

MR084L Acoustic Monitoring & Countermeasures for Long Duration Flights

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR084L Acoustic Monitoring and Countermeasures for Long Duration Flights
Sponsor:	Medical Operations
Discipline:	MMOP Environmental Health Working Group (Acoustics Subgroup) Neurological Function (Acoustics Subgroup)
Category:	Medical Requirements (MR)
References:	SSP 50260 ISS MORD
Purpose/Objectives:	<ul style="list-style-type: none">• To measure and monitor the acoustic environment of the ISS• To measure acoustic levels produced by hardware• To measure the noise exposure of crewmembers over 1) a 16-hour “daytime” period and 2) an 8-hour “night-time” period• This monitoring will be used to assist crewmembers and crew surgeons in the implementation of effective countermeasures to reduce or eliminate high noise levels• To provide hearing protective devices as a countermeasure for high noise levels
Measurement Parameters:	<ul style="list-style-type: none">• A-weighted overall and 1/3 Octave Band (frequency) Sound Pressure Levels at 1 minute intervals to measure crewmember noise exposure (Crew-Worn & Static Deploy measurements using Acoustic Monitor)• 1/3 Octave Band Sound Pressure Levels in dB at discrete locations (Noise Survey measurements using Acoustic Monitor)
Deliverables:	Preliminary and final acoustic measurement reports prepared on-ground by the JSC Acoustics Office
Flight Duration:	≥ 30 days
Number of Flights:	All ISS Increments
Number and Type of Crew Members Required:	<ul style="list-style-type: none">• All crewmembers are trained in Crew-Worn, Static Deploy, and Noise Survey measurements using Acoustic Monitor• All crewmembers are trained in the purpose and wear of hearing protection devices
Other Flight Characteristics:	N/A

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3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity Description:	Training will include nominal operation of the Acoustic Monitor hardware, malfunction procedures, and data transfer. This training lesson also includes the use of hearing protection [e.g. Acoustic Noise Reduction (ANR) headsets, foam earplugs, and custom earwear (i.e. Etymotics earplugs and Prophonics earwear)]. As detailed in MEDB 1.8, this training lesson also includes the On-Orbit Hearing Assessment (OOHA) protocol.				
	Schedule:	Duration:	Schedule:	Flexibility	Personnel Required:
	1st Instance - EHS Acoustics in the Pre-Assignment Training Plan (60 minutes) 2nd Instance - Covered in the EHS Assessment (5 min of a 90-minute lesson), which is part of the assigned crew training flow		No earlier than L-18 months	N/A	Instructors, Crewmembers
Ground Support Requirements: Hardware/Software	Preflight Hardware:		Preflight Software:		Test Location:
	Acoustic Monitor, ZBook Space Station Computer (SSC) Laptop, Mini USB Cable, Hearing Protection Devices (custom Prophonics and Etymotics, Foam earplugs), ANR Headset (Bose), OOHA Headset, OOHA Ear Tips, OOHA CalPod, OOHA USB Cable, AAA Batteries (for Bose QC2 headsets), AA Batteries (for Acoustic Monitor)		Certified “Supervisor” on SSC (for Acoustic Monitor), and KUDUwave software (for OOHA)		U.S.
Training Facilities:	Minimum Room Dimensions:		Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	Approx. 29 feet x 14 feet		Two	Ambient	N/A
	Hot or Cold Running Water:		Privacy Requirements:	Other:	
	N/A		Private room, free of distraction	1 table, 6-8 chairs	
Constraints/Special Requirements:	None				
Launch Delay Requirements:	Crewmembers may request refresher training if necessary.				
Notes:					

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3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

