

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

<b>MEDB# and Title:</b>	MEDB 6.1 EVA Metabolic Task Analysis
<b>Sponsor:</b>	Medical Operations
<b>Discipline:</b>	EVA
<b>Category:</b>	Medical Requirements (MR)
<b>References:</b>	SSP 50260 ISS Medical Operations Requirements Document (MORD)SSP 50667 Medical Evaluation Document (MED) Volume B
<b>Purpose/Objectives:</b>	To assess the medical health status of the EVA crewmembers pre/post EVA
<b>Measurement Parameters:</b>	<u>Preflight</u> : NBL EVA training Metabolic Rates with Major Task Analysis (estimated) <u>In-flight, Pre- and Post EVA</u> : Vital signs (ORLAN only), skin and extremity exam, urinalysis, and review of systems. <u>In-flight, during EVA</u> : Metabolic Rate (estimated), EKG and heart rate, suit pressure, suit CO <sub>2</sub> partial pressure, radiation exposure, body temp (Russian Orlan suit only).
<b>Deliverables:</b>	Preflight, NBL EVA training Metabolic Rates with Major Task Analysis (estimated) reported to the Crew Surgeon, BME, and upon request, MOD leads. EMU OEM Systems Group leads and crewmember. Non-attributable data may also be utilized in the EPL for reports, presentations, and publications supporting the Space Life Sciences Directorate. Pre EVA, Physical Health Status (PHS) consisting of Review of Systems (ROS), and urinalysis. Crew Surgeon will deliver a flight note to the Flight Director regarding crewmember readiness for EVA. Post EVA, Physical Health Status (PHS) consisting of Review of Systems (ROS), and urinalysis. Crew health status will be discussed with Crew Surgeon during scheduled Private Medical Conference (PMC). EPL will receive EVA heart rates and metabolic rates from BME.
<b>Flight Duration:</b>	≥ 30 days
<b>Number of Flights:</b>	All ISS flights requiring an EVA
<b>Number and Type of Crew Members Required:</b>	All long-duration EVA crewmembers
<b>Other Flight Characteristics:</b>	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

<b>Preflight Training Activity</b>	<b>Description:</b>	Classes will be conducted to educate the EVA crew on medical monitoring during an EVA, and to train the CMOs on EVA medical evaluations and diagnosis.			
	<b>Schedule:</b>	<b>Duration:</b>	<b>Schedule:</b>	<b>Flexibility:</b>	<b>Personnel Required:</b>
		Experienced Crewmember: Medical Proficiency I Exp. 2.5 hrs	L-9 months	+/- 6 weeks	JSC Instructors / CMOs
		Inexperienced Crewmember: ISS Med Diagnostics I: 2 hrs	L-9 months	+/- 6 weeks	JSC Instructors / CMOs
		ISS Med Diagnostics II: 2 hrs	L-9 months	+/- 6 weeks	JSC Instructors / CMOs
Med. Eval of Decompression Sickness: 1 hr	L-11 months	+/- 6 weeks	JSC Instructors / EVA crew and CMOs		
Russian medical and hardware training (Exp. & Inexp.): 2 hrs	Approx. L-6 months	+/- 2 months	GCTC Trainers / EVA crew and CMOs		
<b>Ground Support Requirements Hardware/Software</b>	<b>Preflight Hardware:</b>	<b>Preflight Software:</b>		<b>Test Location:</b>	
	Medical Equipment Computer (MEC) Ambulatory Medical Pack (AMP) Advanced Life Support Pack (ALSP) ----- Urilux and accessories	MEC software (In-Flight Examination Program, IFEP) ----- Russian medical & hardware training will be scheduled by and trained by the GCTC personnel in Star City.		U.S. ----- Russia	
<b>Training Facilities</b>	<b>Minimum Room Dimensions:</b>	<b>Number of Electrical Outlets:</b>	<b>Temperature Requirements:</b>	<b>Special Lighting:</b>	
	Standard room, 8 ft. x 10 ft.	4 (U.S. 110V, Russia 220V)	Normal, 20° – 25° C.	Normal lighting	
	<b>Hot or Cold Running Water:</b>	<b>Privacy Requirements:</b>	<b>Other:</b>		
	Hot and cold water for hand washing.	Private room required	Enough chairs and tables to accommodate the crew and trainers.		

<b>Constraints/Special Requirements:</b>	N/A
<b>Launch Delay Requirements:</b>	Refresher training to be scheduled at Crew Surgeon request
<b>Notes:</b>	Training procedures: 1. SODF: ISS Med (Medical Checklist) 2. RODF: Service Module Medical Operations, Book 2

