ALL (ATA 57)
MICROBIOLOGICALLY INDUCED CORROSION IN WING FUEL TANKS

By Jose Veciana, Service Engineering Manager

During the performance of internal wing tank inspections at the Gulfstream Savannah Service Center, several aircraft revealed the presence of corrosion due to Microbiologically Influenced Corrosion (MIC). If left unchecked, corrosion of this nature can progress quickly, requiring major repairs to the wing structure (See Figure 1, on page 4).

What is the root cause of MIC? MIC refers to corrosion and the ensuing loss of metal caused by biological organisms. MIC can occur in any aqueous environment, and because of the omnipresent nature of microbes in fluid systems, MIC is a commonly occurring phenomenon. Although the presence of water greatly influences the growth of microorganisms in the fuel, it is not required for all microorganisms to live and for MIC to occur. MIC is a common problem in industrial processes due to the presence of microbes, adequate nutrients, and corrosive byproducts.

A number of metals, such as structural steels, aluminum alloys, etc., tend to generally corrode across the entire surface in the absence of crevices or galvanic effects. In such cases, corrosion is propagated by the rate at which dissolved oxygen can be delivered to the metal surface. Biological organisms present in the aqueous medium often have the potential to increase or decrease oxygen transport to the surface; consequently, these organisms have a role in increasing or decreasing general corrosion. Most MIC, however, manifests as localized corrosion because most organisms do not form in a continuous film on the metal surface. Microscopic organisms also tend to settle on metal surfaces in the form of discrete colonies or at least spotty rather than continuous films, much like algae in a pool.

Biological organisms fall under two groups based on the type of corrosion they engender: (a) anaerobic corrosion and (b) aerobic corrosion. Sulfate Reducing Bacteria (SRB) from the genera desulfovibrio is a typical example of anaerobic MIC. Aerobic sulfur-oxidizing bacteria of the type thiobacillus can create an environment of up to 10 percent sulfuric acid, thereby encouraging rapid corrosion.

MIC is usually seen in discrete areas on the fuel tank, typically in low-lying areas of the wing, but are not always limited to these areas where water will settle. Two photographs of typical microbiological growth are shown in Figures 2 and 3 on page 4).

MIC cannot always be distinguished from other forms of corrosion by inspection. It looks the same as aluminum corroded by salt water or acids, whether it's viewed with no magnification or at 10X magnification. MIC is caused by acidic by-products of the metabolism of microbes. Typically, when an aircraft exhibits corrosion in the low-lying areas of the tank, fuel samples will be tested for microbes, but the contamination could have occurred from previous fuel loads. Therefore, quite often, nothing of significance is found in these fuel tests. Microbial by-products may not be found in these exams. For this reason, it is important that operators perform routine microbial contamination testing and record the results for trend analysis. This will also help operators identify suspect fuel providers, allowing them to address the uplift of contaminated fuel before it becomes an issue.

Consistent water draining of the aircraft fuel tanks is key to maintaining a healthy fuel system. Gulfstream is revising all Airplane Flight Manuals to include this process as part of the aircraft preflight. Water draining (sumping) procedures are located in the Aircraft Maintenance Manual (AMM) ATA 28, under Fuel Tank Sumping. Gulfstream has proactively designed a new tool that will soon be available for most aircraft models that will allow worry-free sumping of water from the aircraft fuel system, mitigating issues encountered with the new sump valve design.

If there are questions regarding wing tank corrosion or procedures regarding sumping of the wings, contact Technical Operations at technical.operations@gulfstream.com or 1-800-810-GULF (4853) or 1-912-965-4178, option 2.

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MICROBIOLOGICALLY INDUCED CORROSION IN WING FUEL TANKS – CONTINUED

Figure 1
Corner of wing rib flange with missing material due to MIC

Note:
Pitting on the green Hi-Lok collar also due to the effects of MIC

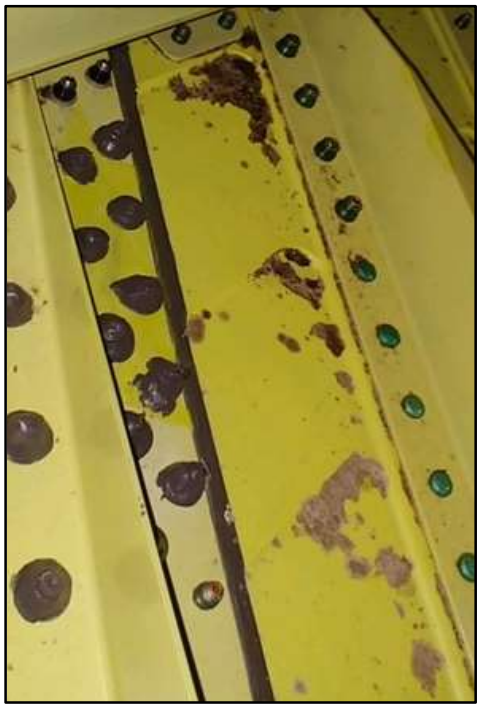

Figure 2
Areas of typical microbiological growth on the lower surface of a wing tank

