3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MEDB# and Title:	MEDB 1.10 Eye Examinations (includes MED Volume B sections 1.10 and 1.10.1)
Sponsor:	Medical Operations
Discipline:	Therapeutics and Clinical Care
Category:	Medical Requirements
References:	SSP 50260 ISS Medical Operations Requirements Document (MORD) SSP 50667 Medical Evaluations Documentation (MED) Volume B
Purpose/Objectives:	To assess the status of ocular health and function pre- in- and postflight.
Measurement Parameters:	Questionnaire, visual acuity, refraction, visual fields, Amsler grid, pupil reflexes, extraocular muscle balance, biomicroscopy (slit lamp), contrast sensitivity, depth perception, color vision testing, fundoscopic examination, retinal photography, tonometry, optical coherence tomography (OCT), Optical biometry, 2-D imaging ultrasound, high-resolution MRI
Deliverables:	All pre- in- and postflight ocular reports are located and/or accessible from the Electronic Medical Record (EMR) or Picture Archive and Communication System (PACS) systems. Image modality files are included in the Picture Archiving Communications System (PACS) or other relevant image viewing/archival software.
Flight Duration:	$\geq$ 30 days
Number of Flights:	All long duration flights
Number and Type of Crew Members Required:	ISS primary crewmembers
Other Flight Characteristics:	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

<table>
<tr><td>Preflight Training Activity Description:</td><td colspan="5">Classes will be conducted to train the crew to conduct in-flight eye examinations.</td></tr>
<tr><td rowspan="6">Schedule:</td><td colspan="2">Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td>Retinal Imaging I</td><td>90 minutes</td><td>2A6</td><td>+/- one trip</td><td rowspan="2">Remote Guider Instructor, Crewmember, Test Subjects</td></tr>
<tr><td>Retinal Imaging II</td><td>60 minutes</td><td>6A1</td><td>+/- one trip</td></tr>
<tr><td>Tonometry Ops</td><td>90 minutes</td><td>2A9</td><td>+/- one trip</td><td>Tonometer Remote Guider, Remote Guider Instructor , Test Subjects, Crewmember</td></tr>
<tr><td>Ultrasound Eye</td><td>60 minutes</td><td>2A8</td><td>+/- one trip</td><td>Remote Guider Instructor, Ultrasound Specialist/Sonographer, ISSMP personnel, Crewmember, PDL mock up personnel</td></tr>
<tr><td>OCT Ops I
OCT Ops II</td><td>90 minutes
60 minutes</td><td>2A6
6A1</td><td>+/- one trip</td><td>Remote Guider Instructor, Crewmember, Test Subjects</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ground Support Requirements Hardware/Software</td><td colspan="3">Preflight Hardware:</td><td>Preflight Software:</td><td>Test Location:</td></tr>
<tr><td></td><td colspan="3">Flight-like Fundoscope, Flight–like OCT, Flight-like SSC, Flight-like OCT laptop, Flight-like Tonometer, Eye Simulator, Tonometer tip covers, Flight-like Ultrasound device, Ultrasound gel, BZK wipes, KIM wipes, *Near Visual Acuity Chart, Amsler Grid; video camera, video camera cables, Tripod, HDMI capable TV; Ground OCT desk and convertor; Ophthalmic medications (Tonometry and Retinal Imaging); stretcher on wheels with wheel lock; Eye patch; hand sanitizer, AA batteries; NetGear Box and cables; Rolling stool x2; Floor lamp</td><td>Flight-like Fundoscope, Vision Testing and OCT software, streaming software, laptop commanding software</td><td>U.S.</td></tr>
<tr><td rowspan="4">Training Facilities</td><td colspan="2">Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td>Special Lighting:</td></tr>
<tr><td colspan="2">Standard room, 8 ft. x 10 ft., Payload Development Lab (PDL) for ultrasound training</td><td>4 (U.S. 110V, Russia 220V)</td><td>Normal, 20° – 25° C.</td><td>Normal lighting with ability to dim lights for Fundoscope training</td></tr>
<tr><td colspan="2">Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td colspan="2">Other:</td></tr>
<tr><td colspan="2">Hot and cold water for hand washing.</td><td>Private room required</td><td colspan="2">Internet access; Enough chairs and tables to accommodate the crew and instructors</td></tr>
</table>