Preflight Activity	Description:	Crewmembers will become familiar with ISS hearing protection devices, be fit for custom hearing-protection devices, and be fit-checked to ensure proper fit of the custom earplugs. This activity is done consecutively with similar procedures (e.g. ear impressions and fit-checks) and training for On-Orbit Hearing Assessments, described in MEDB 1.8_1.8.1 Hearing Assessment (Tables 3.4.1 and 3.4.2 Preflight Activities).			
	Schedule:	Duration:	Schedule:	Flexibility	Personnel Required:
		Session 1: 10 minutes (represents time to familiarize crew with countermeasures) 30 minutes in total when done in conjunction with MEDB 1.8_1.8.1 (20 minutes for ear impressions as described in MEDB 1.8_1.8.1 Table 3.4.1)	NET L-30 months	N/A	Crewmembers, Audiologist
		Session 2: 20 minutes (represents time specifically focused on the fit-check and function of custom earplugs) as described in MEDB 1.8_1.8.1 Table 3.4.2 75 total minutes in total when done in conjunction with MEDB 1.8_1.8.1 (55 minutes for time focused on OOHA familiarization and test)	L-20/5 months	N/A	Crewmembers, Audiologist, Hardware Engineer
Ground Support Requirements: Hardware/Software	Preflight Hardware:			Preflight Software:	Test Location:
	Session 1: Audiologist's materials for fabricating silicone impressions of external ear canals Session 2: ISS hearing protection devices			N/A	US/JSC Clinic
Testing Facilities:	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:	
	8' x 10'	None for Session 1; Two for Session 2	Ambient	N/A	
	Hot or Cold Running Water:	Privacy Requirements:	Vibration/Acoustic Isolation:	Other:	
	Sink for handwashing for Session 1; None for Session 2	Private room free of distractions	N/A for Session 1; Low noise levels for Session 2	Table, 2 chairs, Otoscope	
Constraints/Special Requirements:	<ul style="list-style-type: none">For Session 1, crewmember's ear canals must be free of earwax, which alter the shape of the actual ear canal. Excessive earwax, if seen, must be removed prior to ear impression.For Session 2, crewmember should not be exposed to loud noises (greater than 85 dBA or weapons firing) for at least 16 hours prior to conventional audiometry.Additional time may be necessary for Session 2 if earplugs do not fit.				
Notes:	N/A				
Data Delivery:					

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3.5 In-Flight Activities

TABLE 3.5.1a: IN-FLIGHT ACTIVITIES – Acoustic Monitor Activities

In-Flight Activity	Description:	Acoustic Monitor 24-hour measurements: Crew-worn measurements: Crewmembers will don the Acoustic Monitor and data will be recorded continuously for approximately 24 hours. The Acoustic Monitor in Crew Worn configuration will measure the overall and 1/3 O.B. frequency noise level exposure of the crewmember at 1minute intervals over a 24-hour period. Static Location Measurements: The static location measurement involves the placement of the acoustic monitor for data collection in a specified location for approximately 24 hours. The JSC Acoustics Office will determine locations.				
	Schedule:	Activity:	Duration:	Schedule:	Flexibility:	Personnel Required:
		Acoustic Monitor - Crew Worn	Unstow/Gather: 5 minutes Battery Change, Setup & Deploy: 15 minutes Unattended Pt 1: 12 hours Gather, Battery Charge: Change out & setup: 15 min -Or- Connect to Sleep Station SSC via USB: 5 min/CM Unattended Pt 2: 12 hours Stow (if needed): 5 minutes	<ul style="list-style-type: none">Initial session scheduled in conjunction with baseline OOHA on or before FD21Second session scheduled in conjunction with mid-mission OOHA,Subsequent sessions are performed every 60 days thereafterAs Clinically Indicated	+/- 7 days	All Crewmembers

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	Acoustic Monitor - Static Deploy Measurements	Unstow/Gather: 5 min Battery Change, Setup & Deploy: 15 minutes Unattended: 24 hours Stow: 5 minutes	Schedule in conjunction with the Acoustic Monitor – Crew Worn activities on 1 st set of crew. At the discretion of Acoustic Lead or designee in conjunction with IPs.	May be scheduled before or after Acoustic Monitor - Crew Worn activity. Battery change out prior to Static Deploy. Can be scheduled on 2 nd set of crew worn activities	1 Crewmember
	Acoustic Monitor Data Transfer	Unstow/Gather: 5 minutes Data Transfer: 10 minutes Stow: 5 minutes	After Acoustic Monitor Crew Worn and Static Deploy Measurements	If Acoustic Monitor-Data Transfer activity is scheduled immediately after Acoustic Monitor-Static Deploy activity, stow time is included in the Acoustic Monitor Data Transfer activity.	1 Crewmember

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TABLE 3.5.1a: In-Flight Activities (cont'd.)

