

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR042S Functional Neurological Assessment (Pre- and Postflight) for Short Duration Crewmembers
Sponsor:	Medical Operations
IPT:	Neurological Function
Category:	Medical Requirements (MR)
References:	Astronaut Medical Evaluation Requirements Document (AMERD) JSC 24834, Neurological Standards Appendix A, Section III (3.10) Pre- and Postflight Medical Evaluation Requirements for Short Duration Flights (30 days or fewer) Appendix B, Section V (5.1 c, 5.2 b, 5.2 e, 5.2 h)
Purpose/Objectives:	To perform functional neurological assessments that provide an objective test of neurosensory re-adaptation to Earth's normal gravity following prolonged weightlessness.
Measurement Parameters:	Balance control performance, sensory-motor integration performance
Deliverables:	Results of these tests will be used by flight surgeons to determine when crewmembers can safely return to normal daily activities (stairs, driving a car, showering, etc.). Results will also be used to develop long duration mission recovery signatures to establish return-to-duty criteria.
Flight Duration:	≤ 30 days
Number of Flights:	N/A
Number and Type of Crew Members Required:	All primary U.S. crewmembers. Back-up crew will only complete preflight MATs greater than L-10 days unless specifically waived by crew surgeon. If crew swap does occur, back-up crew will complete all preflight MATs.
Other Flight Characteristics:	Pre- and post-flight data collection only.

3.3 Pre-Flight Training (This training/familiarization session will be coordinated by Mission Integration)

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description:	<p>A Training/Fam session will be conducted at L-60 to negate the "learning effect". Crewmembers who have previously performed the same protocol (detailed below) will not need to perform the Fam session again. Upon arrival at the test room, the crew member will change into shorts and socks (provided). They will be asked to report on recent pharmaceutical and alcohol consumption, physical activities, eating and sleeping schedules, and cognitive performance. Meanwhile, baseline foot and hip measurements will be made. The crew member will be instrumented with motion markers on the lower legs and hips, and they will wear a safety harness and a pair of headphones. The crew member will then complete a standard clinical battery of sensory organization tests (SOTs) provided by the Equitest dynamic posturography system, detailed below. Three randomized trials of each of six sensory organization tests will be performed (upright posture with normal, absent, and/or mechanically altered visual and proprioceptive sensory inputs). Each test lasts for 20 seconds, during which time the crew member must maintain quiet and erect stance. Measured performance will be based on the peak body sway during each condition. The crew member will then perform 3 trials each of 4 static head tilt and dynamic head movement tests (HM), each lasting 20 seconds. Finally, the crew member will perform 4 platform translation and 5 platform rotation tests (MCT), each lasting 10 seconds. When testing is complete, the crew member will be de-instrumented and allowed to change back into their street clothes.</p>		
	Schedule:	<p>The clinical SOT test conditions are (3 trails each):</p> <ol style="list-style-type: none"> 1. Standard eyes open Romberg test-visual surround and support surface fixed 2. Standard eyes closed Romberg test-support surface fixed 3. Sway-referenced visual surround with fixed support surface 4. Sway-referenced support surface with fixed visual surround 5. Sway-referenced support surface with eyes closed 6. Sway-referenced support surface with sway-referenced visual surround <p>The HM test conditions are (3 trials each):</p> <ol style="list-style-type: none"> 1. SOT 2 (above) with static head tilt back (eyes closed) 2. SOT 5 (above) with static head tilt back (eyes closed) 3. SOT 2 (above) with dynamic head pitch (backward and forward, eyes closed) 4. SOT 5 (above) with dynamic head pitch (backward and forward, eyes closed) <p>The MCT test conditions are:</p> <ol style="list-style-type: none"> 1. Eyes open, small amplitude forward translation (2 trials) 2. Eyes open, large amplitude forward translation (2 trials) 3. Eyes open, toes-up support surface rotation (5 trials) 		
	Duration:	Schedule:	Flexibility:	Personnel Required:
	45 minutes	L-60 days	May be performed anytime between L-60 and L-30	2 test operators/ crewmember

