

Microbiological contamination limits for Aircraft Fuel Tanks and what they mean.

IATA *Guidance Material for Microbiological Contamination in Aircraft Fuel Tanks* include guideline limits for microbiological contamination in aircraft fuel tanks based on many years of experience testing with IP385 and IP613 test methods. MicrobMonitor 2 allows testing in accordance with IP613 and ASTM D7978 and is included in all major airframe OEM AMM's.

Users should appreciate the following when interpreting test results against IATA guidance limits;

- They apply to aircraft fuel tank sump samples only (alternative limits for samples from aviation fuel supply facilities and other scenarios are published by organisations such as JIG (contact us for more details)
- Limits categorise contamination as “negligible”, “moderate” and “heavy”.
- For tests which use Colony Forming Unit (CFU), there are separate limits for water phase and fuel phase samples because it is always expected to recover much higher levels of microbial contamination in water phase samples
- The IATA Guidance limits are follows;

Sample type	Negligible Level Contamination	Moderate Level Contamination	Heavy Level Contamination
Fuel	<4000 CFU/Litre	4000 – 20,000 CFU/Litre	>20,000 CFU/Litre
Water	<1000 CFU/mL	1000 – 10,000 CFU/mL	>10,000 CFU/mL

Why are CFU tests considered the reference method?

- The concept of using contamination limits is widely accepted across all industries where microbiological cleanliness is critical (e.g. drinking water quality, food quality, pharmacological preparations and medical devices). Where such limits are used, standard methods based on assessment of Colony Forming Units (CFU) are considered to be the reference methodology – alternative test technologies may be used but will generally have to be validated to demonstrate similar performance in detecting microbial contamination as a standard CFU test. MicrobMonitor2 is a standard CFU test for testing fuels and associated water (IP 613 and ASTM D7978) in either the laboratory or fields. It provides results which have been demonstrated to provide a high degree of correlation with standard laboratory method IP 385 / ASTM D6974).

Results that count

How do microbial CFU contamination limits relate to microbial activity?

- The IATA limits are intended to indicate when levels of contamination present in an aircraft fuel tank are higher than levels that might be expected due to background contamination or general “dirt” ingress. If contamination is detected in excess of the IATA limits it indicates that some degree of microbial proliferation is likely to be occurring within the aircraft fuel tank. If there have been failures in the filtration of fuel prior to uplift to the aircraft, detecting contamination above IATA limits may alternatively or additionally be indication that the fuel has been associated with a significant degree of active microbial proliferation at some point in the supply and delivery chain before uplift of fuel onto the aircraft. It should be noted however, that fuel suppliers generally follow best practice, including multiple stages of fuel filtration and water removal, which will ensure contamination in fuel uplifted is below IATA contamination limits.

How do microbial CFU contamination limits relate to operational risk?

- The contamination limits in the IATA Guidance Material are based on many years’ experience and evaluation of data including observations in aircraft fuel tanks. It is not possible for contamination limits to be perfect for every possible aircraft operation and scenario. However, overall, we believe the IATA contamination limits provide the best possible balance between a conservative approach which enables timely intervention to resolve contamination before it can become an operational and safety issue, whilst avoiding unnecessary maintenance tasks. This is the considered opinion of the IATA Microbial panel, which includes representatives of major airframe OEMs, airlines, test manufacturers and microbiological experts. Limit values can be adjusted by users to take in to account their perceived risk and operating experience but we would only advise this with expert input and OEM endorsement. Users should always appreciate that a risk of false negative results will have a far greater impact on operational safety, than a risk of false positive results.

Why is heavy contamination not always visible?

