

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

3.2 MEDICAL REQUIREMENTS OVERVIEW

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title	MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit
Sponsor	Medical Operations
Discipline	Environmental Health
Category	Medical Requirements (MR)
References	SSP 50260 <u>ISS Medical Operations Requirements Document</u> (ISS MORD)
Purpose/Objectives	To monitor the microbial quality of water that is provided for crew use and consumption and determine compliance to the existing acceptability limits established for ISS water as specified in SSP 41000 System Specifications for ISS.
Measurement Parameters	Detection and enumeration of microorganisms in ISS potable water from preflight and in-flight sampling activities and postflight analysis.
Deliverables	<ul style="list-style-type: none"> • Report of in-flight and ground-based evaluation of microbiological content of potable water by quantification and identification of bacteria, and for determination of presence or absence of coliform bacteria • Report of postflight analyses of samples collected in-flight.
Flight Duration	≥ 30 days
Number of Flights	All flights
Number and Type of Crewmembers Required	Nominally two crewmembers are trained, of which one crewmember is operator. Due to condensed training schedules, only one crewmember may be trained (per CB office request). In-Flight: one operator required
Other Flight Characteristics	N/A

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description	<u>EHS Microbiology Operations Training & Interpretation</u> : Selected crew will be trained to evaluate the microbial content of water on board ISS. Processing, sample analysis, data entry, and proper stowage will first be demonstrated and then performed by crewmembers, as well as the review of the in-flight collection schedule. 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)		
	Schedule	Duration: EHS Microbiology Operations Training & Interpretation – 120/60 min <u>Inexperienced crewmember - 120 min training:</u> 10 min - Micro. Intro & Overview 15 min - Introduction of hardware 55 min – Perform sample processing 30 min – Review examples of growth 10 min - Review & summarize all micro/answer questions -OR- <u>Experienced crewmember - 60 min training:</u> 5 min - Micro. Intro & Overview 40 min – Perform sample processing 10 min – Review examples of growth 5 min - Review & summarize all micro/answer questions	Schedule: L-12 months	Personnel Required: Crewmembers/Instructors
Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:	Test Location:
	Water Microbiology Kit (WMK) Medical Equipment Computer (MEC) Microbiology Water Analysis Kit (MWAK) Water Sampler Collection Kit (WSCK)		Microbiology Data Entry Software	U.S.
Training Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	8' x 10'	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	None			
Launch Delay Requirements	Training will be repeated if requested by the crewmember.			
Notes	Experienced crewmembers: Those crewmembers who have had previous training within the last 1½ yrs.			

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

3.4 Preflight Activities – No crew time

TABLE 3.4: PREFLIGHT ACTIVITIES

Preflight Activity	Description	No crew time involved. <u>Collection of Water Samples</u> : Samples of ground-supplied water will be taken by KSC personnel prior to launch during preparation of the Shuttle water systems for flight to ISS. KSC personnel perform colony counts; any microbial isolates recovered are shipped to JSC Microbiology Laboratory for identification. The results will be used to verify that ground-supplied potable water is within specified limits. This data will also be used to verify that system-servicing procedures were properly performed.			
	Schedule	Duration:	Schedule:	Flexibility:	Personnel Required:
		Collection of water samples – Approx. 2 hrs	At time of servicing L-15 days L-3 days	N/A	KSC/JSC Personnel
Ground Support Requirements Hardware/Software	Preflight Hardware:	Preflight Software:		Test Location:	
	Ground Servicing Equipment	None		U.S.	
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	Repeat Shuttle L-3 days sampling if launch is delayed beyond 3 days				
Notes	None				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):				
	Reports from preflight microbial analysis of water samples will be provided by KSC to JSC Water Quality personnel within 48 hours after sampling.				

