

3.2 Medical Requirements Overview**TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW**

MRID# and Title:	MR034L Toxicological Assessment using Volatile Organic Analyzer (VOA)
Sponsor:	Medical Operations
Discipline:	Environmental Health
Category:	Medical Requirements
References:	ISS Medical Operations Requirements Document SSP 50260
Purpose/Objectives:	To detect, identify and obtain the concentration of potentially toxic volatile organic compounds from air samples on ISS. The VOA will be used for long-term trend analysis of specific volatile organic concentrations.
Measurement Parameters:	Selected volatile organic compounds and their concentrations.
Deliverables:	Identification and quantification of target volatile organic compounds.
Flight Duration:	≥ 30 days
Number of Flights:	7A.1 and subs
Number and Type of Crew Members Required:	2 crewmembers for installation of VOA and repair/maintenance, 1 crewmember to act as operator during contingency only.
Other Flight Characteristics:	None

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description:	VOA training/familiarization will be covered under the following Environmental Health System (EHS) lessons: EHS Toxicology Operations			
	Schedule:	Duration:	Schedule:	Flexibility:	Personnel Required:
		EHS Toxicology Operations: EHS VOA Ops Experienced CM 30 min EHS VOA Ops Inexperienced CM 60 min	L-12 months	Training schedule may depend upon hardware availability.	Crewmembers/Instructors
Ground Support Requirements Hardware/Software	Preflight Hardware:	Preflight Software:	Test Location:		
	Volatile Organic Analyzer (VOA) VOA Orbital Maintainable Items (OMI) Kit VOA Sample Bag Kit	N/A	U.S		
Training Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:	
	8' x 10'	3-4 (110 VDC)	Ambient	N/A	
	Hot or Cold Running Water:	Privacy Requirements:	Other:		
	N/A	N/A	Table and 4-6 chairs (See constraints)		
Constraints/Special Requirements:	<ul style="list-style-type: none"> • Transfer of VOA needs JSC Radiation Safety Office concurrence. If VOA is to be moved offsite JSC, Form 1625 is required to transfer. • UHP (Ultra High Purity) Nitrogen must be available for VOA operation. • Continuous 120 VDC power necessary (VOA cart) 				
Launch Delay Requirements:	Training will be repeated if requested by the crewmember.				
Notes:	Experienced CM – had training within the last 1½ yrs.				

3.4 Preflight Activities

TABLE 3.4 PREFLIGHT ACTIVITIES

Preflight Activity	Description:	VOA checkout at KSC. Approximately 1 week before the VOA is loaded into MPLM; JSC personnel will run a checkout/calibrant sample run for VOA function.			
	Schedule:	Duration:	Schedule:	Flexibility:	Personnel Required:
		Set-up/Take down – approx. 2 hrs. VOA checkout/calibrant run – 4 hr	Approx. 1 week before VOA is loaded into MPLM	N/A	JSC Toxicology Personnel
Ground Support Requirements Hardware/Software	Preflight Hardware:	Preflight Software:		Test Location:	
	Volatile Organic Analyzer (VOA)	N/A		U.S/KSC	
Training Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:	
	8' x 10'	3-4 (110 VDC)	Ambient	N/A	
	Hot or Cold Running Water:	Privacy Requirements:	Other:		
	N/A	N/A	Table & 2-4 chairs		
Constraints/Special Requirements:	<ul style="list-style-type: none"> • Transfer of VOA needs JSC Radiation Safety Office concurrence. If VOA is to be moved offsite from JSC, Form 1625 is required to transfer. • UHP (Ultra High Purity) Nitrogen must be available for VOA operation. • Continuous 120 VDC power necessary (VOA cart) 				
Launch Delay Requirements:	If flight is delayed >30 days, the VOA must be removed from the MPLM and rechecked.				
Notes:	None				

In-Flight Activities

TABLE 3.5.1a: IN-FLIGHT ACTIVITIES – VOA INSTALLATION & CHECKOUT

In-Flight Activity	Description:	Installation and checkout of the VOA will be done once by the ISS crewmembers			
	Schedule:	Activity:	Duration:	Schedule:	Personnel Required:
		Activity includes the VOA removal from Multi-Payload Logistics Module (MPLM); Installation & Checkout in Lab module	120 min	Once	2 crewmembers
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book.				
Constraints / Special Requirements:	VOA will be permanently installed in the CHECS rack in Lab Module. Requires (UHP) Nitrogen carrier gas, AAA cooling, continuous 120 VDC power supply, 1553 data transfer connection				
Photo / TV Requirements:	None				
Cold Stowage Requirements:	N/A				
Mission Extension Requirements:	N/A				
Notes:	None				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency): The initial warm-up data output from the VOA will be sent to the 1553 (for downlink) connection. MCC-H will receive the data and deliver it to Toxicology within 24 hrs. The VOA data summary will be incorporated into the Toxicology report provided 3 months after the return of archival samples collected in flight. The GSC sample data will be compared with the VOA runs.				

