



CLDP-STD-1123
Revision A

Commercial Low-Earth Orbit Development Program Medical Standards and Capabilities

Revision A

August 2025

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PREFACE

**COMMERCIAL LOW-EARTH ORBIT DEVELOPMENT PROGRAM (CLDP) MEDICAL
STANDARDS AND CAPABILITIES**

This document has been developed to define minimum medical and behavioral health evaluation requirements for crew health certification, minimum mission medical evaluations, medical personnel qualifications, and minimum medical capabilities of a Commercial Low-Earth Orbit (LEO) Destination system for NASA missions to a Commercial LEO Destination (CLD).

This document is under the control of a Program Control Board (PCB). The PCB is the authority for baselining and approving changes. The CLDP Operations and Training Office is the Office of Primary Responsibility (OPR) for this document.

See Directive CLDP-D0058 Approval

08/27/2025

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Commercial Low-Earth Orbit Development Program (CLDP)
COMMERCIAL LOW-EARTH ORBIT DEVELOPMENT PROGRAM MEDICAL STANDARDS
AND CAPABILITIES CONCURRENCE

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1.0 INTRODUCTION

Future human spaceflight missions to Low-Earth Orbit (LEO) will involve exciting partnerships between Commercial Providers and the National Aeronautics and Space Administration (NASA). In order to work together to achieve successful mission operations, this document helps communicate the NASA expectations related to medical testing and evaluation of Commercial LEO Destination crew, which encompasses United States Government (USG) crew and Commercial (non-USG) crew. As the International Space Station (ISS) prepares to be decommissioned, NASA is enabling the development and growth of the Commercial LEO economy to promote competition and procure Commercial LEO Destination System (CLDS) services. These services include utilization, ground, transportation, on-orbit, and return operations services of both crew and cargo to support NASA missions.

Every mission exposes the flight crew to various forms of risk. The execution of the mission must balance those risks with the consequences of loss of the mission objectives (such as the incremental risk of repeating the mission or impacts to subsequent missions). Effective execution of real-time operations inherently requires the ability to make timely and informed decisions to continue or terminate a mission based on the full understanding of the immediate and future possible risks, including those that are medical in nature. The standards in this document are derived from best practices and processes established in previous NASA human spaceflight programs. The effective management of, and adherence to, these standards is critical to ensure a successful handover of traditionally NASA-led operations managed by the ISS Program to Contractor-led operations.

1.1 PURPOSE

This document establishes the minimum expectations to reach NASA risk acceptance for the medical and behavioral health certification of CLDS crews, mission medical evaluations to be performed for CLDS crewmembers, medical personnel qualifications, and onboard medical capabilities of the CLDS.

NASA encourages the Commercial Provider to seek new, innovative, and cost-effective methods for meeting these standards. This document is not meant to imply that the Commercial Provider should holistically perform medical certification, testing, and in-flight care in the same manner as NASA's past or present techniques; but it is meant to ensure that the CLDS medical system, medical personnel qualifications, and crew health assessments processes adequately enable evaluation and mitigation of medical risk to which the USG crew will be exposed.

1.2 SCOPE

The scope of the Commercial Low-Earth Orbit Development Program (CLDP) Medical Standards and Capabilities includes the minimum set of standards and evaluations for medical and behavioral health certification of individuals flying on a NASA CLD mission or on a mission cohabitating with USG crew, medical personnel qualifications, the minimum mission medical evaluations to be performed on mission assigned CLD crew

flying on a NASA CLD mission or cohabitating with USG crew, and the minimum medical capabilities to be available onboard the CLDS. These standards apply to both short (less than or equal to 30 days) and long-duration crews (greater than 30 days). Selection and Mission medical evaluation requirements will vary depending on mission duration (short versus long duration) and whether the crew have safety-critical roles.

1.3 PRECEDENCE

Applicable laws and regulations supersede this document unless a specific exemption is granted. Additionally, nothing in this document supersedes operations standards specifically adjudicated, tailored, and levied in the contracts. Beyond the aforementioned items, in the event of a conflict between the text of this document and references cited herein (listed in Section 2.0), the text of this document takes precedence.

1.4 CHANGE AUTHORITY AND RESPONSIBILITY

Proposed changes to this document will be submitted via Change Request (CR) to the CLDP Control Board for consideration and disposition. All CRs to this document will adhere to the CLDP configuration management change process as defined in CLDP-P-4010, Commercial Low-Earth Orbit Development Program Change Management Process. The CLDP Operations and Training Office is the Office of Primary Responsibility (OPR) for this document.

1.5 VERB APPLICATION

CLDP defines its implementation of requirement verbs as follows:

Throughout this document set, “will” is used in a statement of fact, declaration of purpose, or expected occurrence; “shall” is used for binding requirements that must be verified and have an accompanying method of verification; and “should” denotes a statement of best practice. “May” is used to indicate permission. “Is” and “are” indicate descriptive material.

2.0 DOCUMENTS**2.1 APPLICABLE DOCUMENTS**

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph are applicable to the extent specified herein. Inclusion of applicable documents herein does not in any way supersede the order of precedence identified in Paragraph 1.3 of this document.

Document Number	Title
CLDP-PLN-1111	Commercial Low-Earth Orbit Development Program Crew Health Operations Concept
CLDP-P-4010	Commercial Low-Earth Orbit Development Program Change Management Process
CLDP-PLN-3016	Commercial Low-Earth Orbit Development Program (CLDP) Insight Management Plan
NPD 1000.3	The NASA Organization
NPD 8900.1	Medical Operations Responsibilities in Support of Human Space Flight Programs
NPD 8900.5	NASA Health and Medical Policy for Human Space Exploration
NPR 7120.11	NASA Health and Medical Technical Authority (HMTA) Implementation

2.2 REFERENCE DOCUMENTS

The following documents contain supplemental information to guide the user in the application of this document. These reference documents may or may not be specifically cited within the text of this document.

Document Number	Title
	The American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM) – Latest Version
	Centers for Disease Control and Prevention, Third National Health and Nutrition Examination Survey (NHANES III) (https://www.cdc.gov/nchs/nhanes/nh3data.htm)
	Health Insurance Portability and Accountability Act (HIPAA) (https://www.hhs.gov/hipaa/for-professionals/security/laws-regulations/index.html)

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	Privacy Act of 1974, as amended (https://www.justice.gov/opcl/privacy-act-1974)
CLDP-STD-1150	Commercial Low-Earth Orbit Development Program Operations Standards
NASA-STD-3001, Vol. 1	NASA Spaceflight Human-System Standard Volume 1, Crew Health
NASA/TM-2008-214775	International Space Station Human Behavior and Performance Competency Model, Vol 1, and Vol 2
NPD 1382.17	NASA Privacy Policy
OCHMO-STD-100.1	NASA Space Flight Medical Selection, Recertification and Mission Evaluation Standards

3.0 MEDICAL PERSONNEL QUALIFICATIONS

Medical support personnel with appropriate training and expertise are paramount to conducting a thorough and effective medical and behavioral health risk assessment for flight certification process and for providing medical and behavioral health care to crewmembers during all phases of flight. This section describes the required credentials and qualifications of the medical personnel with responsibilities pertaining to CLDS crewmember medical care and assessment.

