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:	• 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:	5A.1 & subs
Number and Type of Crew Members Required:	Nominally, two ISS crewmembers are trained, of which one crewmember is operator. Due to condensed training schedules, only one crewmember may be trained (per CB office request).
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, two crewmembers will be trained, one of which will be operator. Due to condensed training schedules, only one crewmember may be trained (per CB office request).</td></tr>
<tr><td rowspan="2">Schedule:</td><td>Duration:</td><td>Schedule:</td><td colspan="2">Personnel Required:</td></tr>
<tr><td>EHS Microbiology Operations & Interpretation – 120/60 min.

Inexperienced crewmember 120 min training:
10 min - Micro. Intro & Overview
15 min - Introduction to hardware
55 min – Perform sample collection
30 min – Review examples of growth on media
10 min - Review & summarize all micro/answer questions
-OR-
Experienced crewmember – 60 min training
5 min – Micro. Intro & Overview
40 min – Perform sample processing
10 min – Review examples of growth on media
5 min – Review & summarize all micro/answer questions</td><td>L-12 months</td><td colspan="2">Crewmember(s)/Instructor</td></tr>
<tr><td>Ground Support Requirements
Hardware/Software</td><td>Preflight Hardware:</td><td>Preflight Software:</td><td colspan="2">Test Location:</td></tr>
<tr><td></td><td>Microbial Air Sampler (MAS) Kit
Medical Equipment Computer (MEC)</td><td>Microbiology Data Entry Software</td><td colspan="2">U.S.</td></tr>
<tr><td rowspan="4">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>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 rowspan="2">Preflight Activity Description:</td><td colspan="4">ISS Module Preflight Air Sampling - Microbiological sampling of air in specified habitable flight elements shall be performed 15-20 days before final closeout per table in the ISS MORD. This allows time for completion of analyses (quantification and identification), reporting of results, and performance of any remediation activities that may be required. JSC Microbiology Laboratory personnel will travel to KSC for collection of samples and delivery of samples to JSC for processing. Standard laboratory procedures are used to quantify and identify bacteria and fungi.</td></tr>
<tr><td>Schedule:</td><td>Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td></td><td>ISS Module Air Sampling ≤ 2 hrs.</td><td>15-20 days before final module close-out</td><td>N/A</td><td>JSC Microbiology Laboratory Personnel</td></tr>
<tr><td rowspan="2">Ground Support Requirements Hardware/Software</td><td colspan="2">Preflight Hardware:</td><td colspan="2">Preflight Software:</td><td>Test Location:</td></tr>
<tr><td colspan="2">Microbial Air Sampler III</td><td colspan="2">N/A</td><td>U.S.</td></tr>
<tr><td rowspan="4">Testing Facilities</td><td>Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td>Special Lighting:</td></tr>
<tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td>Vibration/Acoustic Isolation:</td><td>Other:</td></tr>
<tr><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="4">• 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="4">None</td></tr>
<tr><td>Notes:</td><td colspan="4">All samples 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: L-2 weeks</td></tr>
<tr><td rowspan="2">Data Delivery</td><td colspan="4">Data/Report to Designated Recipients (Nominal/Contingency):</td></tr>
<tr><td colspan="4">A final report will be delivered to the Crew Surgeon and all appropriate personnel within 10 days after receipt of samples in the laboratory.</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="4">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. Initially, sampling will occur once during the first six weeks in order to establish a baseline evaluation of the microbial environment. Thereafter, 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="3">Schedule:</td><td>Activity:</td><td>Duration:</td><td>Schedule:</td><td>Personnel Required:</td></tr>
<tr><td>Unstow/stow Microbial Air Sampler Kit</td><td>15 min.</td><td rowspan="2">1 sample collection during first 6 weeks in each new module; once every 3 months in each module thereafter. (Two samples per module)</td><td rowspan="2">1 crewmember</td></tr>
<tr><td>Sample Collection using media plates</td><td>15 min./sample</td></tr>
<tr><td>Procedures:</td><td colspan="4">Procedures are located in the System Operations Data file (SODF) Procedures Database Med Ops Book:
• Microbial Air Sampler – Sample Collection</td></tr>
<tr><td>Constraints / Special Requirements:</td><td colspan="4">• If possible, sampling should be performed on the same day as surface sampling.
• Total time will depend upon number of modules to be sampled.
• Bacterial samples are stowed in an incubation bag and placed in a warm environment (25°-37° C) or placed back into the MAS Kit.
• Fungal samples are placed back into the MAS Kit and stowed at ambient temperatures.
• Crew Surgeon may request additional samples if warranted.</td></tr>
<tr><td>Photo / TV Requirements:</td><td colspan="4">N/A</td></tr>
<tr><td>Cold Stowage Requirements:</td><td colspan="4">When refrigeration becomes available, all consumables and archived samples will be stowed at temperatures between +2°C to +8°C.</td></tr>
<tr><td>Mission Extension Requirements:</td><td colspan="4">None</td></tr>
<tr><td>Landing Wave-Off Requirements:</td><td colspan="4">None</td></tr>
<tr><td>Notes:</td><td colspan="4">• Until the time when appropriate trash disposal containers become available, all samples are stored in their respective kits and returned to ground for further analysis.
• On-Board Computer-Based Training (CBT) is available for crewmembers, if desired.
• Extra media plates are available in the MAS kit, if needed.</td></tr>
<tr><td rowspan="2">Data Delivery</td><td colspan="4">Data/Report to Designated Recipients (Nominal/Contingency):</td></tr>
<tr><td colspan="4">N/A</td></tr>
</table>