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Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:		Test Location:	
	Equitest Posture Platform, Optotrak Motion Analysis System, Equipment Racks, Subject Safety Restraint System, Test Supplies, Tone Generation Equipment, Universal Power Supply, Power Converter (Russia only)		N/A		U.S./Russia	
Training Facilities	Minimum Room Dimensions:		Number of Electrical Outlets:		Temperature Requirements:	
	12' x 19' x 9'H (3.66 x 5.79 x 2.74 meters)		# of Electric Outlets with Amp Rating (U.S. and Star City): 2 - 120V, 20A, 60Hz. Note: Each of these circuits should be accessible through a standard three-wire, grounded, duplex receptacle located within 5 feet of the platform.		20 - 22 ⁰ C	
	Hot or Cold Running Water:		Privacy Requirements:		Other:	
	No		Two test operators, one discipline expert, and crew surgeon (if necessary)		2 chairs and 1 small table	
Constraints/Special Requirements:	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.					
Launch Delay Requirements:	N/A					
Notes:	<p>Facilities for performance of the Functional Neurological Assessment have been established and are currently maintained at JSC, KSC, and at GCTC in Star City.</p> <p>Test Termination Criteria:</p> <ol style="list-style-type: none"> 1. Syncope or significant pre-syncopal symptoms. 2. Vomiting or significant motion sickness symptoms. 3. Significant foot tenderness or muscle soreness. 4. Subject request to stop. 					

3.4 Pre-Flight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

Preflight Activity	Description:	The crew member will change into shorts and socks (provided). They will be asked to report on recent pharmaceutical and alcohol consumption, physical activities, eating and sleeping schedules, and cognitive performance. The crew member will be instrumented with motion markers on the lower legs and hips, and they will wear a safety harness and a pair of headphones. The crew member will then complete a reduced set of tests, similar to the training/fam session in Table 3.3, detailed below:			
	Schedule:	<p>The clinical SOT test conditions are:</p> <ol style="list-style-type: none"> 1. Standard eyes open Romberg test-visual surround and support surface fixed (2 trials) 2. Standard eyes closed Romberg test-support surface fixed (3 trials) 3. Sway-referenced visual surround with fixed support surface (2 trials) 4. Sway-referenced support surface with fixed visual surround (2 trials) 5. Sway-referenced support surface with eyes closed (3 trials) 6. Sway-referenced support surface with sway-referenced visual surround (2 trials) <p>The HM test conditions are (3 trials each):</p> <ol style="list-style-type: none"> 1. SOT 2 with static head tilt back (eyes closed) 2. SOT 5 with static head tilt back (eyes closed) 3. SOT 2 with dynamic head pitch (backward and forward, eyes closed) 4. SOT 5 with dynamic head pitch (backward and forward, eyes closed) <p>The MCT test conditions are:</p> <ol style="list-style-type: none"> 1. Eyes open, small amplitude forward translation (2 trials) 2. Eyes open, large amplitude forward translation (2 trials) 3. Eyes open, toes-up support surface rotation (5 trials) 			
		Duration:	Schedule:	Flexibility:	Blood Volume:
	25 minutes	L-30 days	Training/fam and MAT session must be scheduled at least 2 days apart.	N/A	2 test operators /crew member

