3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR052L Microbial Analysis of ISS Air Using the Microbial Air Sampler (MAS)
Sponsor:	Medical Operations
Discipline:	Environmental Health
Category:	Medical Requirements (MR)
References:	SSP 50260 ISS Medical Operations Requirements Document (ISS MORD)
Purpose/Objectives:	To ensure that the air quality is microbiologically safe for crewmembers and to ensure compliance with existing acceptability limits established for microbial air sampling.
Measurement Parameters:	Detection and enumeration of microorganisms (bacteria and fungi) in the ISS air from in-flight sampling activities.
Deliverables:	• Preflight test report of samples that may be collected prior to launch of a module or visiting vehicle • Ground-based evaluation of microbiological content of module air by quantification and identification of bacteria and fungi • In-flight evaluation of air from real-time sampling • Postflight report of samples collected in-flight
Flight Duration:	≥ 30 days
Number of Flights:	All flights
Number and Type of Crew Members Required:	Nominally, one to two ISS crewmembers are trained.
Other Flight Characteristics:	None

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

<table>
<tr><td>Preflight Training Activity
Description:</td><td colspan="4">Training will include the procedure for sampling air on board ISS for microbial content. Collection, processing, analysis, data entry, and proper stowage will be demonstrated and then performed by crewmembers. In-flight collections will be reviewed. Nominally, one to two crewmembers will be trained</td></tr>
<tr><td rowspan="2">Schedule:</td><td colspan="2">Duration:</td><td>Schedule:</td><td>Personnel Required:</td></tr>
<tr><td colspan="2">EHS Microbiology Operations - 90/75 min
Inexperienced crewmember 90 min training:
5 min - Micro. Intro & Overview
15 min - Introduction to hardware
50 min – Perform sample collection
10 min – Review examples of growth on media 10 min -Review & summarize all micro/answer questions
-OR-
Experienced crewmember – 75 min training:
5 min – Micro. Intro & Overview
50 min – Perform sample processing
10 min – Review examples of growth on media
10 min – Review & summarize all micro/answer questions</td><td>Trip 2A7</td><td>Crewmember(s)/Instructor</td></tr>
<tr><td rowspan="2">Ground Support Requirements Hardware/Software</td><td>Preflight Hardware:</td><td>Preflight Software:</td><td colspan="2">Test Location:</td></tr>
<tr><td>Microbial Air Sampler (MAS) Kit</td><td>N/A</td><td colspan="2">U.S.</td></tr>
<tr><td rowspan="3">Training Facilities</td><td>Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td>Special Lighting:</td></tr>
<tr><td>8' x 10'</td><td>2 (110 volts AC)</td><td>Ambient</td><td>N/A</td></tr>
<tr><td>Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td colspan="2">Other:</td></tr>
<tr><td></td><td>No</td><td>N/A</td><td colspan="2">Table & 4 chairs</td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="4">None</td></tr>
<tr><td>Launch Delay Requirements:</td><td colspan="4">Training will be repeated if requested by a crewmember.</td></tr>
<tr><td>Notes:</td><td colspan="4">None</td></tr>
</table>

3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

<table>
<tr><td>Preflight Activity
Description:

Schedule:</td><td colspan="5">Pre-flight microbiological sampling of air of specified habitable flight elements (as specified in ISS MORD) shall be performed before final element closeout (15 to 20 days before is preferred) in the element processing facility, as specified in Test Sheets negotiated with individual vendors. This allows time for completion of analyses (quantification and identification of bacteria and fungi), reporting results, and performance of any remediation activities that may be required. JSC Microbiology personnel will travel to appropriate locations for collection of samples, as specified in JSC 18633. Samples are hand-carried back to JSC for processing, as specified in JSC 32015. Standard laboratory procedures are used to quantify and identify bacteria and fungi. JSC Microbiology Laboratory may only be responsible for the first flight of a vehicle, after which vendors may be required to assure the testing is completed.
<table><tr><th>Duration:</th><th>Schedule:</th><th>Flexibility:</th><th>Personnel Required:</th></tr><tr><td>ISS Module Air Sampling ≤ 2 hrs.</td><td>Preferred is 15-20 days before module close-out</td><td>N/A</td><td>JSC Microbiology Laboratory Personnel or vendor-selected delegate as approved by NASA</td></tr></table></td></tr>
<tr><td>Ground Support Requirements Hardware/Software</td><td colspan="5"><table><tr><th>Preflight Hardware:</th><th>Preflight Software:</th><th>Test Location:</th></tr><tr><td>Microbial Air Sampler III</td><td>N/A</td><td>U.S.</td></tr></table></td></tr>
<tr><td>Testing Facilities</td><td colspan="5"><table><tr><th>Minimum Room Dimensions:</th><th>Number of Electrical Outlets:</th><th>Temperature Requirements:</th><th>Special Lighting:</th></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr><tr><th>Hot or Cold Running Water:</th><th>Privacy Requirements:</th><th>Vibration/Acoustic Isolation:</th><th>Other:</th></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr></table></td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="5">• Air sampling will include one set of samples/module (set = one bacteria sample & one fungi sample).
• The module shall be as close to final configuration as is possible when preflight air sampling activities occur. Airflow is desired but not required.
• Remediation recommendation will be based on test results.</td></tr>
<tr><td>Launch Delay Requirements:</td><td colspan="5">None</td></tr>
<tr><td>Notes:</td><td colspan="5">All samples collected by JSC personnel are transported to the JSC Microbiology Laboratory for analyses. If the results should indicate that an acceptability limit has been exceeded, remediation may be recommended. Following remediation activities, repeat sampling is not required.