Constraints/Special Requirements:	Fundoscope - Crew member dilation requirements: Contact lens must be removed. For 4 hours post dilation, drive with extra caution, avoid operation of any heavy equipment; avoid operation of anything that might require acute vision, such as Remote Arm operation training, avoid bright light situations. No piloting of an aircraft for 24 hours after dilation. Ultrasound Eye: Contact Lens and eye makeup should be removed prior to class
Launch Delay Requirements:	Refresher training to be scheduled at Crew Surgeon request
Notes:	• *Near Visual Acuity Chart without Amsler Grid – dependent on SpX-15 • Training procedures can be found in Space Medicine crew training lesson plans and the SODF: ISS Med (Medical Checklist)

3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES

<table>
<tr><td>Preflight Activity Description:</td><td colspan="4">Preflight eye examinations include:
L-21/18 m
MRI (3T or better using specific ocular imaging protocols)

L-21/18 m and L-9/6 m
(The following tests are performed with and/or in addition to the annual eye exam)

Refraction – manifest and cycloplegic
Amsler grid
Pupil reflexes
Biomicroscopy (slit lamp)
Retinal photography
Optical coherence tomography (high resolution) including Spontaneous Venous Pulsations (SVP) videography
Visual acuity, distance and near
Threshold visual fields
Contrast sensitivity
Extraocular muscle balance
Dilated fundoscopic examination
Tonometry
Optical biometry

L-9/6m
2-D Imaging Ultrasound
Contact Lens / Spectacle Fitting

L-90/30
Best corrected visual acuity
Color vision testing
Refraction (manifest)
Biomicroscopy (slit lamp)
Tonometry
Fundus Exam (undilated)
OCT (if any baseline scans need to be repeated)</td></tr>
<tr><td>Preflight Activity (continued)</td><td>Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td></td><td><u>MRI</u>
Exam time 45 minutes

Travel time to off-site facility approximately 20 minutes each way (not included in MRID time)</td><td>L-21/18 m</td><td>If needed, as close in to schedule as possible</td><td>Crewmember, Imaging Technician(s)</td></tr>
</table>

	Eye examination and testing* 135 minutes total (Includes Eye exam on-site: 60 minutes; OCT on-site: 30 minutes; Travel time to off-site eye facility: 15 minutes; Remaining tests at off-site eye facility: 30 minutes, does not include drive time back)	L-21/18 m, L-9/6 m		Crewmember, Eye Specialists
	2-D Imaging Ultrasound 20 minutes	L-9/6 m		Crewmember, Imaging Technician(s)
	Contact Lens / Spectacle Fitting 60 minutes (Fitting performed at off-site eye facility, travel time is 15 minutes, is performed on a different day after the L-9/6 Eye Exams)	L-9/6 m		Crewmember, Eye Specialists
	Eye examination 60 minutes	L-90/30 days		Crewmember, Eye Specialists
Ground Support Requirements Hardware/Software	**Preflight Hardware:**	**Preflight Software:**	**Test Location:**	
	Ocular examination equipment, OCT, general purpose 2-D ultrasound. MRI is stationary equipment	Acuity Pro	U.S.	

Testing Facilities (NASA/JSC Flight Medicine eye clinic, Coastal Eye Associates, UTMB, or other qualified providers)	**Minimum Room Dimensions:**	**Number of Electrical Outlets:**	**Temperature Requirements:**	**Special Lighting:**
	8’ x 10’	2 (110V)	Ambient	Adjustable
	Hot or Cold Running Water:	**Privacy Requirements:**	**Vibration/Acoustic Isolation:**	**Other:**
	N/A	Private room free of distraction	N/A	N/A

Constraints/Special Requirements:	L-21/18 and L-9/6 testing
	• Drugs used to dilate the pupils will cause increased sensitivity to bright light and blurred vision. Constraints following the exam include:
	  • No piloting of aircraft for 24 hours after dilation
	  • Driving may be done, but, with extra caution
	  • Avoid operation of any heavy equipment
	  • Avoid operation of anything that may require acute vision, such as Remote Arm operation training
	  • Avoid bright light situations
	  • Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks
	  • Neurovestibular activities or other tests that require the use of the eyes should be scheduled at least 8 hours after MRID these exams
	• For all tests - contact lenses should be removed before test so crew members should either bring case and solution or wear glasses to test
	• For L-21/18 m and L-9/6 m, off-site eye examination should occur on a separate day from the on-site eye examination
	• Preflight OCT exam needs to be performed using a Heidelberg OCT