[3001] The Commercial Provider **shall** ensure that any physicians responsible for preparing or who have approval authority for medical certification of CLD crew and/or who provide medical care to crew during hazardous training, Health Stabilization Program, nominal launch and landing activities, and/or during flight will:

- A. Have a Doctor of Medicine (M.D.) or Doctor of Osteopathic Medicine (D.O.) degree from an accredited institution (or Bachelor of Medicine, Bachelor of Surgery [MBBS/MBChB] or equivalent if medical training was completed outside the United States [U.S.]).
- B. Be licensed in a U.S. state to practice medicine,
- C. Have board certification in either their primary specialty or aerospace medicine, and
- D. Have completed either:
 - 1. A military primary aerospace medicine training leading to the designation of flight surgeon, or
 - 2. An accredited (by the American College of Graduate Medical Education) aerospace medicine residency or fellowship training program, or
 - 3. An accredited Undersea and Hyperbaric Medicine fellowship.

[3002] The Commercial Provider **shall** ensure that any physicians providing medical care to CLD crew during launch or landing contingencies will:

- A. Have an M.D. or D.O. degree from an accredited institution (or MBBS/MBChB or equivalent if medical training was completed outside the U.S.),
- B. Be licensed in a U.S. state to practice medicine,
- C. Have board certification in either Emergency Medicine, General Surgery, Anesthesia Critical Care, Pulmonary Critical Care or Critical Care Medicine,
- D. Have active certifications in Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS) and Advanced Trauma Life Support (ATLS),
- E. Have current credentials in their specialty at their main hospital of employment which should be a level 2 trauma center or higher,
- F. Have certification in the use of bedside ultrasound,
- G. Have recent experience running traumas, as evidenced by having active privileges in a relevant area (i.e., Emergency Department, Intensive Care Unit) at a hospital that is a level 2 trauma center or higher.

- H. Have proficiency in stabilizing critically ill patients by means of mechanical ventilation,
- I. Have familiarity with rotary wing air operations including helicopter underwater egress training.

[3003] The Commercial Provider **shall** ensure that any paramedics and/or nurses who provide nominal and off-nominal medical care to CLD crew during launch and/or landing will:

- A. Have paramedic certification or a degree in nursing with an active state medical license,
- B. Have experience and active clinical proficiency in management of polytrauma and medical emergencies in an enroute care setting including but not limited to hemorrhage control, advanced airway management to include intubation, and fluid resuscitation to include blood administration,
- C. Have experience and active clinical proficiency in blood sampling, IV insertion, urinary catheter placement and management,
- D. Have active certifications in BLS, ACLS and ATLS.

[3004] The Commercial Provider **shall** ensure that any psychiatrists responsible for CLD crew behavioral health certification and/or for operational care of crew during preflight crew preparation and in-flight monitoring, support, and intervention will be board certified psychiatrists with experience in selection and operations for spaceflight or similar mission-critical environments.

[3005] The Commercial Provider **shall** ensure that any psychologists responsible for CLD crew behavioral health certification and/or for operational care of crew during preflight crew preparation and in-flight monitoring, support, and intervention will be doctoral-level licensed and qualified Clinical/Operational Psychologists with experience in selection and operations for spaceflight or similar mission-critical environments.

4.0 MINIMUM CLDS CREWMEMBER MEDICAL AND BEHAVIORAL HEALTH CERTIFICATION STANDARDS AND PROCESSES

4.1 GENERAL CONSIDERATIONS

Missions to space involve training, launching, operating aboard the Destination, and returning to Earth. Mission parameters to consider in evaluation of medical and behavioral health risk posed by a crewmember's health status include, but are not limited to mission duration, crew's roles and responsibilities including safety-critical functions, in-flight medical capability, capability for medical evacuation, crew size, crew medical training and proficiency, and the Program's acceptable risk threshold. In addition, the evaluation must consider the interaction between the crew and the vehicle and its subsystems, as well as the anticipated effects of the spaceflight and mission on the human. Some examples of this include consideration of expected levels of carbon dioxide (CO₂) or the presence of food allergens in the food system and the effects of

such factors on a crewmember's health status and the effect of microgravity-induced fluid shifts on the eye or on physical conditioning and musculoskeletal system. Impacts of physical and mental stressors on the crewmember's pre-existing medical conditions or risk factors for development of new conditions are identified and considered prior to final medical certification for each mission.

Medical and behavioral health standards for flight certification are established to identify and disposition risk posed by pre-existing medical conditions or risk factors for development of new conditions to crew health and safety and to mission success. These standards reflect the medical and behavioral health requirements to successfully complete the multifaceted training and performance required of a crewmember including, but not limited to, flying in high performance aircraft, exposure to hypobaric and hyperbaric conditions, exposure to unique environments (e.g., microgravity), and conducting specialized operations (e.g., robotic arm operations).

Medical and behavioral health certification begins with conducting medical and behavioral health evaluations. These include performing an extensive medical history and physical exam and obtaining screening tests. Findings from these evaluations are assessed against medical and behavioral health standards which describe conditions that pose an elevated risk. If the findings from the evaluations do not meet standards, further investigation of the severity of any condition and its impact to crew health and safety or mission success is carefully evaluated. Mitigations may be considered that can either treat the condition or minimize the risk posed by the condition. After all investigations are complete and mitigations have been implemented, risk posed by that condition is re-evaluated to determine if a medical waiver can be granted to enable the individual to fly. Historically, NASA has fixed and flown numerous conditions that did not meet standards and were initially disqualifying for spaceflight duties. Indeed, despite NASA's decades of spaceflight experience, very few NASA astronauts have had to be permanently disqualified from spaceflight duties for medical or behavioral health reasons.

Candidates for selection as CLDS crewmember on a NASA CLD mission or who will be cohabitating with USG crew in-flight are evaluated for early detection of diseases that may interfere with their ability to perform mission tasks and/or pose risk to USG crew or NASA mission success.

Medical and behavioral health evaluation procedures used are designed to select and certify individuals who are free from conditions that may:

- A. Compromise the non-USG crewmember's health and safety during a mission.
- B. Compromise the USG crew's health and safety.
- C. Compromise the completion of NASA mission objectives.

4.2 CERTIFICATION PROCESS

NASA expects the Commercial Provider to medically certify all crew flying to a Destination on a NASA mission or crew cohabitating with USG crew in-flight per the Commercial Provider-developed Medical and Behavioral Health Standards and

Evaluation Requirements that meet NASA-specified minimums per Section 4.3.1, Medical and Behavioral Health Evaluation.

NASA expects to exercise oversight of the Commercial Provider medical and behavioral health certification process to inform and disposition propagated risk to USG crew health or safety. NASA envisions a phased approach to exercising oversight consistent with the Trusted Provider Approach described in CLDP-PLN-3016, Commercial Low-Earth Orbit (CLDP) Insight Management Plan. The Commercial Provider remains responsible for medical and behavioral health certification of all crew for flight for all CLD missions.

[4001] The Commercial Provider **shall** define a medical and behavioral health evaluation/certification process that includes the following:

A. Initial State

1. Commercial Provider develops Medical Certification Package for non-USG crew per Commercial Provider Medical Standards and Evaluation requirements.

Note: NASA develops Medical Certification Package for USG crew per Commercial Provider Medical Standards and Evaluation requirements.

2. Commercial Provider presents non-USG crew Medical Certification Package to NASA Aerospace Medicine Board (AMB) and addresses all NASA AMB identified actions for risk assessment and mitigation.