Figure 3
Areas of typical microbiological growth on a wing spar

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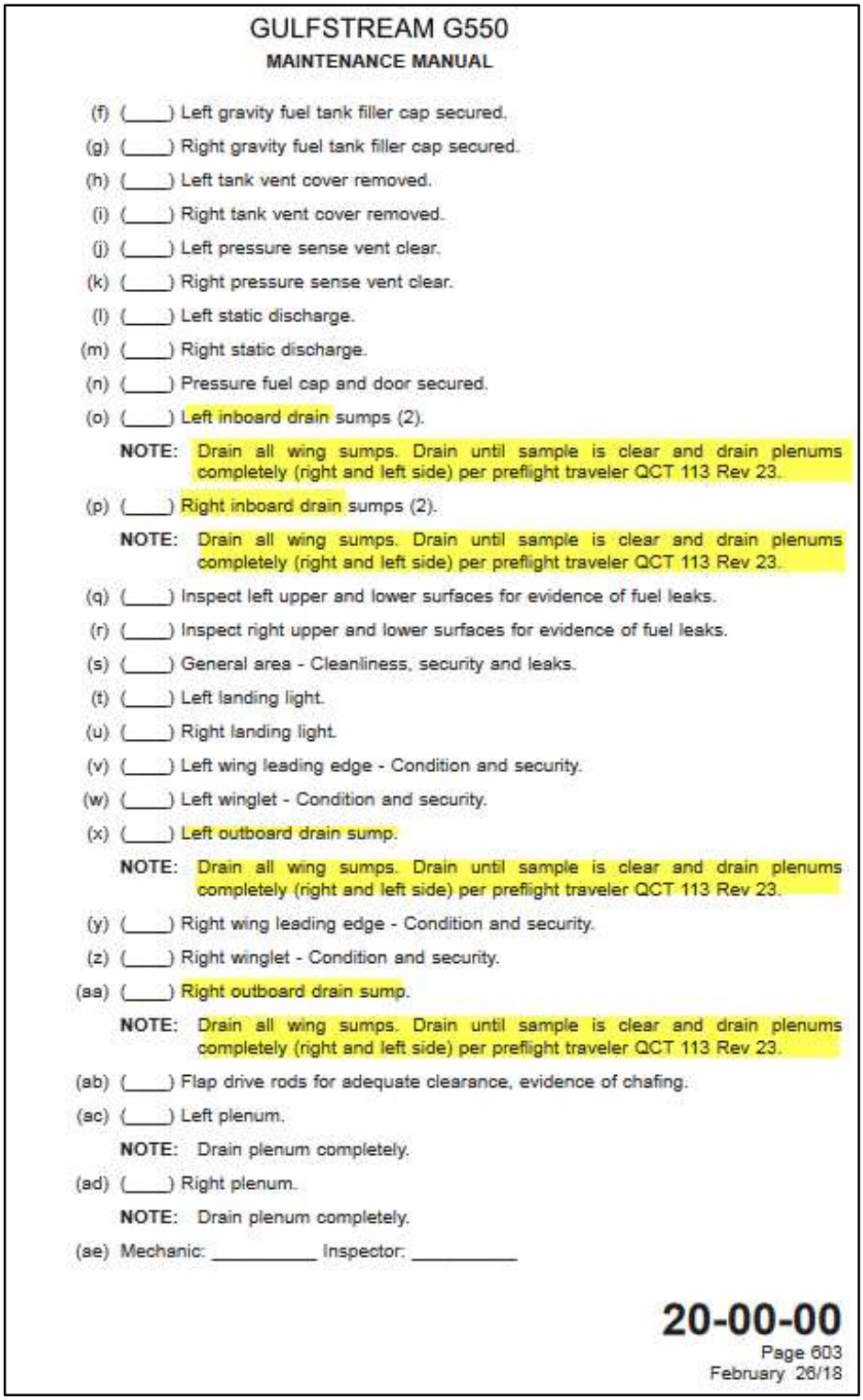
MICROBIOLOGICALLY INDUCED CORROSION IN WING FUEL TANKS – CONTINUED



GULFSTREAM G550

MAINTENANCE MANUAL

(f) (____) Left gravity fuel tank filler cap secured.

(g) (____) Right gravity fuel tank filler cap secured.

(h) (____) Left tank vent cover removed.

(i) (____) Right tank vent cover removed.

(j) (____) Left pressure sense vent clear.

(k) (____) Right pressure sense vent clear.

(l) (____) Left static discharge.

(m) (____) Right static discharge.

(n) (____) Pressure fuel cap and door secured.

(o) (____) Left inboard drain sumps (2).

NOTE: Drain all wing sumps. Drain until sample is clear and drain plenums completely (right and left side) per preflight traveler QCT 113 Rev 23.

(p) (____) Right inboard drain sumps (2).

NOTE: Drain all wing sumps. Drain until sample is clear and drain plenums completely (right and left side) per preflight traveler QCT 113 Rev 23.

(q) (____) Inspect left upper and lower surfaces for evidence of fuel leaks.

(r) (____) Inspect right upper and lower surfaces for evidence of fuel leaks.

(s) (____) General area - Cleanliness, security and leaks.

(t) (____) Left landing light.

(u) (____) Right landing light.

(v) (____) Left wing leading edge - Condition and security.

(w) (____) Left winglet - Condition and security.

(x) (____) Left outboard drain sump.

NOTE: Drain all wing sumps. Drain until sample is clear and drain plenums completely (right and left side) per preflight traveler QCT 113 Rev 23.

(y) (____) Right wing leading edge - Condition and security.

(z) (____) Right winglet - Condition and security.

(aa) (____) Right outboard drain sump.

NOTE: Drain all wing sumps. Drain until sample is clear and drain plenums completely (right and left side) per preflight traveler QCT 113 Rev 23.

(ab) (____) Flap drive rods for adequate clearance, evidence of chafing.

(ac) (____) Left plenum.

NOTE: Drain plenum completely.

(ad) (____) Right plenum.

NOTE: Drain plenum completely.

(ae) Mechanic: _____ Inspector: _____

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Figure 4

Excerpt from the G550 AMM Preflight checks showing the wing sumping requirements (highlighted)

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