Launch Delay Requirements:	N/A
Notes:	• Some tests (e.g. MRI and ultrasound) will need to be scheduled separately from other tests • MRI scans should be combined with similar research scans whenever possible to prevent redundant crew testing • L-90/30 eye examination also includes a comprehensive review of mission eyewear (e.g. safety glasses, laser eye protection, spectacles, contact lenses, etc.) and education on potential vision changes that might be experienced in-flight
Data Delivery	**Vision Testing, Tonometry, Fundoscopy, OCT** Raw data and pre-flight eye examination reports are entered directly into the EMR/PACS system by the eye specialists. Discrete data parameters are archived in a structured data storage format. **2-D Imaging Ultrasound** Raw data/images are transferred to the PACS. Preliminary reports containing preliminary analysis and DICOM images are sent to an outside reading facility for a Radiologist's clinical interpretation. The resulting final reports are loaded into PACS and accessible from the EMR once received. Discrete data parameters are archived in a structured data storage format. **MRI** Raw data/images are transferred to PACS. DICOM images are sent to an outside reading facility for a Radiologist's clinical interpretation. Examination reports are transferred to the EMR. Discrete data parameters are archived in a structured data storage format.

3.5 In-Flight Activities

TABLE 3.5: IN-FLIGHT ACTIVITIES

In-Flight Activity	Eye examinations				
Description:	**Activity:**	**Duration**	**Schedule:**	**Flexibility:**	**Personnel Required:**
Schedule:	Vision Testing (w/o contrast sensitivity) Acuity (near and far) Amsler Grid	Set up: 5 minutes Exam: 20 minutes Stow: 5 minutes	<u>For six month crewmembers</u> L+30, L+90, R-30, and as clinically indicated <u>For one-year crewmembers</u> L+30, L+90, L+180, L+270 and R-30, and as clinically indicated	+/- 10 days	Crewmember– Subject only Remote Guider
	Vision Testing Questionnaire	5 minutes			Crewmember– Subject only
	Fundoscopy	Prep: 5 minutes Setup: 10 minutes Exam: 30 minutes (Operator and Subject each) Stow: 10 minutes			Crewmembers – Subject and Operator Remote Guider Ops Representative SME(Optometrist or Ophthalmologist)
	2-D imaging ultrasound	USND 2 Set Up: 25 minutes (if required) USND 2 Power on: 5 minutes Ultrasound prep: 10 minutes Exam: 30 minutes (subject & operator each) Ultrasound Post Exam: 5 minutes USND 2 Stow: 10 minutes (if required)			Crewmembers – Subject and Operator Remote Guider (Sonographer)

	OCT	Set Up: 15 minutes Exam: 45 minutes (Operator and Subject each) Stow: 10 minutes			Crewmembers – Subject and Operator Remote Guider Ops Representative SME(Optometrist, Ophthalmologist)
	Contrast Sensitivity	Add 10 minutes to Vision Testing exam time	As clinically indicated	N/A	Crewmember– Subject only Remote Guider
	Tonometry	Set up: 15 minutes (Operator or Subject) Practice: 5 minutes per CMO Exam: 15 minutes (Operator and Subject each) Stow: 10 minutes			Crewmembers – Subject and Operator Remote Guider Ops Representative SME(required only if non-clinician Remote Guider)
Procedures:	In-flight procedures can be found within the SODF: ISS Med (Medical Checklist)				

Constraints / Special Requirements:	• Vision Testing requires privatized 2-way audio communication and remote control of onboard laptop for remote guidance and/or operational support.
	• Fundoscopy and OCT require the use of two ground TV monitors.
	• Pre-flight Vision Testing information is required by the Vision Testing Remote Guider, specifically prime eyewear available to crew and Contrast Sensitivity data
	• Drugs used in conjunction with anesthetic drops should be administered prior to use of the anesthetic drops. Anesthetic drops are used for tonometry exams.
	• Schedule other ocular tests at least 8 hours after tonometry
	• Drugs used to dilate the pupils for the Fundoscopy exams will cause increased sensitivity to bright light and blurred vision. The exams should be scheduled after activities or other tests that require the use of the eyes. Constraints following the exams include:
	  • No piloting for 24 hours after dilation
	  • Avoid operation of anything that may require acute vision, such as Remote Arm operation
	  • Avoid bright light situations.
	  • Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks
	  • Dilation and Fundoscopy should be scheduled at the end of the crew day to minimize impacts
	  • Schedule At least 1 hour between Ocular Ultrasound (utilizing ultrasound gel) and other Eye Exams to avoid interference of ultrasound gel with the other exams.				