Note: NASA AMB reviews and dispositions non-USG crew medical risk. For conditions not meeting standards, NASA AMB assesses risk mitigation strategy and identifies additional evaluation/intervention (if applicable). This may involve multiple presentations to NASA AMB and offline discussion to ensure risk mitigation approach is adequate. Following implementation of mitigations, NASA AMB makes recommendation for risk acceptance or rejection to NASA CLD Program Manager.

3. Provider reviews USG crew health status and dispositions medical and behavioral health certification of USG crew for CLD mission.
4. Provider completes initial medical and behavioral health certification process for all crew by no later than Launch Minus (L-)12 months inclusive of NASA review and disposition and prior to start of hazardous training activities on NASA property or using NASA assets.
5. Provider completes periodic certification to ensure certification remains valid through training and flight. All medical and behavioral health certification is valid for 12 months from time of the last physical exam.

B. End State

1. Commercial Provider develops Medical Certification Package for non-USG crew per Commercial Provider Medical Standards and Evaluation requirements.

Note: NASA develops Medical Certification Package for USG crew per Commercial Provider Medical Standards and Evaluation requirements.

2. Commercial Provider presents non-USG crew Medical Certification Package to the Commercial Provider's Space Medicine Board (SMB).

Note: NASA presents USG crew medical certification package to the Commercial Provider's SMB for assessment and disposition of medical risk and conditions not meeting standards.

3. Commercial Provider SMB reviews and dispositions medical risk and mitigation strategies and identifies additional evaluation/intervention (if applicable) for USG and non-USG crew.

Note: This may involve multiple presentations to the Commercial Provider's SMB and offline discussion to ensure risk mitigation approach is adequate.

4. Commercial Provider's SMB makes recommendation for risk acceptance or rejection to Commercial Provider CLD Program Manager.
5. Commercial Provider includes NASA as a member of the Commercial Provider's SMB with veto authority for risks with safety impacts to USG crew.
6. Commercial Provider completes initial medical and behavioral health certification process for all crew by no later than L-12 months, inclusive of NASA review and disposition and prior to start of hazardous training activities on NASA property or using NASA assets.
7. Provider completes periodic certification to ensure certification remains valid through training and flight. All medical and behavioral health certification is valid for 12 months from time of the last physical exam.

4.3 STANDARDS AND EVALUATIONS

4.3.1 MEDICAL AND BEHAVIORAL HEALTH EVALUATIONS

This section describes NASA-specified minimum medical and behavioral health evaluation requirements for long-duration crewmembers and/or those with safety-critical duties. Minimum requirements for short-duration crew without safety-critical duties are described in Appendix F, Medical Evaluations for Non-USG Crew for Short-Duration Missions. All crew, irrespective of duration or role, will be evaluated against the standards described in Table 4.3.2-1, Medical Standards.

A complete medical and behavioral health evaluation of an individual includes a medical history, psychiatric evaluation, medical examination, and medical and behavioral health testing. The medical history and the examination are the foundation of the overall evaluation of the individual and serve as the initial screen for conditions or risk factors for disease. Testing helps to further elucidate conditions not previously known to the candidate or identified on the examination; however, it should be noted that required testing is not sufficient to diagnose all the medical conditions found in the list of medical standards. Based on the initial evaluation additional testing may be warranted beyond those specified in the requirements to adequately characterize the scope and severity of

the condition. It is imperative that all evaluations be thorough to avoid missing conditions or risk factors that may impact mission medical risk.

[4002] The Commercial Provider **shall** develop a medical and behavioral health certification process that includes the minimum evaluations and medical and behavioral health standards, as specified in the following sections in Table 4.3.1.1-1, Medical History and Exam; Table 4.3.1.2-1, Laboratory Tests; Table 4.3.1.3-1, Specialist Evaluations; Table 4.3.1.4-1, Psychiatric Evaluation; Table 4.3.1.5-1, Psychodiagnostic Evaluation; Table 4.3.1.6-1, Behavioral Suitability Evaluation; and Table 4.3.2-1, Medical Standards, for all CLDS crews.

Data generated from the behavioral health evaluations, including Specialist's interpretations, opinions, and recommendations, should follow the guidelines described in Appendix D, Behavioral Health Assessment Report Guidance.

4.3.1.1 MEDICAL HISTORY AND EXAM

Table 4.3.1.1-1, Medical History and Exam, lists the minimum medical history and exam needed for CLDS crews.

TABLE 4.3.1.1-1 MEDICAL HISTORY AND EXAM

1. Comprehensive medical questionnaire ^{1, 3}
2. Full aeromedical physical examination ²

1 – May be completed using a Medical Survey or another similar questionnaire that includes: past medical history and background information; psychosocial and psychiatric history, including alcohol-related and drug-related convictions; personal habits/lifestyle issues; travel history (past year); medication review, including non-prescription and herbal medications, food supplements, vitamins, and minerals; systems review; physical activities and sports.

2 – The aeromedical physical examination will be guided by the details found within this document. Of note, this general, thorough examination includes special attention being paid to the ocular, neurological, and musculoskeletal organ systems.

3 – A medical survey or questionnaire may be used to identify any known allergies and adverse reactions.

4.3.1.2 LABORATORY TESTING

Laboratory testing for medical and behavioral health certification, shown in Table 4.3.1.2-1, Laboratory Tests, describe those tests pertinent to the identification of the presence of, or tendency towards disease states, that might compromise individual health, mission effectiveness, or safety. The “initial” column indicates those evaluations performed at initial medical and behavioral health certification. The “periodic” column indicates those evaluations performed at subsequent re-certification of crew. Evaluations are valid for 12 months unless specified otherwise and must be valid at that time of presentation for certification.

TABLE 4.3.1.2-1 LABORATORY TESTS (2 PAGES)**

Hematology/Thrombophilia Screen	Initial	Periodic
Complete blood count – To include hemoglobin, hematocrit, red blood cell count, red blood cell indices, white blood cell count, differential count, platelet count	✓	✓
Prothrombin time (PT), activated partial thromboplastin time (aPTT)	✓	On record
Sickling Test	✓	On record
ABO blood group and rhesus factor (Rh) type	✓	On record
Biochemistry	Initial	Periodic
Comprehensive metabolic panel – to include glucose, calcium, sodium, potassium, chloride, and bicarbonate, albumin, total protein, alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), bilirubin, and blood urea nitrogen.	✓	✓
Thyroid stimulating hormone (TSH)	✓	✓
Hemoglobin A1C (HbA1c), fasting blood glucose	✓	✓
Cardiovascular profile – fasting total cholesterol, high-density lipoproteins (HDL), low-density lipoprotein (LDL), triglycerides, high-sensitivity C-reactive protein (hs-CRP)	✓	✓
Infectious Disease Screen	Initial	Periodic
Hepatitis B (hepatitis B surface antigen, hepatitis B core antibody, hepatitis B surface antibody)	✓	✓
Hepatitis C	✓	✓
Serologic screen for syphilis (Venereal Disease Research Laboratory (VDRL) or rapid plasma reagin (RPR) or equivalent)	✓	✓

Human immunodeficiency virus (HIV)	✓	✓
Tuberculosis (TB) screening utilizing a Tuberculin Skin Test (TST) or Interferon Gamma Releasing Assay (IGRA) (either QuantiFERON-TB Gold® (QFT-G) or T-SPOT®).	✓	✓
<i>Helicobacter pylori</i> breath test	✓	On record
Urinalysis	Initial	Periodic
Routine (specific gravity, glucose, protein, pH, ketones, blood), microscopic	✓	✓
Human chorionic gonadotropin (hCG) (females, urine, or serum)	✓	✓
Drug profile, expanded targeted panel (targeted list of prescriptions, over-the-counter medications, and illicit drugs)	✓	On record
Test for ethyl alcohol (EtOH) dependence	✓	On record

* Check marks indicate that the evaluation is required. Boxes with text are to be interpreted as written.

