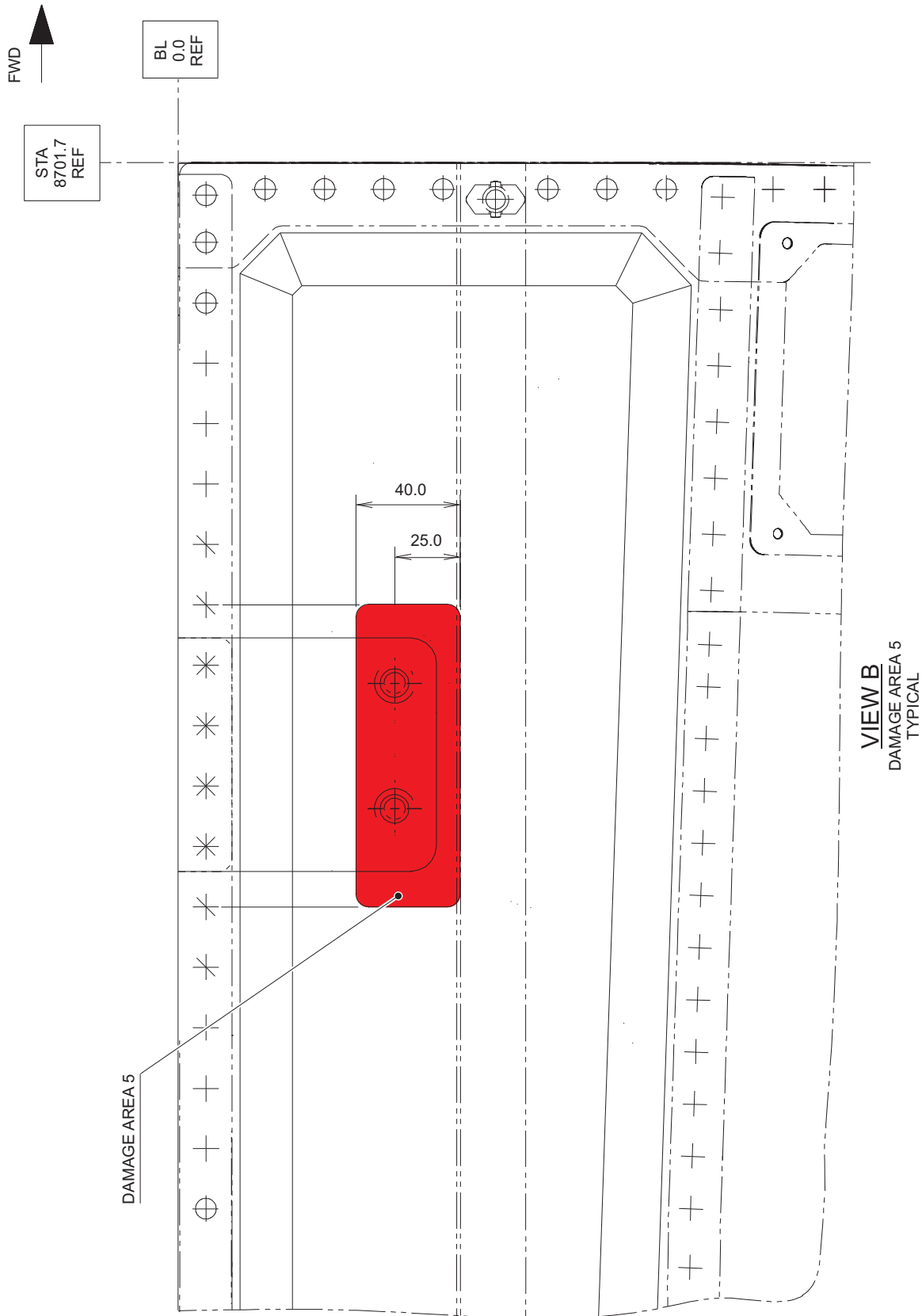


Figure D22