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

3.5 In-Flight Activities

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

In-Flight Activity	Description	<p><u>Potable Water Collection:</u> Water samples will be collected from the Russian water systems located in the Service Module. When the U.S. water reclamation system becomes operational, then both systems will be sampled throughout the life of the Station. Designated samples will be archived and returned to ground for postflight analysis. The ISS MORD contains the detailed sampling schedule for both Russian and U.S. segments.</p> <p>Water samples will be taken from three locations in the Russian Segment for Microbiology analyses: SRV-K (hot water tap), SRV-K (warm water tap), and SVO-ZV. Hot water samples should cool for 1 hr before processing. Date, time and sampling location will be recorded on sample bag.</p> <p>In addition to samples that are collected for in-flight processing, an archive sample(s) is collected during, or as close as possible to the docked phase of Shuttle missions. The archive water samples are stowed at temperatures as cool as possible (until the availability of refrigeration) for return to ground for complete processing and analysis. Microbial archival water collection will be dependent upon Shuttle schedule. In a contingency water samples will be returned, if space available, on Soyuz.</p>														
	Schedule	<table border="1"> <thead> <tr> <th>Activity & Duration</th> <th>Schedule</th> <th>Flexibility</th> <th>Personnel Required</th> </tr> </thead> <tbody> <tr> <td>Unstow WMK and Microbiology Water Analysis Kit</td> <td rowspan="5">Per ISS MORD Water Sampling Tables</td> <td rowspan="5">N/A</td> <td rowspan="5">1 ECLSS Crewmember</td> </tr> <tr> <td>SRV-K heating cycle</td> </tr> <tr> <td>Disinfect port, collect flush</td> </tr> <tr> <td>Collect Sample</td> </tr> <tr> <td>Stow WMK and Microbiology Water Analysis Kit</td> </tr> </tbody> </table>	Activity & Duration	Schedule	Flexibility	Personnel Required	Unstow WMK and Microbiology Water Analysis Kit	Per ISS MORD Water Sampling Tables	N/A	1 ECLSS Crewmember	SRV-K heating cycle	Disinfect port, collect flush	Collect Sample	Stow WMK and Microbiology Water Analysis Kit		
Activity & Duration	Schedule	Flexibility	Personnel Required													
Unstow WMK and Microbiology Water Analysis Kit	Per ISS MORD Water Sampling Tables	N/A	1 ECLSS Crewmember													
SRV-K heating cycle																
Disinfect port, collect flush																
Collect Sample																
Stow WMK and Microbiology Water Analysis Kit																
Procedures	<p>Procedures are located in the Russian Operations Data File (RODF)</p> <ul style="list-style-type: none"> Water Sampling from Potable Water Container using U.S. Water Samplers Water Sampling from EDV using U.S. Water Sampler 															
Constraints / Special Requirements	<ul style="list-style-type: none"> Only one flush is required/port for multiple sampling. 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 will be collected at the same time from a given port and coordinated with the collection of toxicological air samples if possible. Service Module table may be used for kit location during water collection from SRV-K & SVO-ZV. 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). 															
Photo / TV Requirements	N/A															
Cold Storage Requirements	N/A															
Mission Extension Requirements	N/A															
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):															
	N/A															

