

MR051L Microbial Analysis of ISS Water Using the EHS Water Kit

3.2 MEDICAL REQUIREMENTS OVERVIEW

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title	MR051L Microbial Analysis of ISS Water Using the EHS Water Kit
Sponsor	Medical Operations
Discipline	Environmental Health
Category	Medical Requirements (MR)
References	SSP 50260, ISS Medical Operations Requirements Document (MORD) SSP 41000, System Specification for the International Space Station
Purpose/Objectives	To check for the presence of microbial contaminants in the potable water provided for crew use on the ISS and verify compliance with established water quality requirements.
Measurement Parameters	The detection of coliforms and enumeration of microorganisms in ISS potable water Preflight, In-Flight, and Postflight: <ul style="list-style-type: none"> • See SSP 50260, section 7.4.5 and Table D-7 for microbial specifications and monitoring requirements of ISS water
Deliverables	<ul style="list-style-type: none"> • Preflight evaluation of the microbiological content of potable water delivered to the ISS • In-flight evaluation of microbiological content of potable water by quantification of bacteria, and determination of presence or absence of coliform bacteria • Postflight report of microbiological content of archive water samples collected from the Russian and U.S. On-Orbit Segments
Flight Duration	≥ 30 days
Number of Flights	All flights
Number and Type of Crewmembers Required	One crewmember as operator
Other Flight Characteristics	N/A

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3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description	Selected crew will be trained to evaluate the microbial content of water on board ISS. Sample processing will be performed by crewmembers, with instructor guidance and supervision. EHS Microbiology Operations introduces the analysis and allows crewmembers time to work through the process, asking any questions. EHS Water Sim incorporates the microbial analysis activity into the longer water day timeline. Nominally one to two crewmembers will be trained.		
	Schedule	Duration:	Schedule:	Personnel Required:
		EHS Microbiology Operations Training (Micro Ops) - 90/75 min -Inexperienced crewmember - 90 min training -Experienced crewmember – 75 min training	Trip 2A7	Crewmembers/Instructors
		EHS Water Sim – 180 min training	Trip 2A9	Crewmembers/Instructors
Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:	Test Location:
	EHS Water Kit containing: Water Sample Collection Packet (WSCP) Microbial Analysis Packet (MAP) Non-Consumables Items Assembly		N/A	U.S.
Training Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	EHS Micro Ops: 8' x 10' EHS Water Sim: Bldg 9 SSTF	One (110 volt AC)	Ambient	N/A
	Hot or Cold Running Water:	Privacy Requirements:	Other:	
	N/A	N/A	Absorbent towels to collect spillage, if necessary	
Constraints/Special Requirements	EHS Water Sim takes place in the Space Station Training Facility in Building 9.			
Launch Delay Requirements	Refresher training will be conducted if currency (18 mos) expires or at crewmember request. The ISS Training Manual defines the training format for experienced crewmembers.			
Notes	Experienced crewmembers: Assigned expedition crewmembers who have worked onboard ISS.			

3.4 Preflight Activities – No crew time

TABLE 3.4: PREFLIGHT ACTIVITIES

Preflight Activity	Description	Ground Supplied Water (Russian, JAXA, and Commercial Spaceflight Vehicles): Prior to launch water samples are collected and analyzed to determine if the ground-supplied water meets applicable requirements. These data are used to verify that system-servicing procedures were properly performed and that the water transferred to ISS is safe for crew consumption
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Schedule	Duration:	Schedule:	Flexibility:	Personnel Required:
	Collection of water samples – vehicle-dependent	Vehicle Specific	N/A	Vehicle specific
Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:	Test Location:
	Ground Servicing Equipment		None	Vehicle specific
Testing Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	Hot or Cold Running Water:	Privacy Requirements:	Vibration/Acoustic Isolation:	Other:
	Water for hand-washing	None	N/A	N/A
Constraints/Special Requirements	None			
Launch Delay Requirements	N/A			
Notes	None			
Data Delivery	Reports from preflight microbial analysis of water samples will be provided by the appropriate agency to JSC Microbiology Laboratory personnel as soon as results are available.			