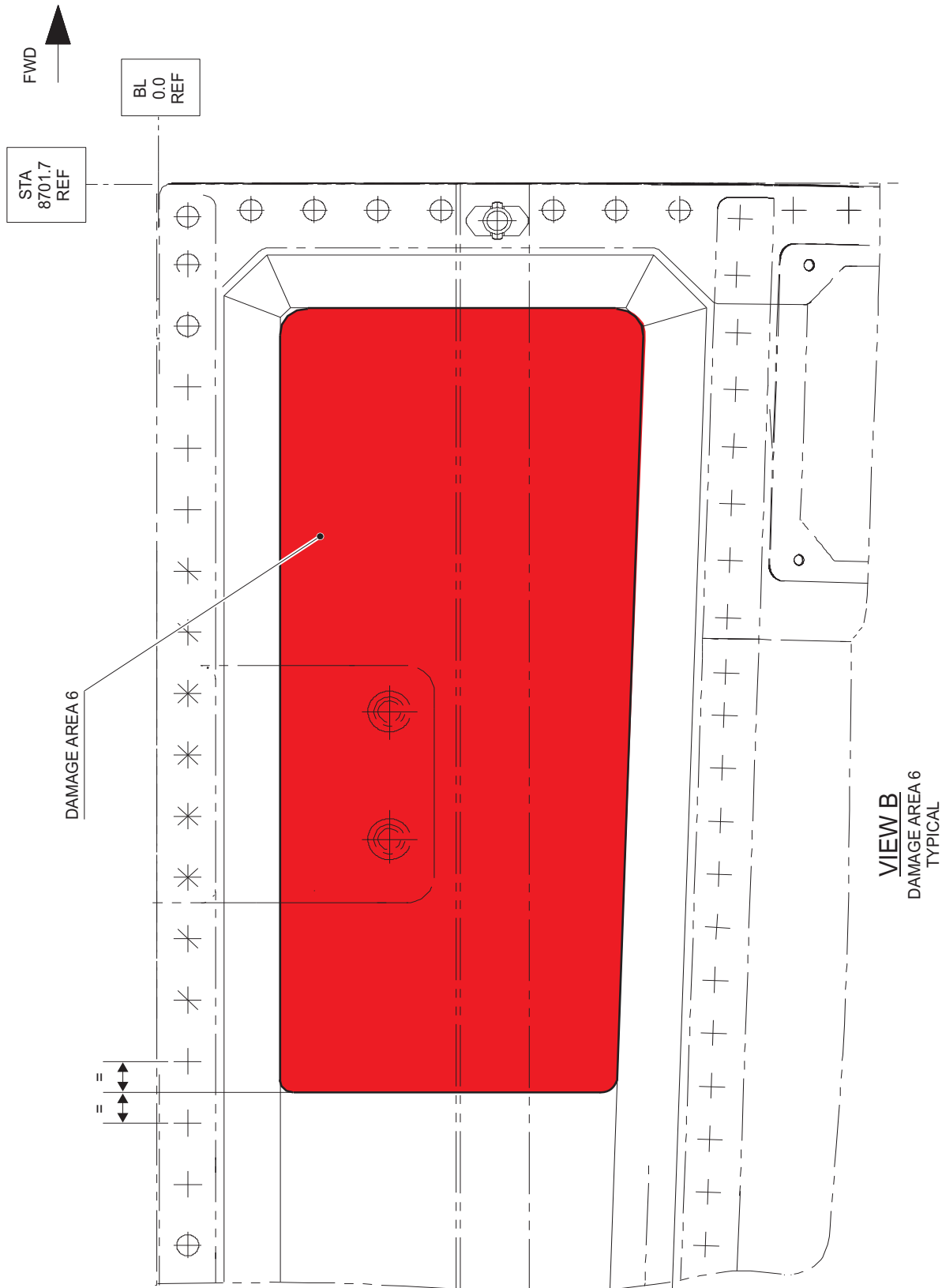
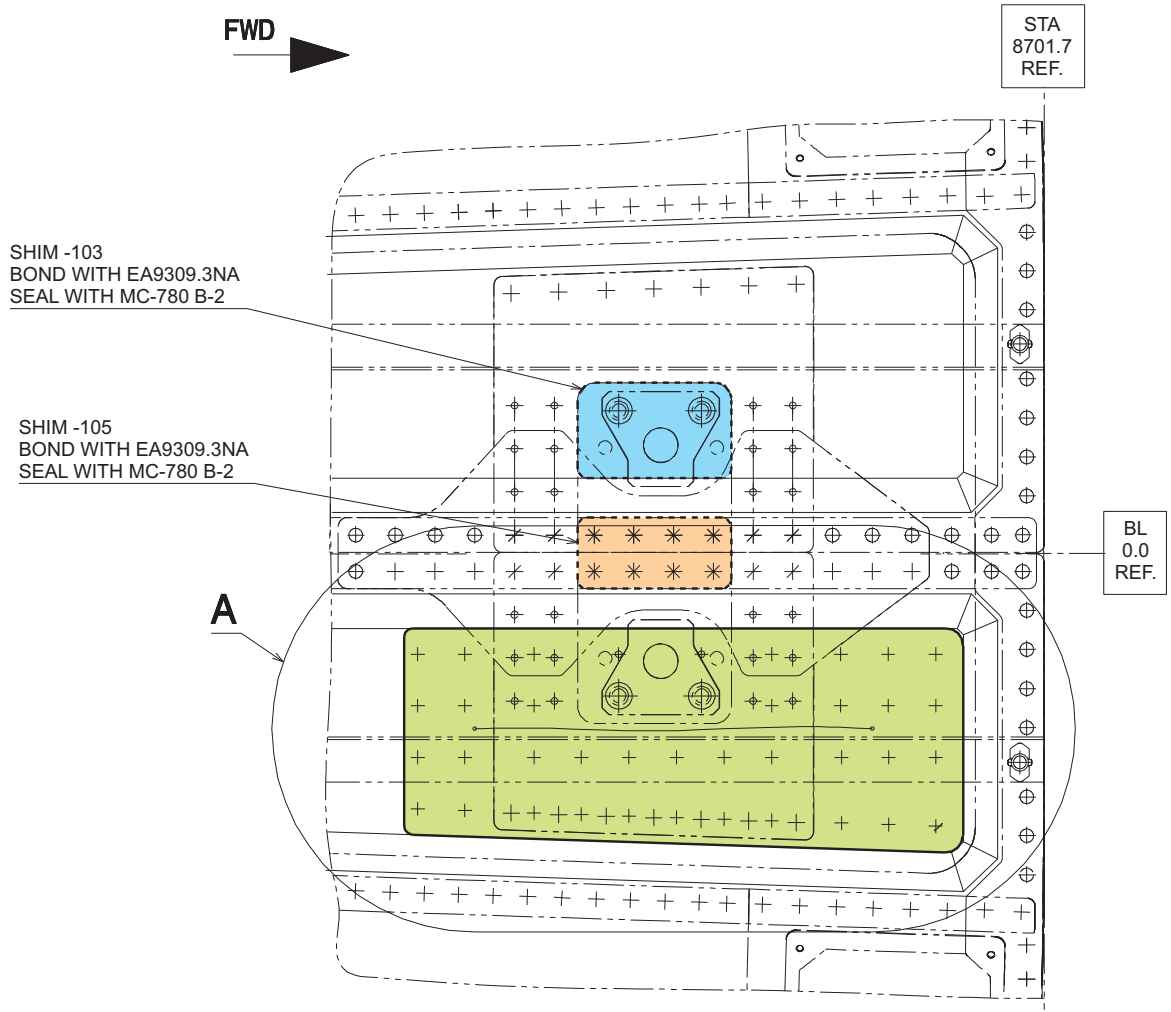
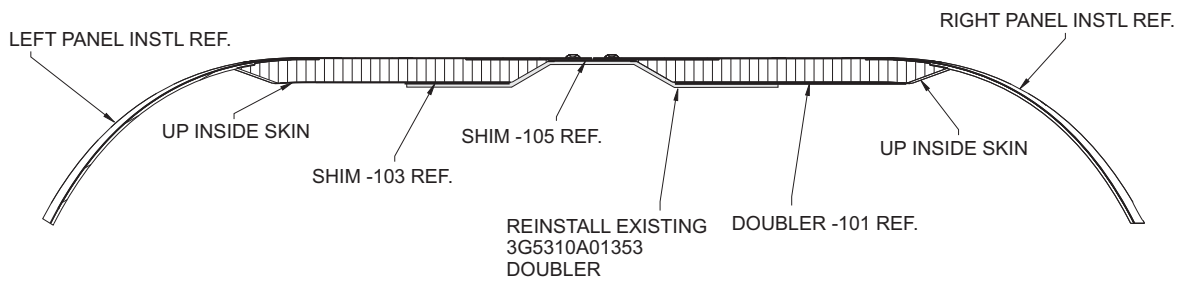