TABLE 3.5.1b: IN-FLIGHT ACTIVITIES – VOA ACTIVATION & CHECKOUT

In-Flight Activity	Description:	Activation and checkout of the VOA will be done once by the ISS crewmembers for all expeditions with VOA resupply.			
	Schedule:	Activity:	Duration:	Schedule:	Personnel Required:
		VOA Activation & Checkout Power up Unattended Verify warm-up complete	30 min 1 hr 2 min	Activation & checkout must be performed after powering on the VOA because of a planned or unplanned power down, OMI or changeout.	1 ECLSS CM
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book: VOA - Activation & Checkout				
Constraints / Special Requirements:	Must be performed following a planned or unplanned power down				
Photo / TV Requirements:	None				
Cold Stowage Requirements:	N/A				
Mission Extension Requirements:	N/A				
Notes:	None				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency): The data output from the VOA will be sent to the 1553 (for downlink) connection				

TABLE 3.5.1c: IN-FLIGHT ACTIVITIES – VOA NOMINAL MONITORING & ANALYSIS

In-Flight Activity	Description:	Air sampling on the ISS will be once per day at the instrument location (hard –mounted in CHeCS rack). The VOA has a single inlet nozzle for sample air to be drawn in automatically from the atmosphere. The average time of operation from sample collection to data output is 4 hours. The data output will be sent to the 1553 (for downlink) connection. The VOA will be commanded from the ground.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA nominal monitoring and analysis.	0 hr crewtime 4 hr session time	Once/day
Personnel Required:				None
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book.			
Constraints / Special Requirements:	<ul style="list-style-type: none"> • Time includes sample collection and data output. • The VOA will be commanded by ground control. • Requires: (UHP) Nitrogen carrier gas, continuous 120 VDC power, AAA cooling, 1553 data transfer connection • A GSC sample collection will be coordinated with a VOA sample run on three different days during the 1st week of VOA operation. • Monthly GSC sample acquisition shall be coordinated with VOA sample run. • A bag sample from an adjacent module will be taken to check apparatus and procedure. 			
Photo / TV Requirements:	None			
Mission Extension Requirements:	N/A			
Landing Wave-Off Requirements:	N/A			
Notes:	None			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			
	The data output from the VOA will be sent to the 1553 (for downlink) connection. MCC-H will receive the data and deliver it to Toxicology within 24 hrs. The VOA data summary will be incorporated into the Toxicology report provided 3 months after the return of archival samples collected in flight. The GSC sample data will be compared with the VOA runs.			

TABLE 3.5.1d: IN-FLIGHT ACTIVITIES – VOA REMOTE SAMPLING

In-Flight Activity	Description:	Remote air sampling – Other areas of ISS can be sampled by the use of VOA Sample Bags. Once filled, the bag is attached to the nozzle inlet and an analysis can be initiated by ground or manually.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA Remote Air Sampling	30 min	Contingency, as needed, and in coordination with GSC samples taken in the SM
	Personnel Required:	1 ECLSS CM		
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book: VOA Remote Sampling.			
Constraints / Special Requirements:	If air samples are needed from a remote area other than where the VOA is installed, the crew will use the VOA sample bags to obtain air samples. Remote sample in SM should be coordinated with GSC samples in SM.			
Photo / TV Requirements:	None			
Notes:	In a contingency the VOA can be commanded from the ground or from the front panel. Requires: (UHP) Nitrogen carrier gas, continuous 120 VDC power, AAA cooling, 1553 data transfer connection			
Data Delivery	Data/Report to Designated Recipients:			
	The data output from the VOA will be sent to the 1553 (for downlink) connection.			