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Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:		Test Location:	
	Equitest Posture Platform, Optotrak Motion Analysis System, Equipment Racks, Subject Safety Restraint System, Test Supplies, Tone Generation Equipment, Universal Power Supply, Power Converter (Russia only)		N/A		U.S./Russia	
Testing Facilities	Minimum Room Dimensions:		Number of Electrical Outlets:		Temperature Requirements:	Special Lighting:
	12' x 19' x 9'H (3.66 x 5.79 x 2.74 meters)		# of Electric Outlets with Amp Rating (U.S. and Star City): 2 - 120V, 20A, 60Hz. Note: Each of these circuits should be accessible through a standard three-wire, grounded, duplex receptacle located within 5 feet of the platform.		20 - 22 ⁰ C	Standard Illumination
	Hot or Cold Running Water:		Privacy Requirements:		Other:	
	No		Two test operators, one discipline expert, and crew surgeon (if necessary)		2 chairs and 1 small table	
Constraints/Special Requirements:	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.					
Launch Delay Requirements:	Repeat L-30 data collection if launch slips by \geq 30 days.					
Notes:	<p>Test Termination Criteria:</p> <ol style="list-style-type: none"> 1. Syncope or significant pre-syncope symptoms. 2. Vomiting or significant motion sickness symptoms. 3. Significant foot tenderness or muscle soreness. 4. Subject request to stop 					
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			Data Archives:		
	Test results will be delivered to the crewmember's flight surgeon via oral report by the discipline lead or designated lab personnel.			Final data reports will be submitted to the Flight Surgeon and Data Archivist within 2 weeks of the last MAT post-flight session.		

3.5 In-Flight Activities – No In-Flight Activities

3.6 Post-Flight Activities

TABLE 3.6.1: POST-FLIGHT ACTIVITIES

Postflight Activity	Description:	The crew member will change into shorts and socks (provided). They will be asked to report on recent pharmaceutical and alcohol consumption, physical activities, eating and sleeping schedules, and cognitive performance. The crew member will be instrumented with motion markers on the lower legs and hips, and they will wear a safety harness and a pair of headphones. The crew member will then complete a graded and reduced set of tests, detailed below. If the crew member is unable to complete or falls during a sub-set of tests (e.g. clinical SOT, HM, or MCT tests sets), the crewmember will move on to the next sub-set. If the crew member falls twice, then the test session will be terminated (usual test termination criteria also applies).			
	Schedule:	<p>The clinical SOT test conditions are (2 trials each):</p> <ol style="list-style-type: none"> 1. SOT 1 2. SOT 3 3. SOT 4 4. SOT 2 5. SOT 5 <p>The HM test conditions are (2 trials each):</p> <ol style="list-style-type: none"> 1. SOT 2 with static head tilt back (eyes closed) 2. SOT 5 with static head tilt back (eyes closed) 3. SOT 2 with dynamic head pitch (backward and forward, eyes closed) 4. SOT 5 with dynamic head pitch (backward and forward, eyes closed) <p>The MCT test conditions are:</p> <ol style="list-style-type: none"> 1. Eyes open, small amplitude forward translation (2 trials) 2. Eyes open, large amplitude forward translation (2 trials) 3. Eyes open, toes-up support surface rotation (5 trials) 			
	Duration:	Schedule:	Flexibility:	Blood Volume:	Personnel Required:
	20 minutes	R+0, R+1, and R+2 days	If both R+1 and R+2 not possible, then R+1 or R+2 acceptable.	N/A	2 test operators / crewmember

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Ground Support Requirements Hardware/Software	Postflight Hardware:		Postflight Software:	Test Location:
	Equitest Posture Platform, Optotrak Motion Analysis System, Equipment Racks, Subject Safety Restraint System, Test Supplies, Tone Generation Equipment, Universal Power Supply, Power Converter (Russia only)		N/A	U.S./Russia
Testing Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:		Temperature Requirements:
	12' x 19' x 9'H (3.66 x 5.79 x 2.74 meters)	# of Electric Outlets with Amp Rating (U.S. and Star City): 2 - 120V, 20A, 60H. Note: Each of these circuits should be accessible through a standard three-wire, grounded, duplex receptacle located within 5 feet of the platform.		20 - 22 ⁰ C
	Hot or Cold Running Water:	Privacy Requirements:		Other:
	No	Two test operators, one discipline expert, and crew surgeon (if necessary)		2 chairs and 1 small table
Constraints/Special Requirements:	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.			
Notes:	Test Termination Criteria: <ol style="list-style-type: none"> 1. Syncope or significant pre-syncopal symptoms. 2. Vomiting or significant motion sickness symptoms. 3. Significant foot tenderness or muscle soreness. 4. Subject request to stop. 			
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):		Data Archives:	
	Test results will be delivered to the crewmember's flight surgeon via oral report by the discipline lead or designated lab personnel.		Final data reports will be submitted to the Flight Surgeon and Data Archivist within 2 weeks of the last MAT post-flight session.	

