**DEFECT – CORROSION FOUND AT LEFT AND RIGHT LOWER FRAME**

**(STATION 5700).**

A **AIRCRAFT DETAILS**

Type: AW139

Serial Number: 31316

Registration: M72-03

Airframe Hours: 2678.9 FH

Aircraft Landing: 4112

1. **COMPONENT DETAILS**

Description: Rear Fuselage Assembly

Part Number: L/H 3P5338A13355

 R/H 3P5338A13455

**C. BACKGROUND**

Galaxy Aerospace (M) Sdn. Bhd. (herein after “GAM”) has been appointed as the Maintenance Service Provider for MMEA’s AW139 fleet since 20th October 2017 - 19th October 2021(BHEM(S)600/13/6/2017 DATED 20TH OCTOBER) and a new contract from 19th October 2021 – 18th October 2024 (KDN/PL/T/APMM/4/2021 dated 31st January 2021)

**D. DEFECTS DESCRIPTION**

On 18/10/2022, helicopter M72-03 has been scheduled for its 3rd 4 Years Scheduled Maintenance Inspection (herein after “4Y SMI”) since this helicopter entered service.

Since the maintenance contract was awarded to GAM in 2017, this is the 2nd time GAM performing the 4Y SMI to this helicopter. (Refer Appendix A: Heavy Maintenance Record Summary)

As to date it has been three 4 Years Inspection carried out to the aircraft. 1st 4 Years has been carried out by previous contractor, 2nd, and 3rd 4 Years Inspection carried out by GAM.

During the maintenance, all access panels and major components had been removed to gain more access to facilitate the 4 years inspection. Thorough inspections had been carried out and GAM had identified signs of corrosion on the left and right lower frame at station STA5700.

GAM had conducted cleaning to the respective area for detailed inspection and found both sponson bolt areas accounted for severe corrosion under the painted surface. The surround center of the bolt head affected approximately 10mm width, 1mm depth on the LH side and 15mm width, 1mm depth on the RH side (Refer Appendix B: Cleaned and dimension area corrosion STA 5700)

E. **IMMEDIATE ACTION AFTER FINDING.**

GAM Technical Service was requested to make a further study and assessment of the defected area. However, through detailed study the team had confirmed no repair procedure is made available in the Aircraft Structure Repair Manual (ASRM)for this defect.

A Technical Query (TQ) PSE/TQ/2022/87278 has been raised to the Original Equipment Manufacturer (OEM) - Leonardo Helicopter. (Refer Appendix C: Corrosion of Bolt Sponson

F. **OEM’S FEEDBACK**

As per OEM, GAM had been requested to clean, measure the area and depth of corrosion. The details of measurement have been replied to LH accordingly.

Based on the feedback from LH, the damage extension reported is not possible to repair in that area, but the frames STA 5700 shall be replaced with reference to Temporary Maintenance Instruction (TMI) TMI139-421. Unfortunately, as this TMI already expired and Serial Number 31316 was not included in the TMI, Leonardo Helicopter are evaluating internally to re- issue this TMI to include affectivity of the SN31316. (Refer to Appendix D: GAM EMAIL – TMI139-421)

Further Instruction and recommendation by OEM during meeting conducted with LM dated 22/11/2022 found that the replacement of the STA5700 frame need to be carried out at Leonardo Malaysia (herein after “LM”) facilities. (Refer Appendix E: Minute Meeting GAM/LM)

G. **MAINTENANCE RECTIFICATION ACTION REQUIRED**

A meeting between GAM and LM was held on 22nd November 2022 to coordinate the rectification task based on OEM recommendation. (Refer Appendix D: TMI)

All major components will be removed from the aircraft at MMEA facilities by GAM before the helicopter is repositioned to LM’s Hangar. The component such as below:

* Main Gearbox Assy.
* Both Engine Assy.
* Tail Gearbox Assy.
* Intermediate Gearbox Assy.
* Tail Rotor Shaft Assy.
* Tail Boom Assy

The initial rectification of frame F5700 replacement will take 6 to 8 weeks after all the spares and special tools have been received. The 2nd update on 4th December 2022, Leonardo Malaysia has revised the repair time frame 12 weeks to 14 weeks due to previous estimation only include one side of repair. (Refer Appendix F – LM email )

The replacement will be carried out by LM personnel and will be assisted/observed by GAM personnel. After completion, the aircraft will be repositioned back to MMEA Hangar for reassembling all the components for final ground run and flight test.