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3.5 In-Flight Activities

TABLE 3.5.1a: IN-FLIGHT ACTIVITIES – POTABLE WATER COLLECTION

In-Flight Activity	Description	In-flight water quality monitoring activities include the collection of water samples from the U.S. and Russian water systems on the ISS. Samples will be collected for in-flight quantification of bacteria, in-flight detection of the presence/absence of coliform bacteria, and comprehensive post-flight microbiological evaluation.												
	Schedule	<table border="1"> <thead> <tr> <th>Activity</th> <th>Duration</th> <th>Schedule</th> <th>Flexibility</th> <th>Personnel Required</th> </tr> </thead> <tbody> <tr> <td>Water sample collection</td> <td> <p>For PWD: Unstow EHS Water Kit Packets 15 min Disinfect needle/ Collect Sample 10 min/sample Tear down/stow 15 min</p> <p>For Russian Segment: Unstow EHS Water Kit Packets 15 min SRV-K heating cycle 20 min/ 525 mL Disinfect port/Collect Sample 10 min/sample Collect Sample 10 min/sample Tear down/Stow 15 min</p> </td> <td> <p>See SSP 50260, Table D-3, ISS U.S. On Orbit Segment Water Sampling and Analysis Schedule</p> <p>See SSP 50260, Table D-2, ISS Russian Segment Water Sampling and Analysis Schedule</p> <p>Number of samples to be collected is specified in the procedure.</p> </td> <td>Contact Lab</td> <td>1 Crewmember</td> </tr> </tbody> </table>	Activity	Duration	Schedule	Flexibility	Personnel Required	Water sample collection	<p>For PWD: Unstow EHS Water Kit Packets 15 min Disinfect needle/ Collect Sample 10 min/sample Tear down/stow 15 min</p> <p>For Russian Segment: Unstow EHS Water Kit Packets 15 min SRV-K heating cycle 20 min/ 525 mL Disinfect port/Collect Sample 10 min/sample Collect Sample 10 min/sample Tear down/Stow 15 min</p>	<p>See SSP 50260, Table D-3, ISS U.S. On Orbit Segment Water Sampling and Analysis Schedule</p> <p>See SSP 50260, Table D-2, ISS Russian Segment Water Sampling and Analysis Schedule</p> <p>Number of samples to be collected is specified in the procedure.</p>	Contact Lab	1 Crewmember		
Activity	Duration	Schedule	Flexibility	Personnel Required										
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Procedures	<p>Sample collection procedures are based on published procedures, but are customized for each sampling session.</p> <p>Russian Water Sampling: SM procedures are located in the Russian Operation Date File (RODF):</p> <ul style="list-style-type: none"> • 2.1.12.4 Water Sampling from Potable Water Container using U.S. Water Samplers • 2.1.12.3 Water Sampling from EDV using U.S. Water Sampler <p>U.S. Water Sampling: PWD water collection procedure is located in the Systems Operation Data File (SODF) Med Ops book:</p> <ul style="list-style-type: none"> ▪ Potable Water Dispenser – Water Sample Collection 													
Constraints / Special Requirements	<p>Potable Water Collection from SM and PWD</p> <ul style="list-style-type: none"> ▪ When microbiology samples are collected in conjunction with chemical sample, only 15 min of unstow time and 15 min of stow time is required. ▪ Microbiological & chemical water samples to be done in the same session 													

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	<ul style="list-style-type: none"> ▪ Samples from SVO-ZV are collected during SRV-K heating cycles ▪ Archive samples from SRV-K will require additional heating cycles for volumes exceeding 525mL ▪ Real-time changes to the sampling schedule & frequency may be made depending on priorities and water systems performance. ▪ Samples collected from the U.S. and Russian hot water ports should cool for 1 hr before processing.
Photo / TV Requirements	N/A
Cold Stowage Requirements	N/A
Mission Extension Requirements	N/A
Data Delivery	N/A