Figure D23



VIEW LOOKING UP



SECTION B-B

Figure D24

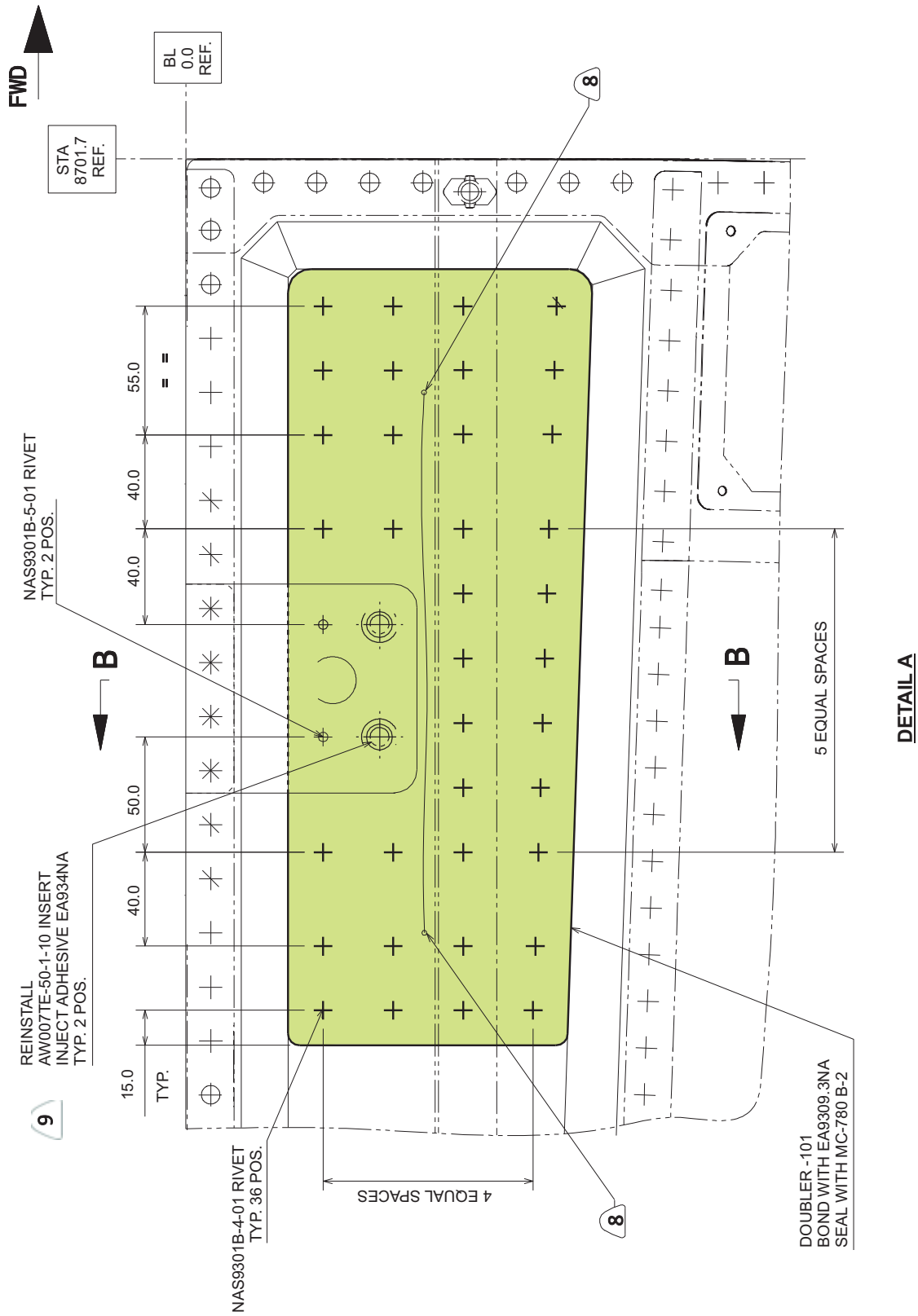


Figure D25

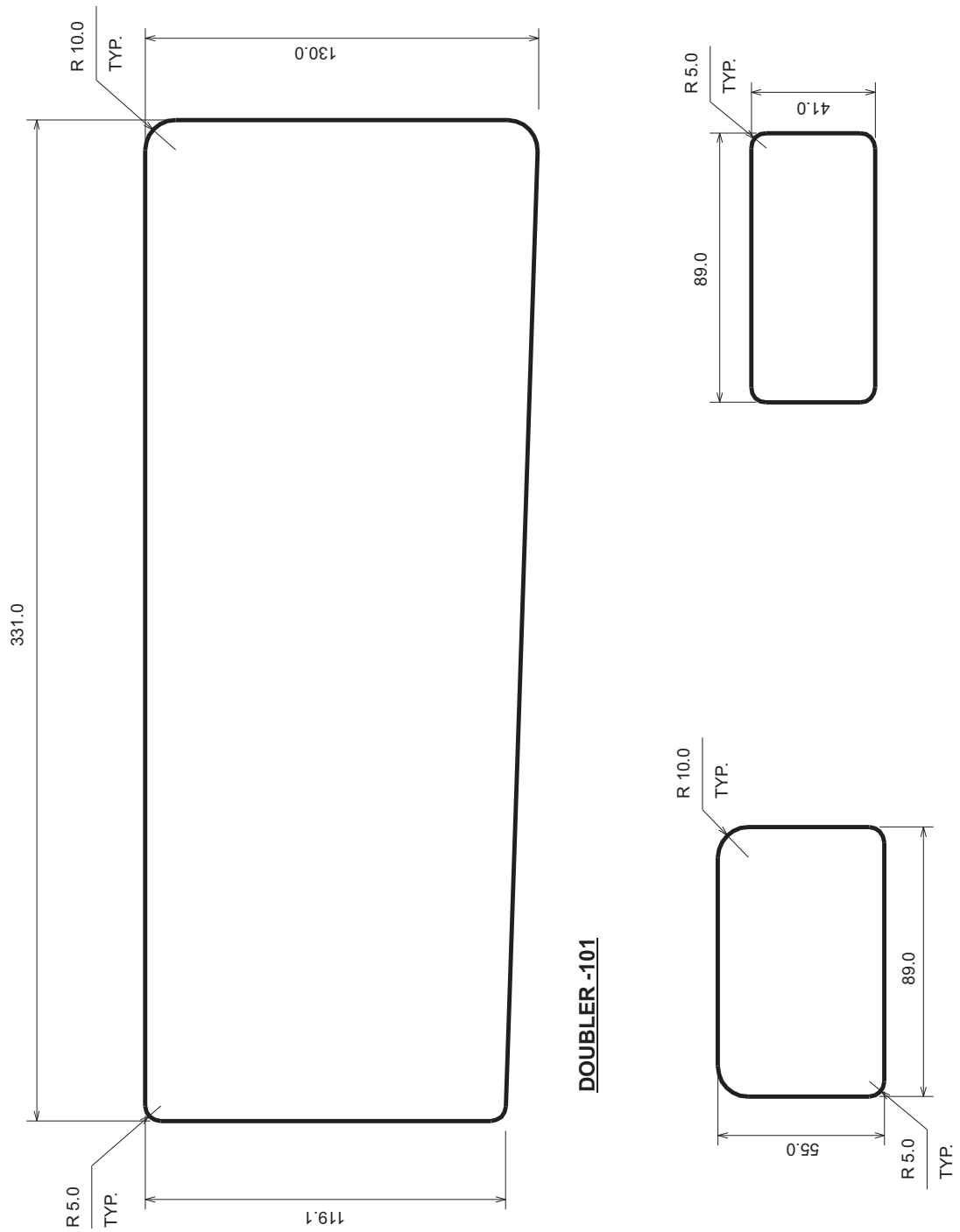


Figure D26

ANNEX E

ASRP DM 39-A-53-51-01-01E-664A-D (REPAIR SK139-1510)

Lateral panels (internal side) - Special repair procedure

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 Procedure
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 5 Support Equipment
 6 Supplies
 7 Spares

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 1 E1 damage - Lateral panels (internal side) - Special repair procedure (Sheet 2 of 3)
 1 E1 damage - Lateral panels (internal side) - Special repair procedure (Sheet 3 of 3)
 2 E1 damage - Doublers and shim

References

Table 1 References

Data Module	Title
39-A-00-20-00-00A-120A-A	Helicopter safety - Pre-operation (make helicopter safe for maintenance)
39-A-00-50-00-00A-010A-D	Local supply consumables, materials and expendables - General data
39-A-53-51-01-01A-028A-D	Lateral panels (internal side) - General
CSRP-A-51-10-00-00A-028A-D	Damage assessment - General
CSRP-A-51-21-00-00A-028A-D	Surface treatments - General
CSRP-A-51-21-05-00A-028A-D	Cleaning of structural parts - General
CSRP-A-51-70-00-00A-010A-D	Standard repairs - General data

Table 2 Access points

Access Panel / Door Id	Data Module
No Access Point	

Table 3 Zones

Zone ID	Data Module
No Zones	

Preliminary Requirements

Required Conditions

Table 4 Required Conditions

Conditions	Data Module/Technical Publication
The helicopter must be safe for maintenance.	39-A-00-20-00-00A-120A-A