H. **DEFECTS ANALYSIS.**

 Based on GAM’s experience on maintaining the same type of helicopter owned by other Government Agencies and private entities, the probable causes of the defect would be as follows:

* Aircraft Corrosion Control Programmed (ACCP) specified only **General Visual Inspection (GVI**) on Landing Gear Bay with the intervals of 1 month (Ref IETP 39-A-20-83-01-00A-310A-D). However, the inspection without removed the access panel. The inspection also are not specifically specified to inspect the defected area.
* The 4 Years schedule inspection which call for **Detailed Inspection (DI)** to the respective area was found not sufficient to detect the **Exfoliation and Intergranular Corrosion**.
* Detail Inspection (DI) for the specific area detected (STA 5700) will only be called out during 4Y SMI (Ref 39-A-53-10-00-00A-31AP-A). The intervals lapsed, had given sufficient time for the corrosion to build up.
* The machine parts of the lower frame at Rear Fuselage Assembly (as mentioned in Para B-Component Detail) painted over, makes such Exfoliation and Intergranular Corrosion very difficult to be detected by G*VI* and *DI* unless ***Specific Detailed Inspection (SDI)****.* Therefore, stringent inspection to be imposed on the fleet in order to avoid/detect such corrosion.
* The **Dissimilar Metal** of the frame (Item 49 - Aluminum Alloy) and the bushing (Item 50 – Steel) makes the component prone to corrosion build up. (Refer Appendix G – Illustrated Parts Catalogue)
* The definition of the terminologies such follows as per Interactive Electronic Technical Publication (IETP) published by Leonardo Helicopter.
* **Exfoliation** - This type of corrosion often occurs in aluminum parts made from plate, bar, tube, and extrusion stock that has long, thin grains. Exfoliation corrosion is recognized by the long thin leafs of material that delaminate from the surface of a part. This type of corrosion looks like a blister on the surface of a part. This is caused by the corrosion effect between the grains, which force the grain apart, causing a bulge on the surface. Exfoliation corrosion is a form of intergranular corrosion
* **Intergranular Corrosion** - This type of corrosion progresses along the grain boundaries of metal alloys. Aluminum alloys, which contain appreciable amounts of copper and zinc (2024 and 7075) and some stainless steel (17-4PH), are vulnerable to intergranular corrosion. Hinges are an example of aluminum alloy extrusions that are vulnerable. Lack of uniformity in alloy structure caused by heat treating procedures or localized overheating may result in intergranular corrosion. The corrosion may exist without visible evidence on exterior surfaces and serious structural weakening may occur without detection.
* ***General Visual Inspection (GVI)*** - A visual examination of an interior or exterior area, installation, or assembly to detect obvious damage, failure or irregularity. This level of inspection is made from within touching distance, unless otherwise specified. A mirror may be necessary to ensure visual access to all surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight or droplight and may require removal or opening of access panel or doors. Stands, ladders, or platforms may be required to gain proximity to the area being checked
* ***Detailed Inspection (DI)*** *-* An intensive visual examination of a specific structural area, system, installation, or assembly to detect obvious damage, failure or irregularity. Available lighting is normally supplemented with a direct source of good lighting at intensity deemed appropriate by the inspector. Inspection aids such as mirrors, magnifying lenses, etc. may be used. Surface cleaning and elaborate access procedures may be required.
* ***Special Detailed Inspection (SD****I) -* An intensive examination of a specific item(s), installation, or assembly to detect damage, failure or irregularity. The examination is likely to make extensive use of specialized inspection techniques and/or equipment. Intricate cleaning and substantial access or disassembly may be required.
1. **CONCLUSION**

Based on the investigation, Technical Query to OEM and GAM experience maintaining Leonardo Helicopter product we can conclude that: -

* The Technical Query Report from the OEM shown that the defect of the corrosion on the STA 5700 was the **first reported in Malaysia** for AW139 aircraft.
* This kind of corrosion rectification **was not stipulated in the Aircraft Structure Repair Manual** (ASRM) as a standard repair**.** Thus, the **Temporary Maintenance Instruction** will be issued for dedicated aircraft serial number (31316) due to abnormal corrosion event.
* GAM as a Maintenance Contractor shall revise the Approved Maintenance Program for all AW139 fleet under GAM CAMO to increase the frequency of inspection at the defected area with the higher rate of inspection (**2 years intervals – Special Detailed Inspection**).
* Fleet inspection shall be called out and should be carried out to the respective location.