TABLE 3.5.1b: In-Flight Activities - Visual Analysis

<table>
<tr><td rowspan="5">In-Flight Activity Description:

Schedule:</td><td colspan="5">Visual Analysis of Colony Counts of the media plates. Colony counts will be performed 5 days post-collection for bacterial samples, and 5 days post-collection for fungal samples. The results will be recorded on data sheets.</td></tr>
<tr><td>Activity:</td><td>Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td>Unstow

Read media plate & record visual count

Stow

Photo of media plate</td><td>5 min

2 min/Petri dish (number of samples depends upon number of modules sampled)

10 min

10 min</td><td>At T.0+5 days post-sampling

Contingency only</td><td>T.0+5 days can be read between 5 & 6 days

N/A</td><td>1 crewmember

1 crewmember</td></tr>
<tr><td>Procedures:</td><td colspan="4">Procedures are located in the Systems Operations Data File (SODF) Procedures Database Med Ops Book:
• WMK/SSK/MAS Visual analysis and Data Recording</td></tr>
<tr><td>Constraints / Special Requirements:</td><td colspan="4">• If the bacterial count matches level 4 or above on the Colony Density Chart (found in MAS Kit) or the fungal count matches level B, C or E on the Colony Density Chart, then results will be voiced down at the next available opportunity.
• A request for contingency video/digital photography downlink of the sample shall be submitted. NASA and RSA microbiologists shall evaluate, by visual inspection, the microbial risk.
• The NASA and RSA microbiologists will notify the Increment Crew Surgeon of their evaluation.
• An attempt to identify the source of the contamination shall be performed. Resampling of the affected module shall 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="4">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 and RSA microbiologists shall evaluate, by visual inspection, the microbial risk.</td></tr>
<tr><td>Mission Extension Requirements:</td><td colspan="4">N/A</td></tr>
<tr><td rowspan="2">Data Delivery</td><td colspan="4">Data/Report to Designated Recipients (Nominal/Contingency):</td></tr>
<tr><td colspan="4">N/A</td></tr>
</table>

In-Flight Activities, (continued)

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N
Microbial Air Sampler (MAS) Kit	SEG46117227-XXX

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:	• Early Destow from Orbiter should be within R+3 hrs of landing. • Early Return to JSC should be within 24 hrs after landing.		
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. 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	 120 min 60 min	L-12 months	N/A	Crewmember(s)/ Instructor	None
Preflight					
ISS Module Air Sampling	≤2 hours	15-20 days before final module close-out	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	1 sample session during the first 6 weeks in each new module; once every 3 months in each module thereafter. (Two samples per module)	N/A	1 Crewmember	-If possible, sampling should be performed on the same day as surface sampling. -Crew Surgeon may request additional samples if warranted by the data.
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.