- **IMPORTANT:** Detection of “heavy” contamination is NOT necessarily indication that fuel is unfit for use, nor that operational problems are imminent, nor that aircraft should be grounded, nor that visible levels of contamination will already be present in the tank. Exceeding the limits is intended to provide early notification that there is a risk these issues could occur, in time, if remedial action is not taken in accordance with OEM AMMs. Therefore, users should not be surprised if, on occasion, tanks which have indicated “heavy” contamination are found to be free of visible contamination when entered and inspected. Microorganisms are tiny and may be present in very significant numbers even if they are not visible. If microbial material is noticed by visual examination of samples or of tank surfaces, it is an indication that contamination is already at an advanced stage which may potentially result in operational problems, and immediate action is thus needed. But “heavy” contamination detected by reliable test methods will not always be accompanied by visible contamination in samples or at tank surfaces. Specifically, if a “heavy” contamination is detected in a sample by MicrobMonitor2 (or any other test) and subsequently no visible evidence of contamination is seen, that is NOT indication that the test is a “false positive”;

users should thus follow the advice given in OEM AMM's and as recommended in IATA Guidance if the test result is confirmed by retest.

Which microorganisms are important?

- Whilst only some microbes are capable of degrading fuel hydrocarbons, it should not be considered that these are the only "important" microbes in an aircraft fuel tank. This is because microbes, called secondary degraders can feed on fuel which has been partially degraded by hydrocarbon degraders. The different types of microbes may be active in a consortia. All can produce biomass which foul filters and fuel gauges and produce acids which can cause corrosion. Therefore, ANY microbe found in significant numbers in the tank (i.e. in excess of IATA contamination limits) is likely to be actively proliferating and therefore should be considered important. MicrobMonitor2 detects a wide range of bacteria and fungi (yeasts and moulds), including hydrocarbon degraders and secondary degraders. MicrobMonitor2 is designed so that it utilises the fuel sample itself to replicate nutrient conditions ideally suited to the microorganisms which actively proliferate in fuel tanks.

If MicrobMonitor2 detects a wide range of microorganisms is there a risk of false positive results?

- Whilst some microorganisms may be present in fuel tanks due to environmental contamination (e.g. from human contact, dirt ingress), they will generally be present in only very low numbers; below the minimum detection limit of MicrobMonitor2 when testing fuel phase samples and either in the "negligible" contamination range or below minimum detection limit when testing water phase samples. Background contaminants which are not relevant to aircraft operational issues or fuel quality issues are not adapted for growth in the fuel tank environment. Thus, even when they are present or introduced into a tank, they will not proliferate to the levels which will register as "moderate" or "heavy" contamination when samples are tested with MicrobMonitor2. Only, in the case of an exceedingly gross environmental contamination could sufficient background microbes be introduced to a tank to register as "moderate" or "heavy" in a MicrobMonitor2 test; we believe users would, in any case, want to be alerted to such contamination, regardless of whether the microbes were capable of subsequent growth in fuel. Therefore, there is a very low risk of detecting "moderate" or "heavy" contamination by MicrobMonitor2 solely due to the presence of unimportant background contaminants. This is highlighted by the fact that in the vast majority of aviation fuel tests performed by users, any contamination present will be below detection levels or in the "negligible" category. For example, in airline field trials to evaluate MicrobMonitor2, of 1833 aircraft fuel tank samples tested, only 6% showed moderate contamination and 8% showed heavy contamination; such a high percentage of negative or negligible results (86%) would be highly unlikely if background contamination was a significant cause of false positive results. Interestingly, in airline trials, when "moderate" or "heavy" contamination is detected by MicrobMonitor2 it usually corroborated by similar indication using an ATP Test Method, HY-LiTE Jet A1. Because ATP is a test which only detects active microbial growth this further supports that MicrobMonitor2 only gives positive indication of contamination when active growth of importance is occurring.

- It should be noted that there is a genuine risk of false positive results if good hygiene practice is not followed during sampling and testing. This is true for ANY test method used. For example, if a sampling tool is used to sample a contaminated aircraft and then used to sample an uncontaminated aircraft without cleaning it, there is a risk that a false positive result may be obtained from the clean aircraft. However, simple good cleanliness and consistent procedure is sufficient to avoid this problem. Contact ECHA Microbiology or your authorised MicrobMonitor2 distributor for further advice on good sampling practice.