	Other specific planning constraints are listed with each activity in the Summary table
Notes	• If Ground is unable to perform USND2 Data Export, an additional 10 minutes (per exam) or 5 minutes (per exam with continuous KU) is required for Crew Data Export. • If Ground is unable to command OCT, an additional 20 minutes is required for Setup, for a total of 35 minutes. • If Ground is unable to perform OCT Data Export, an additional 10 minutes will be added to the Stow activity, for a total of 20 minutes.
Photo/TV Requirements:	Tonometry • Privatized 2-way audio communication • Privatized live cabin video downlink Fundoscopy • Privatized 2-way audio communication • Privatized live cabin video downlink • Privatized live streaming video of onboard laptop used for Fundoscopy OCT • Privatized 2-way audio communication • Privatized live cabin video downlink • Privatized live streaming video of onboard laptop used for OCT 2-D Imaging Ultrasound • Privatized 2-way audio communication • Privatized live cabin video downlink (as requested by remote guidance team or Flight Surgeon) • Privatized live ultrasound scanhead video downlink
Mission Extension Requirements:	N/A
Landing Wave-Off Requirements:	N/A

Data Delivery	**Vision Testing** **In-flight vision testing questionnaire** data is downlinked via Orbital Communications Adapter (OCA). The Med Ops Data Distribution Specialist (DDS) posts the downlinked data to the Mission Extended Medical Enterprise (MEME) Repository and the data is then electronically combined with the Vision Testing Results and transferred to the EMR where the eye specialist(s) performs final interpretation/analysis. **Vision Testing results** are entered directly into the Mission Extended Medical Enterprise (MEME) Repository by a remote guider and electronically combined with the In-flight vision testing questionnaire and transferred to the EMR for final interpretation/analysis by the eye specialist. **Fundoscopy** Fundoscopy data is downlinked via OCA. The Med Ops DDS posts the downlinked images to the MEME Repository and the images are then routed to the PACS/EMR where the eye specialist(s) performs final analysis. The final reports are located and accessible from the EMR or PACS systems. **Tonometry** In-flight tonometry testing data is entered directly into the EMR Inflight Eye Exam Form which serves as the Final Report. **2-D Imaging Ultrasound** In-flight ultrasound data/images are routed by the Telescience Center to Web Mirage. The in-flight data/images are transferred from Web Mirage to PACS. Preliminary reports containing preliminary analysis and DICOM images are sent to an outside reading facility for a Radiologist's clinical interpretation. The resulting final reports are loaded into PACS once received and available from the EMR. **OCT** An OCT baseline testing file is uplinked prior to the crewmember's first session. In-flight OCT data is downlinked via OCA. The Med Ops DDS posts the downlinked OCT data to the MEME Repository and the data is then posted to the Ground OCT Device where eye specialist(s) performs final analysis. The final reports are located and accessible from the EMR.

3.6 Postflight Activities

TABLE 3.6 POSTFLIGHT ACTIVITIES

Postflight Activity

Description:

Eye Examinations

R+0/1

Includes ophthalmoscopic exam

R+1/3 days (or as soon as possible) and as clinically indicated

Ocular Questionnaire	Visual acuity, distance and near
Refraction – manifest and cycloplegic	Threshold visual fields
Amsler grid	Contrast sensitivity
Pupil reflexes	Extraocular muscle balance
Biomicroscopy (slit lamp)	Dilated fundoscopic examination
Retinal photography	Tonometry
Optical coherence tomography (high resolution)	Optical biometry
2-D imaging ultrasound	MRI (3T, orbit and brain protocol)

Schedule:

Duration:	Schedule:	Flexibility:	Personnel Required:
Eye Examination: 5 min	R+0/1	N/A	Flight Surgeon, Crewmember
<u>Eye examinations and testing*</u> 135 minutes (Includes Eye exam on-site: 60 minutes; OCT on-site: 30 minutes; Travel time to off-site eye facility: 15 minutes; Remaining tests at off-site eye facility: 30 minutes (<u>May</u> include annual eye exam, does not include drive time back, MRI or 2-D imaging ultrasound) **<u>MRI</u>** Exam time: 60 minutes Travel time to off-site facility approximately 20 minutes each way (not included in MRID time) **<u>2-D Imaging Ultrasound</u>** 20 minutes	R+1 – R+3 days (or as soon as possible)	See notes	Eye Specialists, Crewmember