¥ Abnormal test should have reflex testing when indicated.

4.3.1.3 SPECIALIST EVALUATIONS

Specialty examinations, shown in Table 4.3.1.3-1, Specialist Evaluations, are performed to detect and identify conditions that may have been missed by the history, physical exam, or laboratory testing. Emphasis is placed on the early detection of latent pathological processes that may impact the performance of duties or the ability to tolerate the physiological effects of alternate gravity exposures.

The “initial” column indicates those evaluations performed at initial medical and behavioral health certification. The “periodic” column indicates those evaluations performed at subsequent re-certification of crew. Evaluations are valid for 12 months unless specified otherwise (e.g., coronary artery calcium scoring is valid for 5 years) and must be valid at that time of presentation for certification.

TABLE 4.3.1.3-1 SPECIALIST EVALUATIONS (3 PAGES)*

Optometrist or Ophthalmologist	Initial	Periodic
Uncorrected and corrected near and distance visual acuity (Snellen or Landolt-C)	✓	✓
Color vision (computer-based test, Ishihara, or equivalent pseudo-isochromatic plates [PIPs] to include red-green and blue-yellow)	✓	✓

Phorias and tropias	✓	✓
Tonometry	✓	✓
Fundoscopy examination	✓	✓
Retinal photographs	✓	On record
Corneal topography	✓	On record
Perimetry	✓	On record
Otolaryngology/ear, nose, and throat (ENT)	Initial	Periodic
Audiometry (pure tone audiogram and speech audiogram, if indicated)	✓	✓
Tympanogram	✓	✓
Musculoskeletal (MSK)	Initial	Periodic
Joint range of motion (ROM) - may be accomplished using goniometry or by thorough manual exam	✓	✓
Muscle strength	✓	✓
Dental	Initial	Periodic
Special evaluation by dentist	✓	✓
Full orthopantomogram or full mouth X-ray series	✓	On record
Cardiopulmonary	Initial	Periodic
Resting 12-lead electrocardiogram (ECG)	✓	✓
Direct or indirect measurement of cardiorespiratory fitness in ml/kg/min on maximum (max) exercise stress test	✓	✓
24-Hour ECG monitoring	✓	On record
Coronary calcium scoring (Males ≥ 40 years old, Females ≥ 50 years old)	✓	Within 5 years
Transthoracic echocardiogram (TTE), doppler, and color flow study	✓	Within 5 years
Atherosclerotic Cardiovascular Disease Risk Calculator (i.e., Astronaut Cardiovascular Health and Risk Modification [Astro-CHARM], Atherosclerotic Cardiovascular Disease [ASCVD])	✓	✓

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Pulmonary function testing	✓	On record
Gastroenterology	Initial	Periodic
Colonoscopy	As Clinically Indicated (ACI)	ACI
Neurology	Initial	Periodic
Magnetic resonance imaging (MRI) of brain, MRI angiogram	✓	On Record
Carotid ultrasound study (to include intima-media thickness and/or carotid plaque area) -	ACI	ACI
Behavioral Health and Psychological Suitability Evaluation	Initial	Periodic
Psychiatric evaluation (See Section 4.3.1.4 for details) <i>Based on the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders, the American Psychiatric Association</i>	✓	✓
Psychodiagnostic evaluation (See Section 4.3.1.5 for details)	✓	On record
Psychological suitability evaluation (See Section 4.3.1.6 for details)	✓	On record
Gynecological	Initial	Periodic
Gynecological Evaluation	ACI	ACI
Radiological/Ultrasound Procedures	Initial	Periodic
Chest X-ray (CXR) (postero-anterior and lateral)	✓	Within 5 years
Thyroid ultrasound	ACI	ACI
Abdominal and pelvic ultrasound	✓	Within 5 years
Mammograms for females beginning at age 40	✓	✓
Bone mineral density - dual energy x-ray absorptiometry (DXA) scan	ACI	ACI

*Check marks indicate that the evaluation is required. Boxes with text are to be interpreted as written.

4.3.1.4 PSYCHIATRIC EVALUATION

All CLDS crews undergo a psychiatric evaluation conducted by a qualified psychiatrist as described in Section 3.0, Medical Personnel Qualifications. The psychiatrist should refer to Table 4.3.2-1, Medical Standards, Section O.

Table 4.3.1.4-1, Psychiatric Evaluation, lists the minimum elements and criteria that are necessary to perform an acceptable psychiatric evaluation of a CLD crew.

TABLE 4.3.1.4-1 PSYCHIATRIC EVALUATION (2 PAGES)

1. Clinical interview, including: a. Detailed developmental and psychosocial history (including family and social) and any problems. b. Academic and employment history and performance. c. Legal issues. d. Substance use/abuse (including treatment and quality of recovery). e. Aviation, military, or any other relevant critical mission or operations background and experience. f. History of all medical, psychiatric, or psychological conditions, and all medication use.
2. Mental status examination, including: a. Findings of a structured clinical interview (e.g., Quick Structured Clinical Interview for DSM-5® Disorders (QuickSCID-5), Schedule for Affective Disorders and Schizophrenia (SADS), or equivalent) to screen for signs and symptoms of the psychiatric disorders that are outlined in Table 4.3.2-1, Medical Standards, Section O. b. Behavioral observations during the interview.
3. Review of all available relevant records, including: a. Relevant academic records. b. Records of prior psychiatric hospitalizations. c. Records of periods of observation or treatment/counseling (e.g., psychiatrist, psychologist, social worker, counselor, or neuropsychologist treatment notes). d. Records must be in sufficient detail to permit a clear evaluation of the nature and extent of any previous mental disorders.
4. Review of any prior psychiatric and/or psychological evaluation, and/or psychological or neuropsychological testing records/reports, and any psychological testing results/report.

4.3.1.5 PSYCHODIAGNOSTIC ASSESSMENT

All CLDS crews undergo a psychodiagnostic assessment conducted by a qualified clinical psychologist as described in Section 3.0, Medical Personnel Qualifications. The psychodiagnostic assessment informs the nature and severity of a psychiatric disorder, as well as identifies affects, traits, or conditions that might be of aeromedical significance (impacting crew functioning, mission effectiveness, safety) short of a psychiatric disorder.

Table 4.3.1.5-1, Psychodiagnostic Assessment, lists the minimum elements and criteria that are necessary to perform an acceptable psychodiagnostic assessment of a CLD crew.