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

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

<p>In-Flight Activity</p>	<p>Description</p> <p><u>In-flight Water Sampling/MCD Processing/Coliform Detection Processing</u> - The Water Microbiology Kit (WMK) and the Water Microbiology Analysis Kit 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 collected from the Russian Segment will be processed for the evaluation of the level of heterotrophic bacteria with one Microbial Capture Device (MCD) processed per sample. Samples collected from the US Segment will be processed for the detection of the level of heterotrophic bacteria and for the presence of ‘coliform’ bacteria. Waste water from on-orbit analyses and unused samples not designated for archive will either be reclaimed on orbit or disposed of on-orbit.</p>																			
<p>Schedule</p>	<table border="1"> <thead> <tr> <th>Activity</th> <th>Duration</th> <th>Schedule</th> <th>Flexibility</th> <th>Personnel</th> </tr> </thead> <tbody> <tr> <td>In-flight Water Sampling</td> <td>Unstow 15 min</td> <td>IDRD Annex 4, Table 3.4-1</td> <td rowspan="4">Processing to be done no sooner than 1 hour after collection but within 6 hours of potable water sample collection</td> <td rowspan="4">1 ECLSS crewmember</td> </tr> <tr> <td>MCD Processing</td> <td>Sample (1 MCD/sample) 10 min</td> <td></td> </tr> <tr> <td>Coliform Detection Processing</td> <td>Sample (1 coliform bag/sample) 10 min</td> <td></td> </tr> <tr> <td>Water Reclamation</td> <td>10 min Stow 15 min</td> <td></td> </tr> </tbody> </table>	Activity	Duration	Schedule	Flexibility	Personnel	In-flight Water Sampling	Unstow 15 min	IDRD Annex 4, Table 3.4-1	Processing to be done no sooner than 1 hour after collection but within 6 hours of potable water sample collection	1 ECLSS crewmember	MCD Processing	Sample (1 MCD/sample) 10 min		Coliform Detection Processing	Sample (1 coliform bag/sample) 10 min		Water Reclamation	10 min Stow 15 min	
Activity	Duration	Schedule	Flexibility	Personnel																
In-flight Water Sampling	Unstow 15 min	IDRD Annex 4, Table 3.4-1	Processing to be done no sooner than 1 hour after collection but within 6 hours of potable water sample collection	1 ECLSS crewmember																
MCD Processing	Sample (1 MCD/sample) 10 min																			
Coliform Detection Processing	Sample (1 coliform bag/sample) 10 min																			
Water Reclamation	10 min Stow 15 min																			
<p>Procedures</p>	<p>Procedures are located in the System Operations Data File (SODF) Med Ops Book</p> <ul style="list-style-type: none"> • WMK: In-flight Water Processing • WMK: Malfunction • Microbiology Water Analysis Kit: In-Flight Coliform Detection • Water Inventory Conservation from Water Bags 																			
<p>Constraints / Special Requirements</p>	<ul style="list-style-type: none"> • If possible, water sampling should be done on the same day as air and surface sampling. • Processing of in-flight Micro Sample Analysis Bags needs to be done no sooner than 1 hour after collection but within 6 hours of sample collection. • Visual analysis of MCDs & data recording should be done after 2 days of incubation • Visual analysis of Coliform Detection Bags should be done after 40-48 hours of incubation. 																			
<p>Photo / TV Requirements</p>	<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>																			
<p>Cold Stowage Requirements</p>	<p>Until refrigeration is available, all microbiology kits should be stored at coolest temperature location possible. After refrigeration is available, all consumables and archived samples will be stowed at +4°C to +8°C.</p>																			
<p>Mission Extension Requirements</p>	<p>N/A</p>																			
<p>Notes</p>	<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. 																			

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

	<ul style="list-style-type: none"> • On-Board Computer-Based Training (CBT) is available for crewmembers. • Date & sample source should be recorded on MCD. • Results of Coliform Detection Bags are recorded on the bag label, then called to ground.
Data Delivery	<p>Data/Report to Designated Recipients (Nominal/Contingency): N/A</p>

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

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. The results are called to the ground.		
	Schedule	<u>Microbiology analysis for Coliform Detection Bags.</u> Color determination of fluid in Coliform Detection Bags is performed after T.0+2 days of incubation. Results are called to the ground.		
		Activity & Duration	Schedule	Flexibility
		Unstow 15 min Read MCD & record colony count 5 min/MCD Read Coliform Detection Bag 5 min/bag Stow 15 min	At T.0+2 days post-sampling	MCDs: T.0+2 days can be read between 36 & 72 hrs. Coliform Detection Bags: T.0+2 days MUST be read between 40 & 48 hrs.
		Photo of samples: 10 min	Contingency only	As requested
Procedures	Procedures are located in the System Operations Data File (SODF) Med Ops Book <ul style="list-style-type: none"> SSK/WMK/Microbiology Water Analysis Kit/MAS Kit Visual Analysis and Data Recording 			
Constraints / Special Requirements	If MCD sample results exceed acceptability limits, the results shall be voiced to the ground at the earliest opportunity. If MCD analysis results are above specified 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 exceed acceptability limits.			
Cold Stowage Requirements	When refrigeration becomes available, archived samples shall be stowed at temperatures between +4°C to +8°C			
Mission Extension Requirements	N/A			
Landing Wave-Off Requirements	N/A			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			
	N/A			

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

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. If samples cannot be returned, they may be reclaimed for water conservation.		
	Schedule	Duration:	Schedule:	Personnel Required:
		Unstow 15 min Sample 5 min Stow 15 min	As needed	1 Crewmember
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	Data/Report to Designated Recipients (Nominal/Contingency):			
	N/A			

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N
Water Microbiology Kit (WMK)	SED46115815-XXX
Microbiology Water Analysis Kit	SEG46119990-XXX
Water Sample Collection Kit (WSCK) (Shared with MR054L)	SEG46119987-XXX