Procedures:	Procedures are contained within the ISS System Operations Data File (SODF) Medical Operations Book
Constraints / Special Requirements:	<p>Acoustic Monitor - Crew Worn</p> <ul style="list-style-type: none"> Batteries are changed before the 24-hour measurement and at 12 hours into the measurement. Measurements: <ul style="list-style-type: none"> Crew should don the Acoustic Monitor and start the measurement around morning DPC timeframe. Record daytime/nighttime data (over 24 hours). To be done during a nominal workday. Schedule crew worn and static deploy measurement activities consecutively to save unstow/stow time. Ideal Scheduling <ul style="list-style-type: none"> (Day 1) Schedule – Acoustic Monitor Crew Worn for 1st set of 3 crew around morning DPC timeframe. Battery Change out after 12-14 hours, before Pre-sleep, or USB connection to Sleep Station SSC, before Pre-sleep. (Day 2) Schedule, if needed - Acoustic Monitor Crew Worn for 2nd set of 3 crew around morning DPC timeframe. Battery Change out after 12-14 hours, before Pre-sleep, or USB connection to Sleep Station SSC, before Pre-sleep. (Day 3) Schedule, if needed - Acoustic Monitor Crew Worn for 3rd set of 3 crew around morning DPC timeframe. Battery Change out after 12-14 hours, before Pre-sleep, or USB connection to Sleep Station SSC, before Pre-sleep. (Day 4) Schedule, if needed - Acoustic Monitor for Static Deploy Measurements and Modified Noise Survey (Day 5) Schedule Acoustic Monitor Data Transfer/Stow <p>Acoustic Monitor - Static Deploy Measurements</p> <ul style="list-style-type: none"> May be scheduled before or after Acoustic Monitor - Crew Worn activity. Locations determined by JSC Acoustics Office
Photo / TV Requirements:	Imagery of Static Deploy locations is needed to use as a reference when analyzing the recorded data.
Mission Extension Requirements:	N/A
Landing Wave-Off Requirements:	N/A
Cold Stowage:	N/A
Notes:	N/A
Data Delivery:	<p>During Acoustic Monitor Data Transfer activity, acoustic data files are downloaded to the ISS Server via an SSC from each Acoustic Monitor (using a mini-USB connection), and then downlinked to the ground, where it is delivered to the JSC Acoustics Office by the SD Data and Comm Group.</p> <p>A preliminary report will be delivered to the Crew Surgeon by the JSC Acoustics Office within 16 hours of receipt of data.</p>

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TABLE 3.5.1b: IN-FLIGHT ACTIVITIES – Acoustic Monitor - Noise Survey

In-Flight Activity	Description:	The Acoustic Monitor in Noise Survey configuration will be used to obtain point measurements aboard the ISS.				
	Schedule:	Activity:	Duration:		Schedule:	Personnel Required:
		Acoustic Monitor Noise Survey	Unstow/Set-up: 5 minutes ISS Survey: 90 seconds/ location (nominal 20-24 locations) Stow (if needed): 5 minutes	Schedule in conjunction with the Acoustic Monitor – Static Deploy activities.	1 Crewmember	
		Acoustic Monitor Data Transfer for Noise Survey	Unstow (if needed): 5 minutes Data Transfer: 10 minutes Stow: 5 minutes	After use of Acoustic Monitor in Noise Survey configuration, same day as survey	1 Crewmember	
Procedures:		Procedures are contained within the ISS System Operations Data File (SODF) Medical Operations Book				
Constraints / Special Requirements:		<ul style="list-style-type: none">• Crewmembers should not talk while taking measurements, and all music should be turned off.• If a measurement is taken out of order or skipped, make a voice memo and link to the file of interest.• If a noise interference event takes place during a measurement, continue with the Noise Survey plan, but make a voice memo note of the interference (cause and duration) and link to the measurement of interest.• If it is determined that a measured event exceeds specified hazardous noise limits (85 dBA) or other noise limits, the crew will call down the dB readings. The ground support team will then refer to the Flight Rule B13-152.• Locations of measurement and survey will be designated in flight note. The JSC Acoustics Office will provide the Noise Survey plan with the specified locations.• Not to be scheduled during exercise or ground communication session.• Noise Survey of ISS is not to be scheduled on the same week as Engineering Acoustic Evaluation or Acoustic Measurement for Development of Noise Reduction Measures.• Not to be scheduled concurrently with Acoustic Monitor – Crew Worn or Acoustic Monitor – Static Deploy measurements unless specifically coordinated to do so.				
Photo/TV Requirements:		N/A				
Cold Stowage Requirements:		N/A				
Mission Extension Requirements:		N/A				
Data Delivery:		Recorded acoustic levels measured during Noise Surveys will be saved and transferred to the to the ISS Server via an SSC from each Acoustic Monitor (using a mini-USB connection), and then downlinked to the ground, where it is delivered to the JSC Acoustics Office by the SD Data and Comm Group. A preliminary report will be delivered to the Crew Surgeon within 1 week after data are received on the ground. A final report will be submitted within 2 weeks after the end of mission.				