TABLE 4.3.1.5-1 PSYCHODIAGNOSTIC ASSESSMENT (2 PAGES)

1. Clinical interview, including: a. Detailed developmental and psychosocial history (including family and social) and any problems. b. Academic and employment history and performance. c. Legal issues. d. Substance use/abuse (including treatment and quality of recovery). e. Aviation, military, or any other relevant critical mission or operations background and experience. f. History of all medical, psychiatric, or psychological conditions, and all medication use.
2. Review of all available relevant records, including: a. Relevant academic records. b. Records of prior psychiatric hospitalizations. c. Records of periods of observation or treatment/counseling (e.g., psychiatrist, psychologist, social worker, counselor, or neuropsychologist treatment notes). d. Records must be in sufficient detail to permit a clear evaluation of the nature and extent of any previous mental disorders.
3. Review of any prior psychological evaluation and/or testing records/reports, including: a. A mental status examination. b. Psychological tests to broadly assess cognitive and psychological functioning, for application to both clinical diagnostic and non-clinical including suitability assessments, including but not limited to the following: i) Cognitive ability measure (e.g., Current version of the Multidimensional Aptitude Battery (MAB) or current Wechsler Adult Intelligence Scale, or other measure of General Mental Ability). ii) Omnibus measure of psychopathology (e.g., Current version of the Minnesota Multiphasic Personality Inventory, or similar). iii) Personality test(s) with scales assessing traits related to interpersonal and social functioning (e.g., current version of either the Neuroticism Extraversion Openness Personal Inventory-3 (NEO-PI-3), California Psychological Inventory, or similar).

4.3.1.6 PSYCHOLOGICAL SUITABILITY ASSESSMENT

All CLDS crews undergo a multi-method assessment of psychological suitability that addresses the spaceflight psychological competencies for selection. These core competencies and behavioral markers were derived based on NASA's operational experience and knowledge of the risk factors present during spaceflight that can disrupt individual and team functioning.

Table 4.3.1.6-1, Psychological Suitability Assessment, lists the minimum assessment methods and spaceflight psychological competencies.

TABLE 4.3.1.6-1 PSYCHOLOGICAL SUITABILITY ASSESSMENT (3 PAGES)

Behavioral Suitability Assessment Methods	
(1) Include a structured interview, two-team behavioral exercises, individual behavioral exercises, and if desired, additional methods, such as peer ratings or individual behavioral exercises. (2) Conducted by multiple qualified and trained behavioral assessors. (3) Utilize systematic behavioral observation, standardized ratings, and systematic integration of data across raters. (4) Address any cross-cultural aspects.	
Spaceflight Psychological Competencies to Assess	
Competency	Behavioral Markers
1. Cross-Cultural Skills	
A. Demonstrate respect towards other cultures [national, organizational, professional].	i. Demonstrates respect and appreciation for team members' culture[s] and viewpoints. ii. Respects differences in sex role expectations, behaviors, and attitudes.
2. Teamwork and Group Living	
A. Interpersonal relationships	i. Demonstrates patience, respect, and appreciation for crewmembers.
B. Active team participation	i. Acts cooperatively rather than competitively. ii. Takes responsibility for own actions and mistakes. iii. Respects team member's roles, responsibilities, and task allocation. iv. Puts common goals above individual needs.
3. Self-Care, Self-Management	
A. Manage stress	i. Identifies symptoms and causes of personal stress. ii. Takes action to prevent and mitigate stress, negative mood, or low morale. iii. Uses calm and flexible approach in dealing with unfamiliar situations.
B. Refine accuracy of self-image	i. Seeks formal and informal feedback to understand impact of own behavior on others. ii. Assesses own skills, knowledge, and abilities against task requirements.*
C. Care for oneself	i. Maintains social relationships. ii. Maintains balance of work, personal time, and rest.
D. Maintain efficiency	i. Keeps items organized. ii. Uses time efficiently.* iii. Sets challenging and attainable goals.*

4. Decision-Making and Problem Solving	
A. Problem-solving and decision-making methods	i. Adopts a problem-solving method to meet situational demands. ii. Assembles facts, considers options, evaluates risks/benefits, decides on an option.
B. Preparation of decision	i. Involves team members in the process as applicable.
C. Execution of a decision	i. Executes decision. ii. Checks results of decision, and if necessary, reapplies process.
5. Leadership/Followership	
A. Followership	i. Supports leader. ii. Reacts promptly to situations requiring immediate response.
B. Execution of designated leader's authority	i. Accepts leadership responsibilities (directs team members and resources toward objectives).*
C. Mentoring skills	i. Leads by example.*
6. Situational Awareness	
A. Maintenance of an accurate perception of the situation	i. Maintains awareness of the environment while focusing on a task or problem ii. Monitors self and others for signs of stress, fatigue, complacency, and task saturation.*
B. Processing of information	i. Assesses impacts of actions, plans, and decisions on others. ii. Identifies and resolves discrepancies between conflicting data or information.*
7. Conflict Management	
A. Conflict Prevention	i. Addresses potential sources for conflict.
B. Conflict Resolution	i. Keeps calm in interpersonal conflicts. ii. Exchanges views and positions.* iii. Seeks resolution.*
8. Communication	
A. Optimize communication	i. Communicates information clearly and concisely. ii. Communicates intentions before taking actions. iii. Adjusts time and/or style of communication to fit the situation.* iv. Shares information.*

* Not required for short duration non-USG crew with no safety-critical tasks.

The following items represent best practices for conducting the Psychological Suitability Assessments:

1. All behavioral exercises should be of high fidelity to the characteristics of the operational environment including austerity, and dynamic, uncertain, and consequential conditions. “Tabletop”, or low fidelity team or individual exercises, are not considered to be sufficient.
2. Assessment of social and interpersonal competencies should include the condition of small group living in which individuals live in a communal arrangement for an extended period (days to weeks).
3. Peer ratings of social and interpersonal competencies are among the best assessment tools for team and social and interpersonal competencies and should be included at multiple points in the assessment process.

4.3.2 MEDICAL STANDARDS

Table 4.3.2-1, Medical Standards, details those conditions that NASA has identified in its experience to pose an elevated risk to the individual, to other crew, or to the mission. The standards are written such that the term “is disqualifying” is not written but implied. The NASA astronaut candidate selection process does not allow for waivers to any disqualifying conditions. The annual medical certification process of existing trained NASA astronauts may accept waivers to these disqualifying conditions once they have been adequately mitigated. The intent is to ensure that any conditions not meeting standards are appropriately evaluated, the risk is dispositioned, and any unacceptable risk is mitigated prior to flight. If the risk cannot be mitigated, then the individual may be considered medically disqualified for spaceflight duties.

Most conditions included in Table 4.3.2-1, Medical Standards, pose sufficiently elevated risk to crew safety or mission success that all such cases of the condition require thorough investigation to determine the risk posed by the condition and implementation of appropriate mitigations prior to considering a waiver. For example, a diagnosis of malignancy requires thorough investigation to ensure that the crewmember has completed active treatment, that the malignancy is in remission, and that risk of recurrence in-flight is acceptable (i.e., low). Generically, factors such as stability of the condition in the spaceflight environment must be assessed to determine the impact of the condition on the individual’s ability to execute their duties and safely complete the mission.

However, for some conditions, the term “unless” is used to indicate that if the condition meets those criteria further testing/evaluations are not necessary to certify for flight. For example, this wording may be used for conditions that have occurred in the past and are stable following intervention or therapy, resolved, or have an acceptable risk of recurrence in-flight, the intervention or therapy is acceptable for spaceflight and training duties, or that the condition does not interfere with performance of duties or of wearing of equipment. Commonly used terms in the standards include “unless surgically corrected”, “that may interfere with wearing equipment”, or “that could interfere with the performance of duties”.

The term “requires specialist evaluation” is also frequently used. For such conditions, inputs from medical specialists with knowledge and experience in management of the

condition, and ideally in evaluation of fitness-for-duty for aviation and spaceflight, may be sufficient to determine whether the listed medical condition poses an acceptable level of risk for training or spaceflight duties or if any mitigations are required. A more exhaustive description of unique terminology used in Table 4.3.2-1, Medical Standards, can be found Appendix B, Glossary.