TABLE 3.5.1e: IN-FLIGHT ACTIVITIES – VOA MAINTENANCE

In-Flight Activity	Description:	VOA maintenance – The VOA will be maintained when the system indicates a malfunction/replacement part is necessary.			
		Activity:	Duration: (These times do not include time to remove and reinstall VOA)	Schedule:	Personnel Required:
	Schedule:	VOA removal & reinstall: VOA hard disk drive replacement Computer back-up battery replacement Cooling fan replacement: GC Fan Power Board Fan Recirculation pumps replacement Sample pumps replacement Sieve packs replacement Nitrogen scrubber replacement Inlet nozzle replacement (no VOA removal needed)	TBD 60 min 60 min 60 min 40 min 60 min 60 min 60 min 60 min 15 min	As necessary when malfunction is indicated	2 Operators
Procedures:		All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book.			
Constraints / Special Requirements:		<ul style="list-style-type: none"> Maintenance should be performed within 7 days of malfunction. The replacement of most items requires access to the interior of the VOA via special access ports; all electrical power, nitrogen input, and data interfaces must be disconnected. 			
Photo / TV Requirements:		None			
Data Delivery		Data/Report to Designated Recipients (Nominal/Contingency):			
		BME will receive call-down of restart and data. Toxicology will receive start-up data as part of nominal ops.			

TABLE 3.5.1f: IN-FLIGHT ACTIVITIES - PHOTO OF VOA ACTIVITY

In-Flight Activity	Description:	Photo documentation is required of VOA front panel screen while the hardware is in an off-nominal state.		
	Schedule:	Activity:	Duration:	Schedule:
		Photo in contingency situation	5-10 min	Contingency
Personnel Required:				1 Crewmember
Procedures:		N/A		
Constraints / Special Requirements:		N/A		
Photo / TV Requirements:		Photo should be at a distance from the VOA to get a good perspective of the surrounding area, (approximately a 2-foot perimeter around the VOA).		
Data Delivery		Data/Report to Designated Recipients (Nominal/Contingency):		
		N/A		

TABLE 3.5.1g: IN-FLIGHT ACTIVITIES - VOA UNPLANNED POWER DOWN - CONTINGENCY

In-Flight Activity	Description:	VOA Unplanned Power Down – Unplanned power down should be performed in the event of a contingency. Involves interrupting the nominal shutdown by opening the dedicated RPCM to the VOA before the nominal shutdown is complete. Unplanned power downs are instructed by MCC-H.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA Unplanned Power Down	Crew time: 05 min.	As needed
Personnel Required:				1 Crewmember
Procedures:		All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book: VOA – Unplanned Power Down		
Constraints / Special Requirements:		None		
Photo / TV Requirements:		None		
Notes:		None		
Data Delivery		Data/Report to Designated Recipients (Nominal/Contingency):		
		N/A		

TABLE 3.5.1h: IN-FLIGHT ACTIVITIES - VOA WARM-UP - CONTINGENCY

In-Flight Activity	Description:	VOA Warm Up – Warm up is necessary to warm the VOA to the operational temperature needed to perform a run. Usually occurs after VOA Activation and Checkout. Warm up takes between 20-70 minutes depending on temperature of VOA at time of warm up.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA Warm Up	Crew time: 05 min No crew time if warm-up is commanded via 1553	As needed
Personnel Required:				1 Crewmember
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book : VOA – Warm Up			
Constraints / Special Requirements:	May be needed after Activation and Checkout if VOA does not automatically perform a Warm Up.			
Photo / TV Requirements:	None			
Notes:	None			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			
	N/A			

TABLE 3.5.1i: IN-FLIGHT ACTIVITIES - VOA POWER DOWN

In-Flight Activity	Description:	VOA Power Down – VOA Power Down prepares the VOA to be turned OFF. VOA Power Down is necessary when the VOA is requested or scheduled to be powered off.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA Power Down	Crew time: 05 min	As needed
Personnel Required:				1 Crewmember
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book: VOA – Power Down			
Constraints / Special Requirements:	Controlled power down required before disconnecting power or nitrogen from VOA.			
Photo / TV Requirements:	None			
Notes:	None			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			
	N/A			

TABLE 3.5.1j: IN-FLIGHT ACTIVITIES - VOA OFF-NOMINAL POWER DOWN

In-Flight Activity	Description:	VOA Off-Nominal Power Down – Power down required before disconnecting power or nitrogen from VOA, also allows VOA ACO to be commanded from the ground without crew assistance.		
	Schedule:	Activity:	Duration:	Schedule:
		VOA Off-Nominal Power Down	Crew time: 05 min	As needed
				Personnel Required:
				1 Crewmember
Procedures:	All in-flight procedures are contained within the System Operations Data File (SODF) Med Ops book: VOA – Off-Nominal Power Down			
Constraints / Special Requirements:	VOA exhaust and inlet caps removed per procedure.			
Photo / TV Requirements:	None			
Notes:	None			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			
	N/A			