<table>
<tr><td rowspan="2">Ground Support Requirements Hardware/Software</td><td colspan="2">Postflight Hardware:</td><td colspan="2">Postflight Software:</td><td colspan="2">Test Location:</td></tr>
<tr><td colspan="2">Ocular examination equipment, OCT, general purpose 2-D ultrasound, MRI</td><td colspan="2">N/A</td><td colspan="2">U.S.</td></tr>
<tr><td rowspan="4">Testing Facilities (NASA/JSC Flight Medicine Eye clinic, Coastal Eye Associates, UT-Houston, or other qualified providers)</td><td>Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td>Special Lighting:</td></tr>
<tr><td>8’ x 10’</td><td>2 (110V)</td><td>Ambient</td><td>Adjustable</td></tr>
<tr><td>Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td>Vibration/Acoustic Isolation:</td><td>Other:</td></tr>
<tr><td>N/A</td><td>Private room free of distraction</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="6">• *For R+1/3, off-site eye examination should occur on a separate day after the on-site eye examination. Due to the negative impact of fatigue on visual field test results, the off-site eye examination can occur later than R+3, but within 7 days of return
Drugs used to dilate the pupils will cause increased sensitivity to bright light and blurred vision. Constraints following the exam include:
• No piloting of aircraft for 24 hours after dilation
• Driving may be done but with extra caution
• Avoid operation of any heavy equipment
• Avoid operation of anything that may require acute vision, such as Remote Arm operation training
• Avoid bright light situations
• Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks
• Neurovestibular activities or other tests that require the use of the eyes should be scheduled after at least 8 hours after these MRID exams</td></tr>
<tr><td>Notes</td><td colspan="6">• Postflight battery of tests should be conducted as soon as possible. If eye exam results are off- nominal, a follow up exam may be scheduled at any time at the discretion of the vision specialist/flight surgeon. Corneal topography performed if indicated.
• Follow abnormal findings every 30 days until clinically stable or as clinically indicated.</td></tr>
</table>

Data Delivery	**<u>Vision Testing, Tonometry, Fundoscopy</u>** Raw data and post-flight eye examination reports are entered directly into the EMR/PACS system by the eye specialist. **<u>2-D Imaging Ultrasound</u>** Raw data/images are transferred to the PACS. Preliminary reports containing preliminary analysis and DICOM images are sent to an outside reading facility for a Radiologist's clinical interpretation. The resulting final reports are loaded into PACS and accessible from the EMR once received. Discrete data parameters are archived in a structured data storage format. **<u>MRI</u>** Raw data/images are transferred to PACS. DICOM images are sent to an outside reading facility for a Radiologist's clinical interpretation. Examination reports are transferred to the EMR. Discrete data parameters are archived in a structured data storage format

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training:					
Retinal Imaging	90 minutes	2A6	+/- one trip	Remote Guider Instructor, Crewmember, Test Subject	If the crewmember chooses to self-image during class (optional), drugs used to dilate the pupils will cause increased sensitivity to bright light and blurred vision. Neurovestibular activities or other tests that require the use of the eyes should be scheduled at least 8 hours after these MRID activities. Constraints following the activity include: •No piloting of aircraft for 24 hours after dilation •Driving may be done but with extra caution •Avoid operation of any heavy equipment •Avoid operation of anything that may require acute vision, such as Remote Arm operation training •Avoid bright light situations •Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks
Retinal Imaging 2	60 minutes	6A1	+/- one trip		
Tonometry Ops	90 minutes	2A9	+/- one trip	Tonometer Remote Guider, Remote Guider Instructor, Test Subjects, Crewmember	N/A
Ultrasound Eye	60 minutes	2A8	+/- one trip	Remote Guider Instructor, Ultrasound Specialist/Sonographer, ISSMP personnel, Crewmember	Contact lenses and eye makeup should be removed before test so crew members should either bring case and solution or wear glasses to test
OCT Ops I OCT Ops II	90 minutes 60 minutes	2A6 6A1	+/- one trip	Remote Guider Instructor, Crewmember, Test Subjects	