Repairable damage: damage to skin must be contained in indicated cut lines. Applicability: P/N 3G5350A00135 and P/N 3G5350A00235. Additional effectivity restrictions: none. Kit/SB/Equipment compatibility limitations: before you start this procedure, make sure that helicopter installations are the same shown in this DM.	
Perform a complete damage assessment before repair execution.	CSRP-A-51-10-00-00A-028A-D
The repair area shall be cleaned before repair execution.	CSRP-A-51-21-05-00A-028A-D
For deviations from the indicated repair design refer to guidelines for standard repairs or tell the Manufacturer.	CSRP-A-51-70-00-00A-010A-D
Paint and primer shall be removed from the repair area.	CSRP-A-51-21-00-00A-028A-D

Support Equipment

Table 5 Support Equipment

Nomenclature
No Support Equipment

Supplies

Table 6 Supplies

Nomenclature	Identification No.	Qty
Adhesive	C021	AR
Adhesive	C057	AR
Conversion coating	C237	AR
Sealant	C465	AR
Alluminum (plate - thickness 0.30 mm - alluminum alloy 2024 T3 AMS-QQ-A-250/5)	Local supply	AR
	Local supply	AR

Nomenclature	Identification No.	Qty
Alluminum (plate - thickness 0.64 mm - aluminum alloy 2024 T3 AMS-QQ-A-250/5)		
Rivet (P/N NAS9301B-5-04)	Local supply	AR
Rivet (P/N NAS9301B-4-01)	Local supply	AR
Insert (P/N 999-5000-50-110)	Local supply	AR

Spares

Table 7 Spares

Nomenclature
No Spares

Safety Conditions

WARNING

The materials that follow are dangerous. Before you do this procedure, make sure that you know all the safety precautions and first aid instructions for these materials:

- Adhesive (C021)
- Adhesive (C057)
- Conversion coating (C237)
- Sealant (C465) .