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			
	Schedule	Duration	Schedule	Flexibility	Personnel Required
		Early destow of samples within R+3 hrs of landing	Samples returned to JSC within 24-48 hours after landing	N/A	KSC/JSC Personnel
Ground support Requirements Hardware/Software	Postflight Hardware	Postflight Software		Test Location	
		N/A		N/A	
Testing Facilities	Minimum Room Dimensions	Number of Electrical Outlets		Temperature Requirements	Special Lighting
		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	Microbial water samples should be placed on ice for transport to JSC for sample processing within 24-48 hours after landing.				
Early Destow/Early Return	Early destow from Orbiter should be within R+3 hours of landing. Early return to JSC should be within 24 to 48 hours after landing.				
Notes	Microbial isolates from in-flight water samples will be identified by standard laboratory methods. Archived water samples will be analyzed for the presence of bacteria				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):	Mission Summary Report:		Data Archives:	
	A report from the final in-flight samples returned for further analysis will be submitted to the 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 to the Crew Surgeon and all appropriate personnel approximately R+3 months following completion of the Expedition. This report will include the results of air, surface, and water sampling as well as crew data.		Electronic report available through computer inquiry linked through the laboratory information system.	

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training				
EHS Microbiology Operations Training & Interpretation		L-12 months	Crewmember/ Instructor	None
Inexperienced crewmember:	120 min			
-OR-				
Experienced crewmember:	60 min			
Preflight Activity - No crew time				
Collection of water samples (no crew time)	Approx. 2 hrs.	At Servicing L-15 days L-3 days	KSC/JSC Personnel	None
In-flight Activity				
<u>Potable Water Collection</u>			1 ECLSS CM	- Microbiological & chemical water samples will be collected at the same time from a given port and coordinated with the collection of toxicological air samples if possible.
Unstow WMK, and Microbiology Water Analysis Kit	15 min	Per ISS MORD Water Sampling Tables		
SRV-K heating cycle	20 min/525mL			-Service Module table may be used for kit location during sample collection from SRV-K & SVO-ZV.
Disinfect port/collect flush	5 min/port			
Collect Sample	10 min/port			
Stow WMK and Microbiology Water Analysis Kit	15 min			-Real-time changes to the sampling schedule & frequency shall be made by recommendations by US and Russian water experts (depending upon real-time flight necessities and water systems performance).
				-When Microbiology samples are collected in conjunction with chemical samples, only 15 min of unstow time and 15 min of stow time is required.
				-Only 1 flush is required/port for multiple sampling.

MR051L Microbial Analysis of ISS Water Using the Water Microbiology Kit (WMK) and
the Microbiology Water Analysis Kit

MR051L
SM-FI-183-R2

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
In-Flight Activities (continued)				
Unstow Processing (1 MCD/ sampling) 1 Coliform Detection Bag/ sampling Water Reclamation Stow	15 min 10 min 10 min 10 min 15 min	Per IDRDR Annex 4, Table 3.4-1	1 ECLSS CM	-If possible, water sampling should be done on the same day as air and surface sampling. -Processing of in-flight Micro Sample Analysis Bags needs to be done no sooner than 1 hour after collection but within 6 hours of sample collection. -Visual analysis of MCDs/Coliform Detection Bags & calldown should be done after 2 days/40-48 hrs of incubation.
<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	15 min 5 min/MCD 5 min/bag 15 min	At T.0+2 days post-sampling	1 ECLSS CM	-If MCD sample results exceed acceptability limits, the results shall be voiced to the ground at the earliest opportunity.
Contingency Water Reclamation	Unstow 15 min Sample 5 min Stow 15 min	As needed	1 ECLSS Crewmember	None
Photo of samples (Digital Photography)	10 min	**Contingency only**	1 Crewmember	-If MCD/Coliform Detection analysis results are above specified limits, digital imaging, repeat sampling, and/or remediation may be required.
Wheels-Stop - N/A				
Postflight - No crew time				
Destow & return of samples to JSC (No crew time)	Early destow of samples within R+3 hrs of landing	Samples returned to JSC within 24-48 hours after landing	KSC/JSC Personnel	Microbial water samples should be placed on ice for transport to JSC for sample processing within 24-48 hrs after landing.
Postflight Debrief				
Debrief	No extra time	~R+30 days	Crewmembers/ Microbiology Team	Included as part of the Med Ops overall debrief.