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N
Volatile Organic Analyzer (VOA)	SEG46116015-XXX
VOA Orbital Maintainable Items (OMI) Kit	SEG46116017-XXX
VOA Sample Bag Kit	SEG46116016-XXX

3.5 Postflight Activities – None

3.6 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training					
EHS Toxicology Operations: EHS VOA Ops Experienced CM EHS VOA Ops Inexperienced CM	30 min 60 min	L-12 months	Training schedule may depend upon hardware availability.	Crewmembers/ Instructors	-Transfer of VOA needs JSC Radiation Safety Office concurrence. If VOA is to be moved offsite JSC, Form 1625 is required to transfer. -UHP (Ultra High Purity) Nitrogen must be available for VOA operation.
Preflight Activity					
VOA Checkout at KSC		Approx. 1 week before VOA is loaded into MPLM	N/A	JSC Toxicology Personnel	-Transfer of VOA needs JSC Radiation Safety Office concurrence. If VOA is to be moved offsite JSC, Form 1625 is required to transfer. -UHP (Ultra High Purity) Nitrogen must be available for VOA operation. -If flight is delayed >30 days, the VOA must be removed from the MPLM and rechecked.

Table 3.7 Summary Schedule (continued)

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
In-Flight					
VOA removal from MPLM & installation & checkout in module	120 min	Once	N/A	2 crewmembers	Permanently installed in CHECS Rack in LAB Module
VOA Activation & Checkout	30 min - power up 1 hr - unattended 2 min - verify warm-up complete	Must be performed after powering on the VOA because of a planned or unplanned power down, OMI or changeout	N/A	1 ECLSS CM	Must be performed following a planned or unplanned power down.
VOA Nominal Monitoring and Analysis	0 min crew time 4 hr session time	Once/day	N/A	None	-No crew time. -Sessions are ground controlled -Time includes sample collection and data output.
VOA Remote Sampling	30 min crew time	Contingency as needed and in coordination with GSC samples taken in the SM.	N/A	1 ECLSS CM	-If air samples are needed from a remote area other than where the VOA is installed, the crew will use the VOA sample bags to obtain air samples. -Remote sample in SM should be coordinated with GSC samples in SM.

Table 3.7 Summary Schedule (continued)

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
VOA Maintenance: VOA removal from rack & reinstallation VOA hard disk drive replacement Computer back-up battery replacement Fan replacement GC Fan Power Board Fan Recirculation pumps replacement Sample pumps replacement Sieve packs replacement Nitrogen scrubber replacement Inlet nozzle replacement (no VOA removal required)	TBD 60 min 60 min 60 min 40 min 60 min 60 min 60 min 60 min 15 min	As necessary when malfunction is indicated	N/A	2 Operators	-Maintenance should be performed within 7 days of malfunction. -The replacement of most items requires access to the interior of the VOA via special access ports; all electrical power, nitrogen input, and data interfaces must be disconnected. -These times do not include removal from rack & reinstallation of VOA
Photo Documentation is required of VOA from panel screen while the hardware is in an off-nominal state	5-10 min	Contingency	N/A	1 Operator	Photo should be at a distance from the VOA to get a good perspective of the surrounding area, (approximately a 2-foot perimeter around the VOA).
VOA Unplanned Power Down – Contingency	5 min	As needed	N/A	1 crewmember	None

Table 3.7 Summary Schedule (continued)

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
VOA Warm Up – Contingency	5 min No crew time if Warm Up is commanded via 1553	As needed	N/A	1 crewmember	May be needed after Activation and checkout if VOA does not automatically perform a Warm Up.
VOA Power Down	5 min	As needed	N/A	1 crewmember	Controlled power down required before disconnecting power or nitrogen from VOA.
VOA Off-Nominal Power Down	5 min	As needed	N/A	1 crewmember	VOA exhaust and inlet caps removed per procedure.
Wheels-Stop: N/A					
Postflight: N/A					
Postflight Debrief:					
Debrief	No extra time	R+30 days	N/A	Crewmembers/ Toxicology Team	Included as part of the Med Ops debrief