Procedure

- 1 During this procedure:
 - Refer to CSRP for all the processes described in this DM
 - Adapt manufactured items during installation on existing structure
 - Protect bare aluminium surfaces (manufactured items, sanded areas and cut edges) with Conversion coating (C237)
 - Protect all manufactured items with Primer
 - Round out manufactured parts/cut lines corners with 5 mm radius typ
 - During cutting/sanding operations take care not to damage surrounding items
 - Break sharp edges with radius 0.13 thru 0.38 mm
 - Deburr new fastener holes
 - Select actual fastener grip at installation
 - Dip the shank of fasteners into Sealant (C465) before installation
 - Rivet as indicated, if holes conditions are not suitable use oversize rivets.

Note

For the identification of the applicable damages of this data module refer to 39-A-53-51-01-01A-028A-D.

2 Manufacture these components in accordance with the table that follows:

	Component	Material	Applicable figure
E1 damage	Doublers	Alluminum (plate - thickness 0.64 mm - alluminum alloy 2024 T3 AMS-QQ-A-250/5) (Local supply)	Figure 2
	Shim		
	Fillers	Alluminum (plate - thickness 0.30 mm - alluminum alloy 2024 T3 AMS-QQ-A-250/5) (Local supply)	Figure 1

3 Remove the four inserts (refer to Figure 1) that attach the lateral panels to the tail rotor drive structural provision.

4 Remove the existing doubler from the lateral panels.

5 Remove the eight rivets that attach the lateral panels to the structure at BL 0.0.

6 Drill on the lateral panels the 40 holes for the new rivets.

7 Drill as indicated the 4 holes for the inserts on the lateral panels.

8 Clean as indicated the core of the 4 holes for the inserts on the lateral panels.

9 Countermark the positions of the existing holes of the lateral panel on these parts:

- The doublers
- The fillers
- The shim.

10 Drill the countermarked holes on these parts:

- The doublers
- The fillers
- The shim.

11 Do the cuts out of the skin of the lateral panels.

12 Bond in their correct position the fillers with the Adhesive (C057) .

13 Apply the Adhesive (C021) on the mating surface between the doublers and the lateral panels.

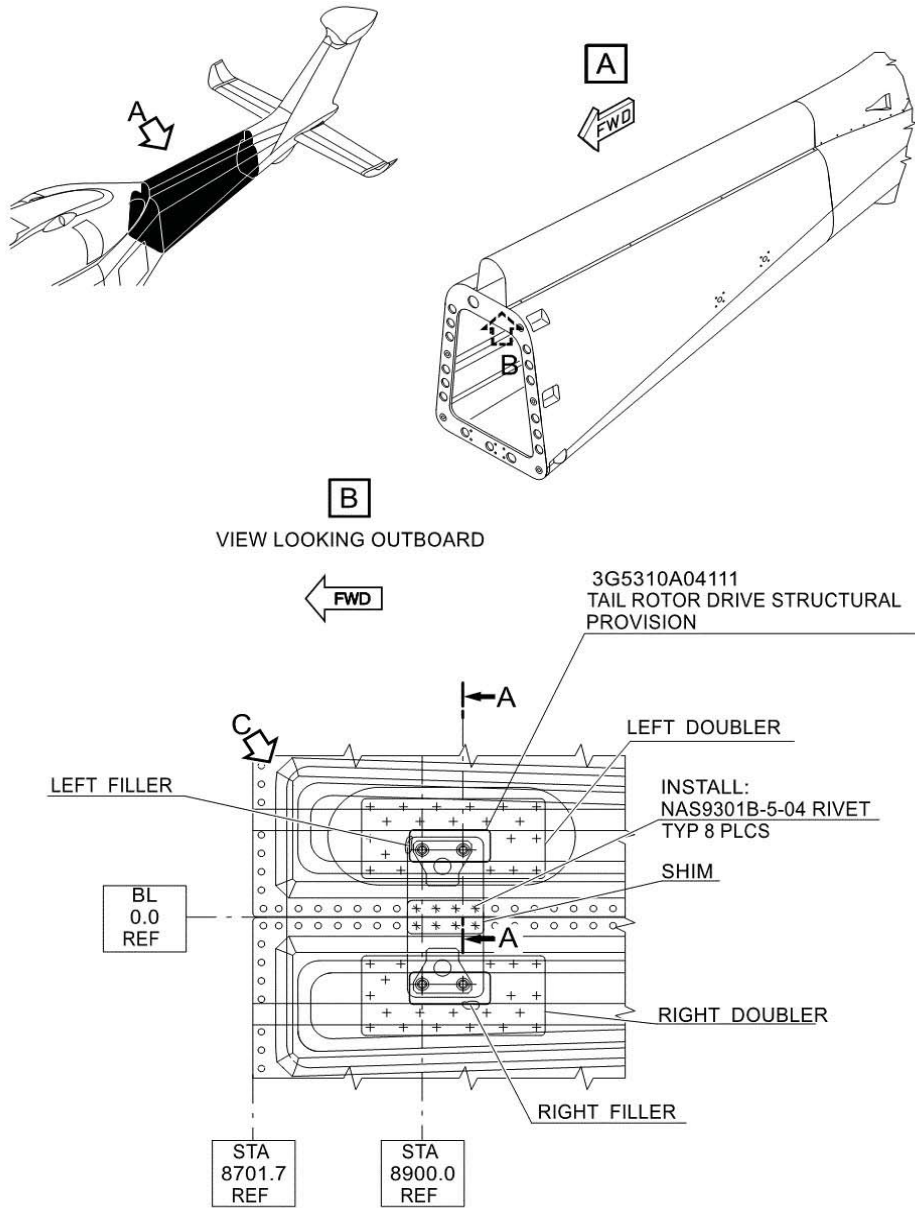
14 Put and secure the doublers in their position on the lateral panels.