3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

<b>Preflight Activity</b>	<b>Description:</b>	Metabolic rate (estimated) of the crewmember will be recorded during either the Extra Vehicular Activity Acceptance Test (EVAAT) run or the Final EVA training session in the Neutral Buoyancy Lab (NBL) in order to establish a baseline metabolic rate for each EVA day. This is a passive test that requires zero additional crew time during their EVA training sessions. Low, high, and average met rates for major EVA tasks will be determined. In addition, decrement in O2 tank pressure will be calculated based on total O2 consumption for each major EVA task. If task timeline is unavailable, 30-minute intervals will be used instead. The Environmental Physiology Lab (EPL) is responsible for scheduling this session.			
	<b>Schedule:</b>	<b>Duration:</b>	<b>Schedule:</b>	<b>Flexibility:</b>	<b>Personnel Required:</b>
		Metabolic rate (estimated): 6 hrs	During at least one EVA training session per EVA day per Shuttle or Expedition EVA crew member.	N/A	Environmental Physiology Lab personnel EVA crewmember Environmental Control System Technician
<b>Ground Support Requirements Hardware/Software</b>	<b>Preflight Hardware:</b>	<b>Preflight Software:</b>		<b>Test Location:</b>	
	Medical Gas Analyzer Flow Meter Assy Laptop computer Environmental Control System (ECS)	Data collection software using LabVIEW (made by National Instruments)		JSC / Neutral Buoyancy Lab (NBL)	
<b>Testing Facilities</b>	<b>Minimum Room Dimensions:</b>	<b>Number of Electrical Outlets:</b>	<b>Temperature Requirements:</b>	<b>Special Lighting:</b>	
	JSC NBL Topside A or B	2	Normal	N/A	
	<b>Hot or Cold Running Water:</b>	<b>Privacy Requirements:</b>	<b>Vibration/Acoustic Isolation:</b>	<b>Other:</b>	
	N/A	N/A	N/A	N/A	
<b>Constraints/Special Requirements:</b>	.				
<b>Launch Delay Requirements:</b>	N/A				
<b>Notes:</b>	N/A				

<b>Data Delivery</b>	<b>Data/Report to Designated Recipients (Nominal/Contingency):</b>
	The results (VO <sub>2</sub> ml/min and HR) of the L-30/45 Submaximal Cycle Ergometer test (MR080L) will be delivered to the EPL within 2 weeks of flight. NBL EVA training metabolic rates and task analysis will be prepared along with cycle ergometry metabolic rates vs heart rates chart, and sent to the Crew Surgeon prior to launch in order to compare with in-flight EVA results.

**3.5 In-Flight Activities**

**TABLE 3.5.1: IN-FLIGHT ACTIVITIES**

<b>In-Flight Activity</b>	<b>Description:</b>	Pre- and Post EVA: Within 24 hours of suit donning and suit doffing the medical evaluation/Physical Health Status (PHS) will consist of a review of systems (ROS) by the expedition crew surgeon, a brief skin and extremity examination by the crew medical officer (CMO), urinalysis, and vital signs (for ORLAN only as part of nominal suit check-out). The crew surgeon may direct a specific medical exam based on ROS findings.													
	<b>Schedule:</b>	<ul style="list-style-type: none"> <li>▪ During the EVA, the following measurements will be taken (real-time except for radiation exposure):                             <table style="margin-left: 20px; border: none;"> <tr> <td>EKG</td> <td>O<sub>2</sub> consumption</td> <td>Body temperature (Russian Orlan suit only)</td> </tr> <tr> <td>Heart rate</td> <td>Suit CO<sub>2</sub> partial pressure</td> <td></td> </tr> <tr> <td>Suit pressure</td> <td>Radiation exposure</td> <td></td> </tr> </table> </li> </ul>					EKG	O <sub>2</sub> consumption	Body temperature (Russian Orlan suit only)	Heart rate	Suit CO <sub>2</sub> partial pressure		Suit pressure	Radiation exposure	
	EKG	O <sub>2</sub> consumption	Body temperature (Russian Orlan suit only)												
	Heart rate	Suit CO <sub>2</sub> partial pressure													
Suit pressure	Radiation exposure														
<b>Activity:</b>	<b>Duration:</b>	<b>Schedule:</b>	<b>Flexibility:</b>	<b>Blood Volume:</b>	<b>Personnel Required:</b>										
<b>Schedule:</b>	Pre-EVA Physical Health Status (PHS)	Equipment Setup (AMP, MEC, Urilux) 15 min. Urinalysis: Urilux 15 min/CM ROS/PHS EVA Subject 10min/CM PHS CMO 10 min/CM Data entry & stow 20 min.	Within 24 hrs of suit donning	≤ 24hrs before EVA	N/A	CS+ CMO + EVA crew									
	Post-EVA PHS	Equipment Setup (AMP, MEC, Urilux) 15 min. Urinalysis: Urilux 15 min/CM ROS/PHS EVA Subject 10 min/CM PHS CMO 10 min/CM Data entry & stow 20 min.	Within 24 hrs of suit doffing	≤ 24 hrs after EVA	N/A	CS+ CMO + EVA crew									
	EVA monitoring	Up to 8 hrs	Every EVA	N/A	N/A	EVA crew + Ground control									