TABLE 4.3.2-1 MEDICAL STANDARDS (15 PAGES)

A. GENERAL	
1.	Any medical condition that, in the judgment of the AMB/SMB, may compromise mission operations, performance of duties, or crew health or safety.
2.	All acute and chronic conditions such as infections, injuries, contusions, fractures, or surgeries unless healed and not associated with functional deficit that could interfere with the performance of duties.
3.	History of heat stroke, temperature intolerance, or environmental injuries associated with significant sequelae that could interfere with performance of duties.
4.	History of sensitivity or demonstrated allergy of sufficient severity to interfere with the performance of duties.
5.	Chronic use of any medication (prescribed or over the counter) requires AMB/SMB review.
6.	All malignancies or history of malignancies, unless: A. Malignancies which were treated and are considered “cured” require specialist evaluation. B. Malignancies in remission require specialist evaluation. C. When specifically called out in the organ system sections.
7.	Any foreign body or implant, unless considered not to be a hazard during the performance of duties.
8.	Any condition or situation that precludes completion of the medical evaluation process.
9.	Sarcoidosis, all forms.
10.	Decompression Illness (DCI): A. Type II decompression sickness (DCS) or arterial gas embolism (AGE) [involving the Central Nervous System (CNS), spinal cord, pulmonary DCS, or cardiovascular collapse] unless adequately treated and completely resolved. Such cases require specialist evaluation. B. Type I DCS involving joint pain, the peripheral nervous system, or skin unless adequately treated and completely resolved.
11.	Presence or history of systemic exertion intolerance disease or myalgic encephalomyelitis (previously known as chronic fatigue syndrome) and fibromyalgia.
12.	Autoimmune disorders, including conditions such as systemic lupus erythematosus and dermatomyositis.
B. HEAD, FACE, AND NECK	
1.	Any acute, chronic, progressive, or recurrent disorder that interferes with the performance of duties or performance of crew health countermeasures: A. Current/recurrent deformities (e.g., scars, depressions, or exostoses) or chronic muscular contractions/spasms (e.g., torticollis) of the skull/head, face, and neck. B. Craniomaxillofacial deformities. Examples include benign tumors, scars/mutilations due to injuries or surgery, ulcerations, fistulae, and atrophy or paralysis of part of the face or head, temporomandibular joint disorders.
2.	Temporomandibular disorders (e.g., chronic temporomandibular joint (TMJ) arthritis, complete or partial ankylosis, recurrent dislocation, or chronic myofascial pain).
3.	Congenital branchial cleft or thyroglossal duct cysts, unless greater than 1-year post-surgical resection and without evidence of residual cysts or tracts.
4.	Chronic draining fistulae, regardless of cause.

5. Cervical ribs with signs or symptoms of thoracic outlet compression.
C. NOSE, SINUSES, MOUTH, AND THROAT
1. Deformities, injuries, or diseases of the mouth, nose, throat, pharynx, or larynx that interfere with breathing, speech, mastication, and/or the swallowing of ordinary food, unless corrected with normal function and enough time has passed to ensure no recurrence. Examples include any condition that reduces nasal air passage, sino-nasal polyps, nasal septal perforation, chronic rhinitis or sinusitis, cleft lip/palate, atrophic muscles, paralyzed muscles, oral cysts, or calculi.
2. Anosmia.
3. Obstructive sleep apnea.
D. EARS
1. Any diseases of the ear or mastoid with residual auditory or vestibular dysfunction sufficient to interfere with performance of duties.
2. Congenital deformation of the external meatus or canal that interferes with hearing or performance of duties.
3. Chronic external otitis.
4. Chronic otitis media, suppurative or serous.
5. Persistent perforation of the tympanic membrane.
6. History of stapedectomy.
7. Chronic mastoiditis, mastoid fistula, or mastoidectomy, unless complete recovery from simple mastoidectomy.
8. History or presence of abnormal labyrinthine function (e.g., vestibular neuronitis), unless an isolated, remote episode with full recovery.
9. History or presence of Meniere's disease.
10. Chronic inability to equalize the pressure of the middle ear (Valsalva's maneuver).
11. Hearing Standards: A. Applicant must demonstrate ability to meet the following: i. Audiometric pure-tone thresholds that meet the values shown in Table D.11, Acceptable Hearing Thresholds

TABLE D.11 ACCEPTABLE HEARING THRESHOLDS

Frequency (Hz)	500	1000	2000	3000	4000	6000	
Better Ear	≤ 25	≤ 30	≤ 25	≤ 40	≤ 60	≤ 70	
Worse Ear	≤ 40	≤ 40	≤ 60	--	--	--	

B. Applicants with hearing thresholds that exceed Acceptable Hearing Thresholds but meet ALL of the following are considered acceptable: i. Speech-in-Noise Criteria: (a) Modified Rhyme Test (MRT)- MRT80 $\geq$ 55/80 or 104/160 and better ear $\leq$ 20 Decibels (dB) at 2000 Hz (b) OR MRT80 $\geq$ 59/80 or 112/160 and better ear $>$ 20 dB at 2000 Hz ii. Spatial Awareness Criteria: (a) Monaural Word Recognition in quiet: $\geq$ 78% in both ears (b) AND Worse ear thresholds $\leq$ 40 dB at 500 Hz, and $\leq$ 40 dB at 1000 Hz, and $\leq$ 60 dB at 2000 Hz (c) OR $\geq$ 8/10 on Spatial Digit Test
E. EYES
1. Disease, defect, or deformity of either eye or supporting structure that may interfere with the performance of duties. Any condition that may negatively impact vision or normal eye-related function requires specialist evaluation. This includes any chronic, progressive, or recurrent condition that affects any portion of the eye (cornea, iris, lens, retina, vitreous), optic nerve, or any of the peri-orbital structures such as ocular muscles, eyelids, eyelashes. Any history of ocular surgery requires specialist evaluation.
2. Pterygium that encroaches on the cornea more than 2 millimeters or recurs after two operative procedures (evaluation will be performed no earlier than 6 months post- operatively).
3. Medically required use of a contact lens.
4. Corneal dystrophy of any type requires specialist evaluation.
5. History of orthokeratology treatments within the previous 6 months.
6. Refractive surgical procedures other than Photorefractive Keratectomy (PRK, laser assisted sub-epithelial keratectomy (LASEK), epi-LASIK; or other excimer laser surface procedures), or laser-assisted in-situ keratomileusis (LASIK), Wavefront guided procedures with a femtosecond laser are preferred). Following acceptable surgical procedures, there needs to be no demonstrated adverse sequelae, including contrast sensitivity, glare, or night vision problems.
7. History or evidence of retinal detachment, unless traumatic with no sequelae, retinal tears, or edema.
8. Retinal hole with presence of fluid or vitreous traction. Other retinal holes require specialist evaluation.
9. Degradation or dystrophies of the central or peripheral retina, including lattice degeneration, requires specialist evaluation.
10. Previous retinal treatment of any type requires specialist evaluation.
11. Distance or near visual acuity not correctable to 20/20 in each eye.
12. Any visual field defect, whether active, inactive, or migrainous requires specialist evaluation.
13. Extraocular muscle balance: A. Any heterotropia measured at any distance. B. Paralysis of ocular motion in any distance. C. Diplopia, suppression or a history of diplopia or suppression
14. Lack of adequate depth perception on objective testing, with a minimum of 40 arcseconds.
15. Color Vision Deficiency: Greater than mild deficiency on red-green or blue-yellow using computer-based color vision testing