15 Install the 40 new rivets that attach the doublers to the lateral panels.

- 16 Apply the Adhesive (C021) on the mating surface between the shim and the lateral panels.
- 17 Put and secure the shim in its position on the lateral panels.
- 18 Seal the shim with the Sealant (C465) .
- 19 Apply the Adhesive (C057) on the mating surface between the existing doubler and these parts:
 - The doublers
 - The shim
 - The lateral panels.
- 20 Put and secure the existing doubler in its position on these parts:
 - The doublers
 - The shim
 - The lateral panels.
- 21 Install the four inserts in their correct position with Adhesive (C057) .
- 22 Install the eight rivets that attach the existing doubler and the shim to the lateral panels.
- 23 Seal the doublers with the Sealant (C465) .

Requirements After Job Completion

- 1 Remove all the tools and the other items from the work area. Make sure that the work area is clean.
- 2 Record the performance of this repair activity into the applicable helicopter documents. If applicable part mark DM code adjacent to repair using black ink overcoated with lacquer.



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Figure 1 E1 damage - Lateral panels (internal side) - Special repair procedure (Sheet 1 of 3)

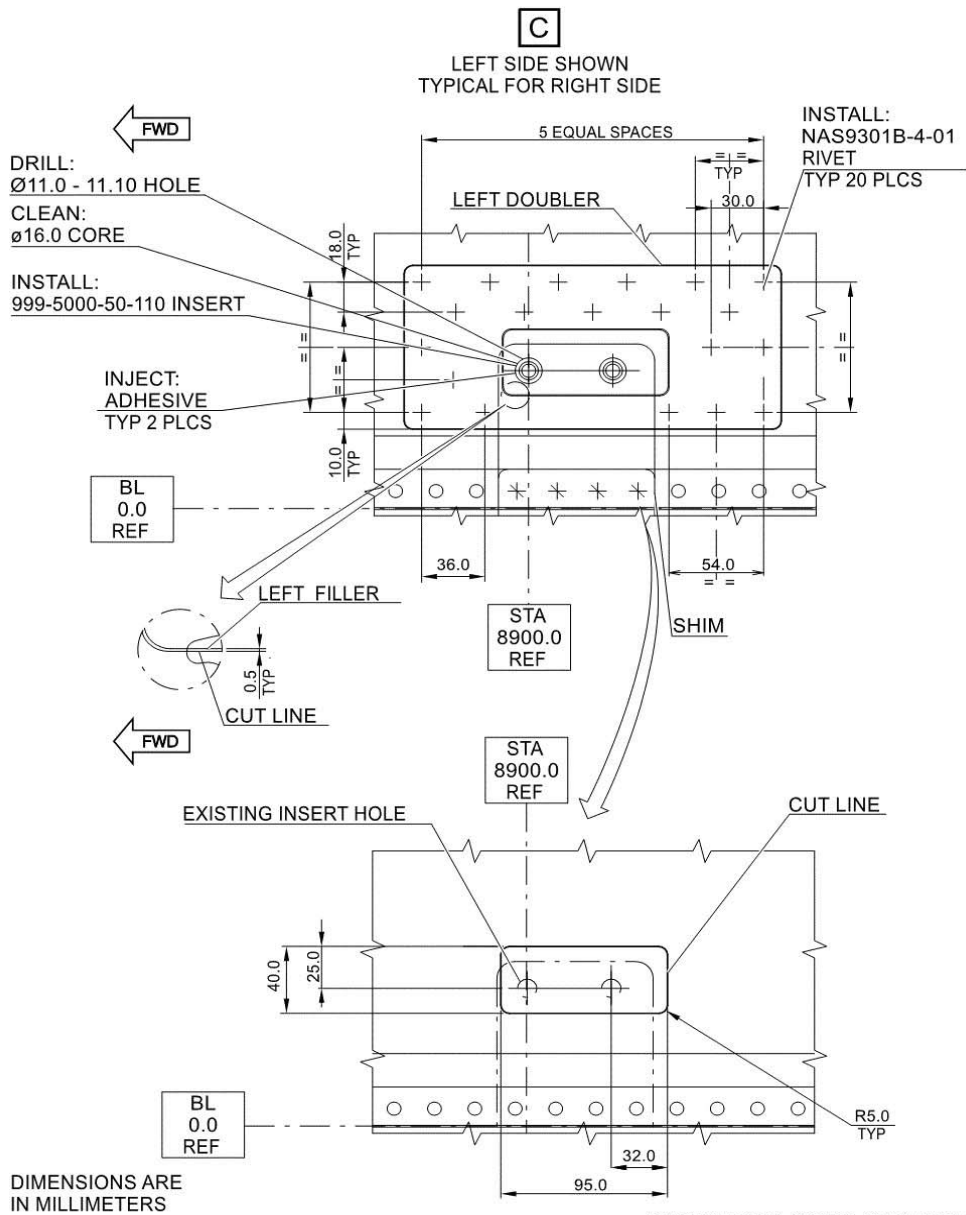
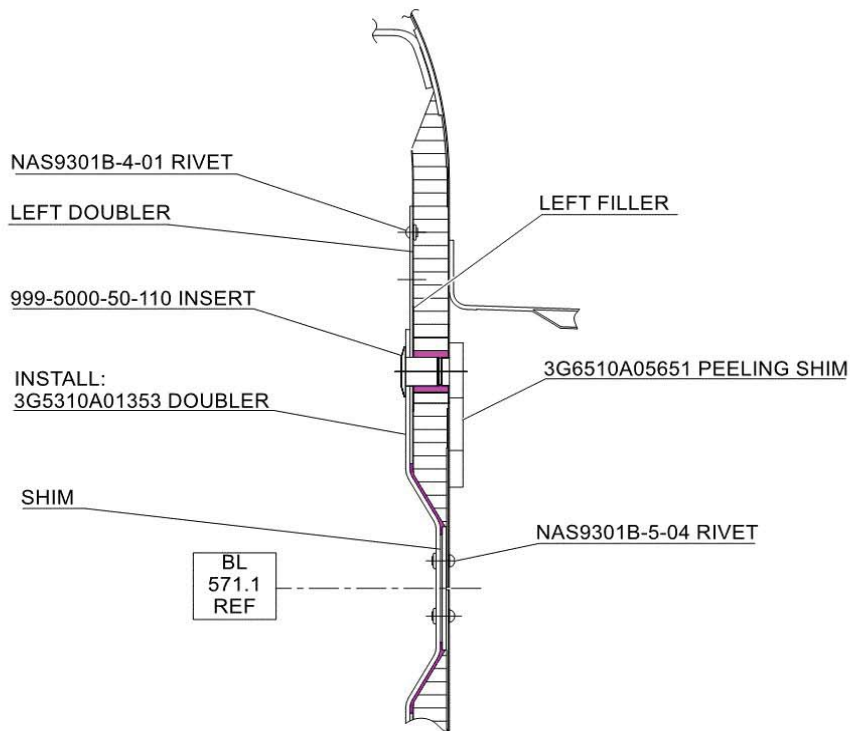


Figure 1 E1 damage - Lateral panels (internal side) - Special repair procedure (Sheet 2 of 3)

 ADHESIVE

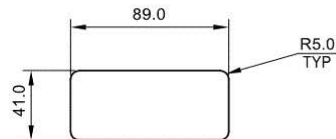
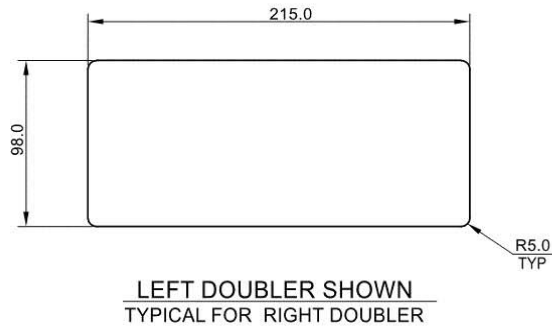


SECTION A-A
LEFT SIDE SHOWN
TYPICAL FOR RIGHT SIDE

ICN-39-A-535101-G-00001-24432-A-001-01

Figure 1 E1 damage - Lateral panels (internal side) - Special repair procedure (Sheet 3 of 3)

ASRP - 39-A-53-51-01-01E-664A-D Lateral panels (internal side) - Special repair p... Printed on 22/01/2021



SHIM

DIMENSIONS ARE
IN MILLIMETERS

ICN-39-A-535101-G-00001-24433-A-001-01

Figure 2 E1 damage - Doublers and shim