Preflight Activity:					
ACTIVITY	**DURATION**	**SCHEDULE**	**FLEXIBILITY**	**PERSONNEL REQUIRED**	**CONSTRAINTS**
MRI (3T or better using specific ocular imaging protocols)	Exam time 45 minutes	AME L-21/18 m	If needed, as close in to schedule as possible	Crewmember, Imaging Technician(s)	
Eye Examinations: • Visual acuity, distance and near • Refraction – manifest and cycloplegic • Threshold visual fields • Amsler grid • Contrast sensitivity • Pupil reflexes • Extraocular muscle balance • Biomicroscopy (slit lamp) • Dilated fundoscopic examination • Retinal photography • Tonometry • Optical coherence tomography (high resolution) including SVP videography • Optical biometry	135 minutes (Includes drive time to off-site eye facility, does not include drive time back)	L-21/18 m and L-9/6 m		Crewmember, Eye Specialists	-Drugs used to dilate the pupils will cause increased sensitivity to bright light and blurred vision. Constraints following the exam include: • No piloting of aircraft for 24 hours after dilation • Driving may be done but with extra caution • Avoid operation of any heavy equipment • Avoid operation of anything that may require acute vision, such as Remote Arm operation training • Avoid bright light situations. • Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks • Neurovestibular activities or other tests that require the use of the eyes should be scheduled at least 8 hours after these MRID exams -Contact lenses should be removed before test so crew members should either bring case and solution or wear glasses to test. -Off-site eye examination should occur on a separate day from the on-site eye examination.

Contact Lens / Spectacle Fitting	60 minutes	L-9/6 m		Crewmember, Eye Specialists	
2-D Imaging Ultrasound	20 minutes	L-9/6 m		Crewmember, Imaging Technician(s)	Contact lenses and eye makeup should be removed before test so crew members should either bring case and solution or wear glasses to test
Eye Examinations: • Best corrected visual acuity • Color vision testing • Refraction (manifest) • Biomicroscopy (slit lamp) • Tonometry • Fundus Exam (undilated) • OCT (if any baseline scans need to be repeated)	60 minutes	L-90/30 days		Crewmember, Eye Specialists	

In-flight Activity					
ACTIVITY	**DURATION**	**SCHEDULE**	**FLEXIBILITY**	**PERSONNEL REQUIRED***	**CONSTRAINTS**
Vision Testing (w/o contrast sensitivity) Acuity (near and far) Amsler Grid	Set up: 5 minutes Exam: 20 minutes Stow: 5 minutes	<u>For six month crewmembers</u> L+30, L+90, R-30, and as clinically indicated <u>For one-year crewmembers</u> L+30, L+90, L+180, L+270 and R-30, and as clinically indicated	+/- 10 days	Crewmember – Subject only Remote Guider	Schedule at least 1 day prior to Eye Ultrasound, Fundoscopy, and OCT to allow time for eye doctors to evaluate Vision Testing results prior to other eye exams
Vision Testing Questionnaire	5 minutes			Crewmember – Subject only	Schedule after Vision Testing and at least 1 day prior to Eye Ultrasound, Fundoscopy, and OCT to allow time for eye doctors to evaluate Vision Testing and Questionnaire results prior to other eye exams.
Fundoscopy	Prep (eye dilation): 5 minutes Setup: 10 minutes Exam: 30 minutes (Operator and Subject each) Stow: 10 minutes			Crewmembers- Subject and Operator Remote Guider Ops Representative SME(Optometrist or Ophthalmologist)	• Schedule Prep 30 minutes before Exam to allow for eye dilation. • Schedule Prep and Exam at the end of the crew duty day to minimize impacts due to eye dilation. • Schedule at least 1 day after Vision Testing to allow for eye doctors to evaluate Vision Testing results prior to Fundoscopy. • Best if not scheduled same day as Tonometry. If tonometry scheduled on same day, schedule at least 8 hours after tonometry. Tonometry requires numbing of the eye and can compromise eye for Fundoscopy. • Subject should not be piloting for 24 hours after dilation, and should avoid operation of anything that may require acute vision, such as Remote Arm operation. • May not be done during docking, attitude maneuvers or burns as eye damage may occur from sudden movements.