16. Glaucoma
F. LUNGS AND CHEST WALL
1. Any condition of the lungs, pleura, mediastinum, and chest wall that could interfere with performance of duties.
2. Pneumothorax or pneumomediastinum: A. History of spontaneous pneumothorax or pneumomediastinum that is surgically corrected with apical pleurodesis or pleurectomy and free of complications, with full expansion of lungs on CXR, with normal pulmonary function tests (PFTs), and without pathology predisposing to recurrence on thin-cut Computed Tomography (CT) requires specialist evaluation. B. Presence or history of traumatic pneumothorax, that is fully resolved and free of complications, with full expansion of lungs on CXR, with normal PFTs, and without pathology predisposing to recurrence on thin-cut CT requires specialist evaluation.
3. Chronic obstructive pulmonary disease (chronic bronchitis or emphysema) with evidence of pulmonary dysfunction and causing impairment or increased risk for pulmonary barotrauma.
4. Chronic pulmonary processes such as interstitial pneumonitis, pulmonary injury, neuropulmonary disorders, hypersensitivity, and pneumoconiosis.
5. Abnormal pulmonary function tests require specialist evaluation
6. Bronchiectasis
7. Asthma: A. Current asthma of any degree. B. History of asthma will require provoked bronchoconstriction testing and specialist evaluation.
8. Pulmonary blebs, bullae, or cysts.
9. History of lung abscess requires specialist evaluation.
10. Granulomatous inflammation: A. Non-infectious granulomatous inflammation (such as sarcoidosis, Wegener's, allergic, or bronchocentric). B. History of infectious causes, including mycotic infection (such as coccidioidomycosis, histoplasmosis) or protozoal infection (such as dirofilariasis, pneumocystis) requires specialist evaluation.
11. History of intrathoracic surgery requires specialist evaluation: A. History of lobectomy or multiple segmental resections with normal pulmonary function requires specialist evaluation. B. Removal of more than one lobe is cause for rejection.
12. History of benign tumors of the lung require specialist evaluation.
13. History of suppurative periostitis, osteomyelitis, or necrosis of the ribs, sternum, clavicle, scapulae, or vertebrae with complete resolution and normal lung function requires specialist evaluation.
14. Chronic or recurrent mastitis.
15. Benign tumor or surgery of the breast or chest wall that interferes with the performance of duties.
16. History of unprovoked or recurrent pulmonary embolus. History of single provoked pulmonary embolus requires specialist evaluation.
17. History of empyema or sinus tracts of the chest wall require specialist evaluation.

18.	History of surgically corrected tracheoesophageal fistula requires specialist evaluation.
19.	History of pleural effusion of unknown etiology.
20.	History of hemoptysis requires specialist evaluation.
G. CARDIOVASCULAR	
1.	Any condition of the cardiovascular system that interferes with the performance of duties.
2.	Cardiomyopathy, such as hypertrophic or right ventricular cardiomyopathy (other than physiologic heart changes). History of acquired cardiomyopathy if recovered and left ventricular ejection fraction is <50% requires specialist evaluation.
3.	Hypertension, as defined by sustained systolic blood pressure of 140 mmHg or greater or diastolic of 90 mmHg or greater unless adequately treated.
4.	Recurrent syncope or symptomatic orthostatic intolerance (e.g., medication-induced, autonomic dysfunction, or other causes not otherwise specified), excepting post-spaceflight orthostasis. Recurrent neurally mediated syncope with clear precipitating factors requires specialist evaluation.
5.	Pericarditis, myocarditis, and endocarditis. A. History of the above without residual dysfunction requires specialist evaluation.
6.	Congenital abnormalities: A. History or findings of major congenital abnormalities of the heart and vessels. B. History of atrial septal defect (ASD), ventricular septal defect (VSD), or patent ductus arteriosus (PDA), that has been surgically repaired requires specialist evaluation. C. A Patent Foramen Ovale (PFO) requires specialist evaluation.
7.	Clinical evidence (angiographic, imaging, symptoms, history of prior event) of coronary artery disease.

8. Electrocardiographic abnormalities: Any cardiac dysrhythmia, conduction defect, or other ECG abnormalities on resting ECG, ambulatory ECG monitor, or any monitoring ECG rhythm strips, history of the below require specialist evaluation.
 - A. Supraventricular arrhythmias:
 - i. Require specialist evaluation:
 - (1) Supraventricular tachycardia (SVT) assessed at least 6 months after ablation.
 - (2) Atrial fibrillation/flutter assessed at least 6 months after ablation.
 - (3) Presence or history of SVT or atrial fibrillation/flutter > 5 seconds.
 - (4) Atrial ectopy (premature atrial complexes) > 1% and ≤ 20% of total beats on ambulatory ECG.
 - (5) Presence of sustained (> 1 hour) sinus tachycardia at rest > 130 beats/min not related to physical activity during evaluation.
 - ii. Require AMB/SMB review and risk acceptance:
 - (1) Presence or history of SVT or atrial fibrillation/flutter that is recurrent after intervention.
 - (2) Presence of SVT with hemodynamic compromise.
 - (3) Presence or history of atrial ectopy (premature atrial complexes) > 20% of total beats on ambulatory ECG.
 - B. Ventricular arrhythmias:
 - i. Require specialist evaluation:
 - (1) Presence or history of ventricular tachycardia of 11 beats or greater without hemodynamic compromise.
 - (2) Presence or history of frequent ventricular ectopy (frequent Premature Ventricular Contractions [PVCs]) > 1% and ≤ 20% of total beats on ambulatory ECG.
 - (3) Right ventricular outflow tract tachycardia at least 6 months after ablation.
 - ii. Require AMB/SMB review and risk acceptance:
 - (1) Ventricular tachycardia > 11 beats with ventricular dysfunction.
 - (2) Ventricular tachycardia > 30 seconds.
 - (3) Ventricular tachycardia with hemodynamic compromise.
 - (4) Ventricular flutter/fibrillation or sudden cardiac arrest requiring resuscitation.
 - (5) Frequent ventricular ectopy (frequent premature ventricular complexes) > 20% of total beats on ambulatory ECG.
 - C. Conduction/repolarization defects:
 - i. Require specialist evaluation:
 - (1) First degree Atrioventricular (AV) block > 300 millisecond (msec).
 - (2) Right bundle branch block with axis deviation or atrial enlargement.
 - (3) Left bundle branch block.
 - (4) Wolff Parkinson White (WPW) ECG pattern.
 - (5) WPW syndrome after successful ablation.
 - (6) Prolonged QT > 470 msec for men and > 480 msec for women in the absence of drugs known to prolong QT interval.
 - (7) Brugada ECG pattern.
 - (8) Prolonged sinus pause > 3 seconds or heart rate < 30 beats per minute not during sleep.
 - ii. Require AMB/SMB review and risk acceptance:
 - (1) WPW syndrome.
 - (2) Third-degree AV block and Mobitz type 2 AV block.