Late Access of hardware: Will be dependent on vendor processing schedule</td></tr>
<tr><td>Data Delivery</td><td colspan="5">A report will be delivered to the Crew Surgeon and all appropriate personnel within 10 days of JSC sample processing or forwarded upon receipt of data from vendor.</td></tr>
</table>

3.5 In-Flight Activities

TABLE 3.5.1a: IN-FLIGHT ACTIVITIES

<table>
<tr><td>In-Flight Activity Description:</td><td colspan="3">Microbial Air Sample Collection - ISS cabin air will be monitored in specified habitable modules using the MAS Kit according to the schedule as specified in the ISS MORD. Sampling will occur once every 3 months in each specified module for continuous monitoring of the environment. Two samples will be collected in each module (one media plate for bacterial analysis & one media plate for fungal analysis). The time and location of sampling will be recorded on the media plate.</td></tr>
<tr><td rowspan="2">Schedule:</td><td>Activity & Duration:</td><td>Schedule:</td><td>Personnel Required:</td></tr>
<tr><td>Unstow/stow Microbial Air Sampling hardware 15 min
Sample Collection using 2 media plates 15 min./site</td><td>Once every 3 months in each designated module. (Lab, Nodes 1,2, and 3, Columbus, JEM PM)</td><td>1 crewmember</td></tr>
<tr><td>Procedures:</td><td colspan="3">Procedures are located in the System Operations Data file (SODF) Procedures Database Med Ops Book:
Microbiology Air Sampler Kit – Sample Collection</td></tr>
<tr><td>Constraints / Special Requirements:</td><td colspan="3">If possible, sampling should be performed on the same day as surface sampling.
Total time will depend upon number of modules to be sampled.
Incubation is required for all air samples collected for in-flight processing and analyses. Samples will be stowed in a convenient location and incubated at ambient ISS temperature.
All microbiology kits should be stowed at temperatures between 40-95 deg F (+4° C and +35° C).</td></tr>
<tr><td>Photo / TV Requirements:</td><td colspan="3">N/A</td></tr>
<tr><td>Cold Stowage Requirements:</td><td colspan="3">N/A</td></tr>
<tr><td>Mission Extension Requirements:</td><td colspan="3">None</td></tr>
<tr><td>Landing Wave-Off Requirements:</td><td colspan="3">None</td></tr>
<tr><td>Notes:</td><td colspan="3">Extra sampling packets are available for contingency</td></tr>
<tr><td>Data Delivery</td><td colspan="3">Real-time surface samples data - See Table 3.5.1b In-flight Activity - Visual Analysis

Data from the final in-flight samples returned for analysis:
Results will be available within 7-10 days following sample receipt in the laboratory.
If a clinically significant organism is observed upon completion of analysis, an interim report will be delivered to the Crew Surgeon as soon as possible.</td></tr>
</table>