2-D imaging ultrasound	USND 2 Set Up: 25 minutes (if required) USND 2 Power on: 5 minutes Ultrasound prep: 10 minutes Exam: 30 minutes (Operator and Subject each) Ultrasound Post Exam: 5 minutes USND 2 Stow: 10 minutes *If Ground is unable to perform USND 2 Data Export, an additional 10 minutes (per exam) or 5 minutes (per exam with continuous KU) is required for Crew Data Export.			Crewmembers-Subject and Operator Remote Guider (Sonographer) Remote Guider Assistant	• May not be done during docking, attitude maneuvers or burns as eye damage may occur from sudden movements. • Schedule at least 1 day after Vision Testing to allow for eye doctors to evaluate Vision Testing results prior to Ultrasound. • Schedule At least 1 hour between Ocular Ultrasound (utilizing ultrasound gel) and other Eye Exams to avoid interference of ultrasound gel with the other exams. • If tonometry scheduled on same day, schedule at least 8 hours after tonometry.
OCT	Set Up: 15 minutes Exam: 45 minutes (Operator and Subject each) Stow: 10 minutes * If Ground is unable to command OCT, an additional 20 minutes is required for Setup, for a total of 35 minutes. * If Ground is unable to perform OCT Data Export, an additional 10 minutes will be added to the Stow activity, for a total of 20 minutes.			Crewmembers-Subject and Operator Remote Guider Ops Representative SME(Optometrist, Ophthalmologist)	• Schedule at least 1 day after Vision Testing to allow for eye doctors to evaluate Vision Testing prior to OCT exam. • OCT should be scheduled at least 8 hours after eye exams requiring numbing. • May not be done during docking, attitude maneuvers or burns as eye damage may occur from sudden movements.
Contrast Sensitivity	Add 10 minutes to Vision Testing exam time	As clinically indicated	N/A	Crewmember – Subject only Remote Guider	• Same as Vision testing
Tonometry	Set up: 15 minutes (Operator or Subject) Practice: 5 minutes per CMO Exam: 15 minutes (Operator and Subject each) Stow: 10 minutes	As clinically indicated	N/A	Crewmembers-Subject and Operator Remote Guider Ops Representative	• Requires eye anesthesia. • May not be done during docking, attitude maneuvers or burns as eye damage may occur from sudden movements.

				SME(required only if non-clinician Remote Guider)	

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Postflight Activity					
Eye examination:	5 minutes	R+0/1	N/A	Flight Surgeon, Crewmember	-Drugs used to dilate the pupils will cause increased sensitivity to bright light and blurred vision. Constraints following the exam include: • No piloting of aircraft for 24 hours after dilation • Driving may be done but with extra caution • Avoid operation of any heavy equipment • Avoid operation of anything that may require acute vision, such as Remote Arm operation training • Avoid bright light situations. • Small print will be difficult to read: avoid scheduling dilation prior to reading or computer tasks • Neurovestibular activities or other tests that require the use of the eyes should be scheduled at least 8 hours after these MRID exams -Contact lenses and eye makeup should be removed before test so crew members should either bring case and solution or wear glasses to test -Off-site eye examination should occur on a separate day after the on-site eye examination. Due to the negative impact of fatigue on visual field test results, the off-site eye examination can occur later than R+3, but within 7 days of return.
Eye Examinations: • Ocular Questionnaire • Visual acuity distance and near • Refraction (manifest and cycloplegic) • Threshold visual fields • Contrast sensitivity • Pupil reflexes • Extraocular muscle balance • Biomicroscopy (slit lamp) • Dilated fundoscopy • Retinal photography • Tonometry • Optical coherence tomography - OCT (high resolution) • Optical biometry	**Eye examinations and testing** 135 minutes (Includes Eye exam on-site: 60 minutes; OCT on-site: 30 minutes; Travel time to off-site eye facility: 15 minutes; Remaining tests at off-site eye facility: 30 minutes, may include annual eye exam does not include drive time back),	R+1 – R+3 days (or as soon as possible) Follow abnormal findings every 30 days until clinically stable or as clinically indicated.	If eye exam results are off- nominal, a follow up exam may be scheduled at any time at the discretion of the specialist/flight surgeon.	Eye Specialists, Crewmember	
MRI (3T, orbit and brain protocol)	**MRI** Exam time 60 minutes				

2-D Imaging ultrasound	**2-D Imaging Ultrasound** 20 minutes				Contact lenses and eye makeup should be removed before test so crew members should either bring case and solution or wear glasses to test
Postflight Debrief: N/A					