TABLE 3.5.1b: IN-FLIGHT ACTIVITIES – IN-FLIGHT WATER SAMPLING/MCD PROCESSING/COLIFORM DETECTION PROCESSING

In-Flight Activity	Description	<u>In-flight Water Sampling/MCD Processing/Coliform Detection Processing</u> - The Microbial Analysis Packet and the Non-Consumables Items Assembly are used to process potable and stored water samples for microbial analysis. Microbiology samples are collected at the same time that samples are collected for chemical analysis. Samples will be processed for the evaluation of the level of heterotrophic bacteria with one Microbial Capture Device (MCD) and one Coliform Detection Bag processed per sample. Waste water from on-orbit analyses and unused samples not designated for archive will be disposed of on-orbit.			
	Schedule	Activity & Duration	Schedule	Flexibility	Personnel
		MCD Processing Sample (1 MCD/sample) 10 min	IDRD Annex 4, Table 3.4- 1	Processing to be done no sooner than 1 hour after collection for samples collected from hot ports but within 6 hours of potable water sample collection for all ports.	1 crewmember
		Coliform Detection Processing Sample (1 coliform bag/sample) 10 min			
Procedures	Procedures are located in the System Operations Data File (SODF) Med Ops Book <ul style="list-style-type: none"> • 2.6.150 EHS Microbiology In-Flight Water Processing and Coliform Detection 				
Constraints / Special Requirements	<ul style="list-style-type: none"> • Stowage time is bookkept in water collection activities. • Processing of in-flight Micro Sample Analysis Bags needs to be done no sooner than 1 hour after collection for samples collected from hot ports but no later than 6 hours after sample collection for all ports. • Visual analysis of MCDs & data recording should be done after 48 hours of incubation • Visual analysis of Coliform Detection Bags should be done after 48 hours of incubation. 				
Photo / TV Requirements	<p>In the event that a heterotrophic bacteria acceptability limit is exceeded, contingency digital photography downlink of the sample (MCD) may be requested by ground-control.</p> <p>In the event that a Coliform Detection Bag is positive, contingency digital photography downlink of the sample may be requested by ground-control.</p>				

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Cold Stowage Requirements	All microbiology kits should be stored at coolest temperature location possible.
Mission Extension Requirements	N/A
Notes	<ul style="list-style-type: none"> Late access for hardware: L-2 weeks When analytical results for in-flight water quality samples exceed the specified limits, remediation actions may be initiated. Follow-up samples may be taken and analyzed to ensure any remediation actions that were performed were successful. On-Board Computer-Based Training (CBT) is available for crewmembers. Date & sample source should be recorded on MCD. Results are called down or recorded in crew notes, and/or IPV.
Data Delivery	N/A