TABLE 3.5.1b: In-Flight Activities - Visual Analysis

<table>
<tr><td>In-Flight Activity Description:</td><td colspan="5">Visual Analysis of Colony Counts of the media plates. Colony counts will be performed 5 days after collection of bacterial and fungal samples. The results will be recorded in the procedure.</td></tr>
<tr><td rowspan="4">Schedule:</td><td>Activity:</td><td>Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td>Unstow</td><td>5 min</td><td rowspan="3">At T.0+5 days post-sampling</td><td rowspan="3">T.0+5 days can be read between 5 & 6 days</td><td rowspan="3">1 crewmember</td></tr>
<tr><td>Read media plate & record visual count</td><td>2 min/Petri dish (number of samples depends upon number of sites sampled)</td></tr>
<tr><td>Stow</td><td>10 min</td></tr>
<tr><td>Photo of media plate</td><td>10 min</td><td>Contingency only</td><td>N/A</td><td>1 crewmember</td></tr>
<tr><td>Procedures:</td><td colspan="5">Procedures are located in the Systems Operations Data File (SODF) Procedures Database Med Ops Book:
• Microbiology Surface Sampling and Air Sampling - Visual analysis and Data Recording</td></tr>
<tr><td>Constraints / Special Requirements:</td><td colspan="5">• In the event that an acceptability limit is exceeded, a request for contingency digital photography downlink of the sample shall be requested. NASA/JSC microbiologists shall evaluate, by visual inspection, the microbial risk.
• The NASA/JSC microbiologists will notify the MMOP Microbiology Subgroup and Increment Flight Surgeon of their evaluation.
• An attempt to identify the source of the contamination shall be performed. Resampling of the affected module may be performed, including the air inlet source(s) of the module.
• Coordination of all appropriate personnel (Microbiology Specialists, Med Ops, ECLSS) shall occur to determine appropriate remediation operations.</td></tr>
<tr><td>Photo / TV Requirements:</td><td colspan="5">If microbial counts exceed the specifications in as specified in the ISS MORD, then:
A request for contingency video/digital photography downlink of the sample shall be requested. NASA/JSC microbiologists microbiologists shall evaluate, by visual inspection, the microbial risk.</td></tr>
<tr><td>Mission Extension Requirements:</td><td colspan="5">N/A</td></tr>
<tr><td>Data Delivery</td><td colspan="5">If sample results exceed specified acceptability limits as indicated in the ISS MORD and SODF procedures, the results shall be called down to the ground at the first available communication opportunity.

Results from real-time surface samples are downlinked to the ground at the first available opportunity and are delivered to the Microbiology Laboratory as soon as possible. A preliminary report is delivered to the Crew Surgeon and all appropriate personnel within 1 business day from the receipt of data.

Comprehensive final report – See Table 3.6 Postflight Activity Data Delivery</td></tr>
</table>

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name
Microbial Air Sampler (MAS) Kit
Petri Dish Packet
Incubation Bag

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES

Postflight Activity Description:	Sample destow and return to JSC.		
Constraints/Special Requirements:	Microbial Air Sampler Kit needs to be returned to JSC Microbiology Lab within 24 hours after destow. Stowage temperatures during transport must be between +2ºC to +8ºC.		
Early Destow / Early Return:	N/A.		
Notes:	None		
Data Delivery:	**Data/Report to Designated Recipient (Nominal/Contingency)**	**Mission Summary Report**	**Data Archives**
	An interim report from the final in-flight samples returned for further analysis will be submitted via Mission Integration Coordinator to Crew Surgeon within 7-10 days following sample receipt in the laboratory. If a clinically significant organism is observed upon completion of the analysis, an interim report will be delivered to the Crew Surgeon within 48 hours following sample receipt in the laboratory.	A comprehensive final report of the ISS microbial environment will be submitted via Mission Integration Coordinator to the Crew Surgeon and all appropriate personnel no later than R+3 months following completion of the expedition if requested. The report will include the results of crew data, air, surface, and water sampling.	Electronic report available through computer inquiry linked to the laboratory information system

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training					
EHS Microbiology Ops & Interpretation Inexperienced crewmember -OR- Experienced crewmember	 90 min 75 min	Trip 2A7	N/A	Crewmember(s)/ Instructor	None
Preflight					
ISS Module Air Sampling	≤2 hours	15-20 days before element close-out is preferred	N/A	JSC Microbiology Laboratory Personnel	The module shall be as close to final configuration as possible. Airflow is desired but not required.
In-Flight					
Unstow/Stow MAS Kit Sample Collection using media plate	15 min 15 min/sample	Once every 3 months in each module (Lab, Nodes 1,2, and 3, Columbus, JEM PM)	N/A	1 Crewmember	-Samples will be incubated for a total of 5 days after sample collection. -Total time will depend upon number of modules to be sampled. -If possible, sampling should be performed on the same day as surface sampling.
Visual Analysis (colony count) Unstow Read media plate & record visual count Stow	 5 min 2 min/ Petri Dish 10 min	At T.0+5 days post-sampling	T.0+5 days can be read between 5 & 6 days	1 Crewmember	-Total time will depend upon number of samples to be analyzed. -If sample results exceed acceptability limits, the results shall be voiced to the ground at the earliest opportunity.
Photo of media plate (Contingency only)	10 min	**Contingency only** (Digital Photography)	N/A	1 Crewmember	Required when specified acceptability limits are exceeded during Visual Analysis.
Postflight: N/A					
Postflight Debrief:					
Debrief	No extra time	~R+30 days	N/A	Crewmembers/ Microbiology Team	Included as part of the Med Ops overall debrief.