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TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name
Acoustic Monitors
Mini UBS Cable
Acoustic Monitor Belt Pouch
Acoustic Monitor Microphone/Pre-amp Cable
Space Station Computer (ZBook)
Acoustic Monitor Data Download Software "Supervisor"

3.6 Postflight Activities – No Postflight Activities

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3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY:	DURATION:	SCHEDULE:	FLEXIBILITY:	PERSONNEL REQUIRED:	CONSTRAINTS:
Preflight Training:					
1st Instance - EHS Acoustics in the Pre-Assignment Training Plan (60 minutes) 2nd Instance - Covered in the EHS Assessment (5 min of a 90-minute lesson), which is part of the assigned crew training flow	1st Instance – 60 minutes 2nd Instance – 5 minutes	No earlier than L-18 months	N/A	Instructors, Crewmembers	None
Preflight Activities:					
Session 1 Ear impressions	10 minutes (represents time to familiarize crew with countermeasures) 30 minutes in total when done in conjunction with MEDB 1.8_1.8.1 (20 minutes for ear impressions as described in MEDB 1.8 Table 3.4.1)	NET L-30 months	N/A	Crewmembers, Audiologist	Crewmember's ear canals must be free of earwax, which alter the shape of the actual ear canal. Excessive earwax, if seen, must be removed prior to ear impression.
Session 2 Fit-check	20 minutes (represents time specifically focused on the fit-check and function of custom earplugs) as described in MEDB1.8 Table 3.4.2 75 total minutes in total when done in conjunction with MEDB 1.8_1.8.1 (55 minutes for time focused on OOHA familiarization and test)	L-20/5 months	N/A	Crewmember, Audiologist, Hardware Engineer	Additional time may be necessary for Session 2 if custom earplugs do not fit.
In-Flight Activities:					

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Acoustic Monitor - Crew Worn	Unstow/Gather: 5 minutes Battery Change, Setup & Deploy: 15 minutes Unattended Pt 1: 12 hours Gather, Battery Charge: Change out & setup: 15 min -Or- Connect to Sleep Station SSC via USB: 5 min/CM Unattended Pt 2: 12 hours Stow (if needed): 5 minutes	<ul style="list-style-type: none"> Initial session scheduled in conjunction with baseline OOHA on or before FD21 Second session scheduled in conjunction with mid-mission OOHA Subsequent sessions every 60 days thereafter As Clinically Indicated 	+/- 7 days	All Crewmembers	See Table 3.5.1a
Acoustic Monitor - Static Deploy	Unstow/Gather: 5 minutes Battery Change, Setup & Deploy: 15 minutes Unattended: 24 hours Stow: 5 minutes	<ul style="list-style-type: none"> Schedule in conjunction with the Acoustic Monitor – Crew Worn activities. Crew worn activities on 1st set of crew. . At the discretion of Acoustic Lead or designee in conjunction with IPs. 	If scheduled consecutively after first day of Acoustic Monitor ops, unstow time not needed.	1 Crewmember	Locations determined by JSC Acoustics Office. Schedule and recommendation on duration and location of deploy to be submitted to the BME Increment Manager by JSC Acoustics Office.

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TABLE 3.7: SUMMARY SCHEDULE (cont'd)

ACTIVITY:	DURATION:	SCHEDULE:	FLEXIBILITY:	PERSONNEL REQUIRED:	CONSTRAINTS:
Acoustic Monitor Data Transfer	Unstow: 5 minutes Data Transfer: 5 minutes* Stow: 5 minutes *Time for 3 Acoustic Dosimeters with approx. 72 hours of data on each	After use of Acoustic Monitor in Crew Worn and Static Deploy configurations	N/A	1 Crewmember	None
Acoustic Monitor Noise Survey of ISS	Unstow/Set-up: 5 minutes Survey: 90 seconds/ location (nominal 20-24 locations) Stow (if needed): 5 minutes	Schedule in conjunction with the Acoustic Monitor – Static Deploy activities	N/A	1 crewmember	Crewmembers should not talk while taking measurements, and all music should be turned off. Not to be scheduled during exercise or ground communication session. Noise Survey of ISS is not to be scheduled on the same week as Engineering Acoustic Evaluation or Acoustic Measurement for Development of Noise Reduction Measures.
Acoustic Monitor Data Transfer for Noise Survey	Unstow (if needed): 5 minutes Data Transfer: 10 minutes Stow: 5 minutes	After use of Acoustic Monitor in Noise Survey configuration, same day as survey	N/A	1 crewmember	None
Postflight:					
Debrief	No extra time	~R+30 days		Crewmembers, JSC Acoustics Office, Audiologist	Included as part of the Med Ops overall debrief