TABLE 3.5.1c: IN-FLIGHT ACTIVITIES – MICROBIOLOGY ANALYSIS FOR COLONY COUNT ON THE MCDs and COLIFORM DETECTION BAGS

In-Flight Activity	Description	<u>Microbiology analysis for Colony Count on the Microbial Capture Devices (MCDs)</u> . Colony counts are performed after T.0+2 days of incubation. Results are called down, recorded in crew notes, and/or IPV		
	Schedule	<u>Microbiology analysis for Coliform Detection Bags</u> . Color determination of fluid in Coliform Detection Bags is performed after 40-48 hours of incubation. Results are called down, recorded in crew notes, and/or IPV		
		Activity & Duration	Schedule	Flexibility
		Unstow 5 min Read MCD & record colony count 5 min/MCD Read Coliform Detection Bag 5 min/bag Stow 20 min	At T.0+2 days post-sampling	MCDs: T.0+2 days can be read between 36 & 72 hours Coliform Detection Bags: MUST be read between 40 & 48 hours incubation time
		Photo of samples: 10 min	Contingency only	As requested
	Personnel Required	1 Crewmember		
Procedures	Procedures are located in the System Operations Data File (SODF) Med Ops Book <ul style="list-style-type: none"> 2.7.610 Microbiology Visual Analysis and Data Recording 			
Constraints / Special Requirements	If MCD analysis results are unable to be quantified or above limits, digital imaging, repeat sampling, and/or remediation may be required. If Coliform Detection Bag is positive, digital imaging, repeat sampling, and/or remediation may be required.			
Photo / TV Requirements	A request for contingency digital photography downlink of the sample (MCD or Coliform Detection Bag) may be requested by ground control if sample results if results are unable to be quantified.			
Cold Stowage Requirements	Archived samples shall be stowed at coolest temperature location possible.			
Mission Extension Requirements	N/A			
Landing Wave-Off Requirements	N/A			
Data Delivery	Visual analysis data (negative or positive results) must be entered into crew notes section of OSTPV, XML downlink or called down to MCC-H.			

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TABLE 3.5.1d: IN-FLIGHT ACTIVITIES – CONTINGENCY WATER RECLAMATION

In-Flight Activity	Description	Contingency Water Reclamation – In an off-nominal situation, water samples will be collected and returned to ground if space is available on Soyuz/COTS. If samples cannot be returned, they may be reclaimed for water conservation.		
	Schedule	Activity & Duration	Schedule	Personnel Required
		Unstow 15 min	As needed	1 Crewmember
		Reclaim Sample 5 min/sample		
		Stow 15 min		
Procedures	Procedures are located in the System Operations Data File (SODF) Med Ops Book <ul style="list-style-type: none"> Water Inventory Conservation for Water Bags 			
Constraints / Special Requirements	N/A			
Photo / TV Requirements	N/A			
Data Delivery	N/A			

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name
EHS Water Kit
Water Sample Collection Packet (WSCP) (Shared with MR054L)
Microbial Analysis Packet (MAP)
Non-Consumables Items Kit

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3.6 Postflight Activities – No crew time

TABLE 3.6: POSTFLIGHT ACTIVITIES

Postflight Activity	Description	No crew time. <u>Destow and return of samples to JSC</u> : Comprehensive microbial analyses will be performed on returned archive water samples at JSC Microbiology Laboratory. Identification of isolates will be performed on returned MCDs. Coliform Detection Bags are not returned.			
	Schedule	Duration	Schedule	Flexibility	Personnel Required
		Vehicle dependent	Vehicle dependent	N/A	JSC Personnel
Ground support Requirements Hardware/Software	Postflight Hardware	Postflight Software		Test Location	
	N/A	N/A		N/A	
Testing Facilities	Minimum Room Dimensions	Number of Electrical Outlets		Temperature Requirements	Special Lighting
	10' x 15'	4		Ambient	N/A
	Hot or Cold Running Water	Privacy Requirements		Vibration/Acoustic Isolation	Other
	Water for hand-washing	None		N/A	N/A
Constraints/Special Requirements	Returned water samples should be maintained between 2°C - 10°C and temperatures shall be monitored during storage and transport.				
Early Destow/Early Return	Early destow of water samples and return to JSC is requested.				
Notes	Microbial isolates from in-flight water samples will be identified by standard laboratory methods. Archived water samples will be analyzed for the quantification and identification of bacteria.				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):		Mission Summary Report:		Data Archives:
	<p>Nominal: A report from the final in-flight samples returned for further analysis is submitted to the Crew Surgeon within 7-10 days following sample receipt in the laboratory.</p> <p>Contingency: 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.</p>		<p>A comprehensive final report of the ISS microbial environment is submitted to the Crew Surgeon and all appropriate personnel approximately 3 months following completion of the Increment if requested. This report will include the results of air, surface, and water sampling data.</p>		<p>Electronic report available through computer inquiry linked through the laboratory information system.</p>