TABLE 3.6.2: POST-FLIGHT ACTIVITIES

Postflight Activity	Description:	Same as L-30 protocol, see Table 3.4.			
	Schedule:	Duration: 25 minutes	Schedule: R+4 days	Flexibility:	Blood Volume: N/A
Ground Support Requirements Hardware/Software	Postflight Hardware:	Equitest Posture Platform, Optotrak Motion Analysis System, Equipment Racks, Subject Safety Restraint System, Test Supplies, Tone Generation Equipment, Universal Power Supply, Power Converter (Russia only)		Postflight Software: N/A	Test Location: U.S./Russia
	Testing Facilities	Minimum Room Dimensions: 12' x 19' x 9'H (3.66 x 5.79 x 2.74 meters)	Number of Electrical Outlets: # of Electric Outlets with Amp Rating (U.S. and Star City): 2 - 120V, 20A, 60H. Note: Each of these circuits should be accessible through a standard three-wire, grounded, duplex receptacle located within 5 feet of the platform.	Temperature Requirements: 20 - 22 ⁰ C	Special Lighting: Standard Illumination
	Hot or Cold Running Water: No	Privacy Requirements: Two test operators, one discipline expert, and crew surgeon (if necessary)	Other: 2 chairs and 1 small table		
Constraints/Special Requirements:	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.				
Notes:	Test Termination Criteria: <ol style="list-style-type: none"> 1. Syncope or significant pre-syncopal symptoms. 2. Vomiting or significant motion sickness symptoms. 3. Significant foot tenderness or muscle soreness. 4. Subject request to stop 				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):	Data Archives:			
	Test results will be delivered to the crewmember's flight surgeon via oral report by the discipline lead or designated lab personnel.	Final data reports will be submitted to the Flight Surgeon and Data Archivist within 2 weeks of the last MAT post-flight session.			

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	BLOOD VOLUME	PERSONNEL REQUIRED	CONSTRAINTS
Pre-Flight Training						
Training/Fam Session	45 minutes	L-60 days	May occur anytime between L-60 and L-30	N/A	2 test operators/ crewmember	This Training/Fam session will be coordinated by Mission Integration. Crewmembers who have previously performed the same protocol (see Table 3.3) will not need to perform the Fam session again. Fam session and L-30 test must be at least 2 days apart.
Pre-Flight						
Neurological Assessment	25 minutes	L-30 days	N/A	N/A	2 test operators/ crewmember	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance. Fam session and L-30 test must be at least 2 days apart.
In-Flight – N/A						
Wheels-Stop – N/A						

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Post-Flight						
Neurological Assessment	20 minutes	R+0, R+1, and R+2 days	If both R+1 and R+2 not possible, then R+1 or R+2 acceptable.	N/A	2 test operators / crewmember	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.
Neurological Assessment	25 minutes	R+4 days	N/A	N/A	2 test operators / crewmember	Limit participation in provocative training exercise (i.e., flight motion simulators, centrifuge simulations, training aircraft) for 24 hours prior to testing; limit alcohol consumption for 24 hours prior to testing. The optometry exam (MR014S) should not be scheduled prior to MR042S. No maximal exercise 4 hours prior to test. No drugs that affect sensorimotor performance.
Post-Flight Debrief						
Neurological Assessment	No extra time	~R+10 days	As scheduled/ requested by crew surgeon	N/A	discipline lead or designated lab personnel	Included as part of the Med Ops overall debrief.