<b>Procedures:</b>	In-flight procedures can be found within these books: SODF: MED OPS, ISS MED ( <i>Med checklist</i> ) RODF: Service Module Medical Operations Book 2 ISS Medical Console Handbook
<b>Constraints / Special Requirements:</b>	<ul style="list-style-type: none"> <li>• When possible, urinalysis should be performed and reported to Flight Surgeon on day of EVA.</li> <li>• If a medical contingency occurs post EVA that is non-DCS related, schedule 1 additional hour for the PHS.</li> </ul>
<b>Photo / TV Requirements:</b>	N/A
<b>Cold Stowage Requirements:</b>	N/A
<b>Mission Extension Requirements:</b>	N/A
<b>Landing Wave-Off Requirements:</b>	N/A
<b>Data Delivery</b>	<p><b>Data/Report to Designated Recipients (Nominal/Contingency):</b></p> <p>PHS results will be shared with the FS during the Pre- and Post-EVA Private Medical Conference (PMC - see MR017L) Downlinked PHS data, via the MEC, will be delivered by the BME to the Flight Surgeon within 24 hrs of receipt. Distribution of this data to the appropriate JSC discipline specialists will be at the Flight Surgeon's discretion. In-flight EVA Timeline data per EVA, EVA Oxygen Consumption and Heart Rate data per crewmember per EVA, will be delivered to the EPL post flight. The pre- and post EVA exams are entered into the IFEP and results are downloaded onto the FTP server by the BMEs.</p>

**In-Flight Activities, (cont.)**

**TABLE 3.5.2: IN-FLIGHT HARDWARE**

Hardware/Software Name	P/N
Medical Equipment Computer (MEC) and kit	SEG46116031-xxx
In-flight Examination Program (IFEP) software on the MEC	WLSD210052-xxx
Advanced Life Support Pack (ALSP)	SKD42101830-xxx
Ambulatory Medical Pack (AMP)	SKD42101500-xxx
Urilux Instrument	Xt2.850.605

3.6 Postflight Activities – No Postflight Activities

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	BLOOD VOLUME	PERSONNEL REQUIRED	CONSTRAINTS
<b>Preflight Training</b>						
Experienced Crewmember: Medical Proficiency I Exp.	2.5 hrs	L-9 months	+/- 6 weeks	N/A	JSC Instructors / CMOs	N/A
Inexperienced Crewmember: ISS Med Diagnostics I	2 hrs	L-9 months	+/- 6 weeks		JSC Instructors / CMOs	
ISS Med Diagnostics II	2 hrs	L-9 months	+/- 6 weeks		JSC Instructors / CMOs	
Med. Eval of Decompression Sickness	1 hr	L-11 months	+/- 6 weeks		JSC Instructors / EVA crew and CMOs	
Russian medical and hardware training (Exp. & Inexp.)	2 hrs	Approx. L-6 months	+/- 2 months		GCTC Trainers / EVA crew and CMOs	
<b>Preflight Activities</b>						
Preflight, NBL EVA training Metabolic Rates with Major Task Analysis (estimated)	6 hrs	During at least one EVA training session per EVA day per Shuttle or Expedition EVA crewmember.	Schedules permitting, data will be collected during the EVAAT session. If the session terminated early, or the data is questionable, the Final session will be used to collect data. If the Final session also terminated early, the data from the longer session will be used for analysis.	N/A	Environmental Physiology Lab personnel EVA crewmember Environmental Control System Technician	If equipment failure or schedule conflict prevents collection of current NBL data, previous flight/training/Submaxi mal Cycle Ergometry test data will be accepted. If L-30/45 Submaximal Cycle Ergometer Test data is not available, the most recent cycle ergometry test data will be acceptable.

**MEDB 6.1 EVA Metabolic Task Analysis**

**MEDB 6.1  
SLSDCR-SMCCB-09-061-R4**

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	BLOOD VOLUME	PERSONNEL REQUIRED	CONSTRAINTS
<b>In-Flight Activities</b>						
Pre-EVA Physical Health Status (PHS)	Equipment Setup (AMP, MEC, Urilux) 15 min. Urinalysis: Urilux 15 min/CM ROS/PHS EVA Subject 10 min/CM PHS CMO 10 min/CM Data entry & stow 20 min.	Within 24 hrs of suit donning	≤ 24hrs before EVA	N/A	CS+ CMO + EVA crew	When possible, urinalysis should be performed and reported to Flight Surgeon on day of EVA. If a medical contingency occurs post EVA that is non-DCS related, schedule 1 additional hour for the PHS.
EVA	During the EVA, the following measurements will be taken : EKG, Metabolic rate (estimated), Heart rate, Suit CO <sub>2</sub> partial pressure, Suit pressure, Radiation exposure, Body temperature (Russian Orlan suit only)	Real-time except for radiation exposure			CS+ CMO + EVA crew	
Post-EVA PHS	Equipment Setup (AMP, MEC, Urilux) 15 min. Urinalysis: Urilux 15 min/CM ROS/PHS EVA Subject 10 min/CM PHS CMO 10 min/CM Data entry & stow 20 min.	Within 24 hrs of suit doffing	≤ 24 hrs after EVA		CS+ CMO + EVA crew	

EVA monitoring	Up to 8 hrs	Every EVA			EVA crew	
<b>Postflight Activities – N/A</b>						
<b>Postflight Debrief</b>						
Part of the overall MedOps debrief.						