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3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training				
EHS Microbiology Operations Training & Interpretation		Trip 2A7	Crewmember/ Instructor	EHS Water Sim takes place in the Space Station Training Facility in Building 9.
Inexperienced crewmember: -OR- Experienced crewmember:	90 min 75 min			
EHS Water Sim	180 min	Trip 2A9	Crewmember/ Instructor	
Preflight Activity - No crew time				
Collection of water samples	Vehicle dependent	Vehicle dependent	Vehicle dependent	None

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In-flight Activity				
<u>Potable Water Collection</u> Potable Water Dispenser: Unstow EHS Water Kit Disinfect needle/Collect Sample Tear down/Stow	15 min 10 min 15 min	See SSP 50260, Appendix D-3, ISS U.S. On Orbit Segment Water Sampling and Analysis Schedule	1 CM	Potable Water Collection from SM and PWD <ul style="list-style-type: none"> ▪ When microbiology samples are collected in conjunction with chemical sample, only 15 min of unstow time and 15 min of stow time is required. ▪ Microbiological & chemical water samples to be done in the same session ▪ Water samples collected from the SRV-K, SVO-ZV, and PWD with SVO-ZV collected during SRV-K heating cycles ▪ Archive samples from SRV-K will require additional heating cycles for volumes exceeding 525mL ▪ Service Module table may be used for kit location during water collection from SRV-K & SVO-ZV ▪ Record or call-down results after each analysis ▪ Real-time changes to the sampling schedule & frequency shall be made by recommendations from US and Russian water experts (depending upon real-time flight necessities and water systems performance).
<u>Russian Segment</u> Unstow EHS Water Kit SRV-K heating cycle Disinfect port/Collect Sample Tear down/Stow	15 min 20 min/525mL 10 min/port 15 min	See SSP 50260, Appendix D-2, ISS Russian Segment Water Sampling and Analysis Schedule Number of samples to be collected is specified in the procedure.		

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ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
In-Flight Activities (continued)				
Processing (1 MCD/ sampling) 1 Coliform Detection Bag/ sampling	10 min 10 min	Per IDRD Annex 4, Table 3.4-1	1 CM	-Processing of in-flight Micro Sample Analysis Bags needs to be done no sooner than 1 hour after collection for hot port but no later than 6 hours after sample collection for all ports. -Visual analysis of MCDs/Coliform Detection Bags & call down should be done after 44± 4 hours hrs of incubation. - Stowage time is bookkept in water collection activities.
<u>Microbiology analysis for Colony Counts on MCDs, Coliform Detection Bags</u> Unstow Read MCD & record colony count Read Coliform Detection Bag & record results Stow	5 min 5 min/MCD 5 min/bag 20 min	For MCD - At T.0+2 days post-sampling For Coliform Detection Bag – 40-48 hours post-sampling	1 CM	-If MCD sample results are unable to be quantified or above limits, digital imaging, repeat sampling, and/or remediation may be required. If Coliform Bag is positive, digital imaging, repeat sampling, and/or remediation may be required.
Contingency Water Reclamation	Unstow 10 min Sample 5 min Stow 5 min	As needed	1 Crewmember	None
Photo of samples (Digital Photography)	10 min	**Contingency only**	1 Crewmember	<ul style="list-style-type: none"> If MCD/Coliform Detection analysis results are above specified limits, photo document. Repeat sampling and/or remediation may be required.
Postflight - No crew time				
Destow & return of samples to JSC (No crew time)	Vehicle dependent	Vehicle dependent	JSC Personnel	Returned water samples should be maintained between 2°C - 10°C and temperatures shall be monitored during storage and transport. Early destow of water samples and return to JSC is requested.
Postflight Debrief				
Debrief	No extra time	~R+30 days	Crewmembers/ Microbiology Team	Included as part of the Med Ops overall debrief.