(3) Prolonged QT > 500 msec. iii. Brugada syndrome.
9. Cardiac tumors. Benign cardiac tumors successfully resected and without residual cardiac disease require specialist evaluation.
10. All valvular disorders of the heart require specialist evaluation.
11. Venous and lymphatic disorders such as chronic venous insufficiency, varicose veins, and lymphedema that impair performance of duties.
12. Abnormalities of the arteries, including aneurysms, atherosclerosis, and arteritis. Includes intermittent claudication or any condition associated with inadequate blood flow to any extremity. Arterial wall thickening (including carotids), focal plaque, or calcifications detected with imaging studies require specialist evaluation.
13. Primary Raynaud's disease or other symptomatic vasospastic disorders require specialist evaluation.
H. HEMATOLOGY
1. Any hematologic or reticuloendothelial disorders that could interfere with the performance of duties.
2. Red cell disorders: A. Anemias require specialist evaluation. B. Hemoglobin sickle cell (SS) and sickle-hemoglobin C (SC) disease. C. Hemoglobin S trait with a history of complications, such as renal papillary necrosis, pulmonary sequestration, or splenic infarct condition. D. Hemoglobinopathies other than hemoglobin SS or SC disease, or S trait (example: thalassemia) require specialist evaluation for physiologic impairment (such as magnitude of anemia, level of anaerobic impairment, splenomegaly). E. Polycythemia requires specialist evaluation.
3. White cell disorders: A. Absolute leukopenia and absolute leukocytosis require specialist evaluation. B. Leukemia or lymphoma C. History of lymphoproliferative disorders. D. History of hematologic malignancies in remission require specialist evaluation. E. Plasma cell dyscrasias require specialist evaluation. F. Lymphadenopathy requires specialist evaluation.
4. Platelet disorders: A. Thrombocytopenia requires specialist evaluation. B. History of Idiopathic Thrombocytopenic Purpura (ITP), unless isolated episode in childhood with complete recovery. C. History of Thrombotic Thrombocytopenic Purpura (TTP) or Hemolytic Uremic Syndrome (HUS). D. Thrombocytosis requires specialist evaluation.
5. History of chronic myeloproliferative diseases or myelodysplastic syndromes.
6. Hypercoagulable disorders: A. Vascular thrombosis or embolism requires specialist evaluation. B. Two or more episodes of deep venous thrombosis.
7. Disorders of hemostasis: A. Personal history of bleeding disorder requires specialist evaluation. B. Hemophilias.
8. Splenic disorders:

A. Splenomegaly requires specialist evaluation. B. Hyposplenism or post-splenectomy state requires specialist evaluation.
I. ABDOMEN AND DIGESTIVE SYSTEM
1. Any acute, chronic, progressive, or recurrent disease or disorder of the gastrointestinal (GI) tract that interferes with the performance of duties or performance of crew health countermeasures: A. Functional bowel disorder. B. External or internal hemorrhoids that cause marked symptoms
2. Wounds, injuries, scars, or weaknesses of the muscles of the abdominal wall sufficient to interfere with function.
3. Abdominal wall and inguinal hernias require specialist evaluation.
4. Sinus or fistula of the abdominal wall that is associated with underlying disease or is not surgically corrected.
5. Diseases of the esophagus including reflux require specialist evaluation.
6. Chronic abdominal pain unless asymptomatic for 5 years and after specialist evaluation.
7. History of gastric or duodenal ulcers, unless caused by medication or <i>Helicobacter pylori</i> with appropriate treatment and endoscopic confirmation of resolution.
8. History of GI surgery for malignant or recurrent conditions.
9. Benign GI neoplasm that is likely to enlarge or show malignant potential, unless removed.
10. History of intestinal obstruction due to any chronic or potentially recurrent disease unless surgical treatment for childhood pyloric stenosis, intussusception, volvulus, or Meckel's diverticulum and without sequelae.
11. Adhesive disease. History of symptomatic adhesive disease requires specialist evaluation.
12. Inflammatory bowel disease such as Crohn's disease and ulcerative colitis.
13. Malabsorption syndromes, including Celiac disease, unless appropriate in-flight accommodations are available to manage.
14. Chronic diarrhea
15. Chronic constipation requiring chronic or continuous medication or therapy.
16. Diverticulitis.
17. Gastrostomy, ileostomy, or colostomy unless surgically corrected and resulting in no post-operative dysfunction.
18. History of GI bleeding unless due to trauma, medication-induced gastritis, or minor causes such as hemorrhoids or resolved infectious colitis.
19. Acute or chronic diseases of the rectum or anus.
20. Disorders of the liver, including cysts, require specialist evaluation.
21. Pancreas: A. History of acute pancreatitis unless due to trauma, medication, or stones with complete resolution following cholecystectomy or sphincterotomy requires specialist evaluation. B. Chronic, recurrent, or progressive pancreatic disorders (e.g., pseudocyst).
22. Biliary tract: A. Cholecystitis, cholelithiasis, or acalculous cholecystitis, until surgically corrected and resulting in no post-operative dysfunction. B. Any chronic, progressive biliary tract disorder.

J. ENDOCRINE
1. Any endocrine disease or disorder that may affect the performance of duties.
2. Presence or history of diseases of the hypothalamus or pituitary gland. History of prolactin secreting pituitary adenoma 5 years after surgical resection requires specialist evaluation.
3. Diseases of the thyroid gland, unless: A. Presence or history of multi-nodular goiter, autoantibodies, benign cysts, or palpable nodules of the thyroid require specialist evaluation. B. History of toxic adenoma 1 year after surgical resection requires specialist evaluation.
4. Diseases of the parathyroid gland. Parathyroid adenoma after surgical resection requires specialist evaluation.
5. Diseases of the adrenal medulla or cortex.
6. Metabolic disorders: A. Diabetes mellitus, type 1 or type 2 on insulin. B. Diabetes mellitus type 2, not on insulin, requires specialist evaluation. C. Presence or history of gout or pseudogout. D. Inborn errors of metabolic pathways (except for Gilbert's disease): i. Acquired errors of metabolic pathways with potential pathologic sequelae require specialist evaluation.
7. Carcinoid syndrome: History of carcinoid tumors requires specialist evaluation.
8. Pancreatic endocrine tumors (e.g., islet cell tumor or gastrinoma).
K. GENITOURINARY
1. Any disorders of the testes, genitalia, or associated anatomical structures that interfere with the performance of duties.
2. Anatomical abnormalities or the loss of one or both kidneys and lower urinary tract producing functional impact to the urogenital system. A duplicated collecting system is considered a variant of normal anatomy when not associated with other pathology.
3. Polycystic kidney disease.
4. Acute nephropathy or history of chronic nephropathy (e.g., hypertensive nephrosclerosis, diabetic nephropathy, and glomerulonephritis).
5. History of autoimmune parenchymal disorders, vascular renal disorders, or tubular necrosis from any cause if associated with residual renal functional impairment requires specialist evaluation.
6. Urinary calculus (crystalline concretion within the urine-collecting system). A. History of urinary calculus requires specialist evaluation.
7. History of recurrent (≥ 3 per year) infections of the urinary tract requires specialist evaluation.
8. Bladder, prostate, or urethral diseases that result in urinary retention, or interfere with micturition. History of the above requires specialist evaluation.
9. Penile prosthetic implants require specialist evaluation.
10. Prostate cancer that is being followed requires specialist evaluation.
L. MUSCULOSKELETAL DISORDERS
1. Any acute, chronic, progressive, or recurrent disorder that interferes with the performance of duties or performance of crew health countermeasures: A. Any disorder of the bone, joint, muscle, or supporting structure.

B. Chronic osteoarthritis with functional disability. C. Osteochondromatosis or multiple cartilaginous exostoses. D. Mal-union of fractures. E. Amputations F. Hyperdactyly or syndactyly (webbed fingers) G. Scars and deformities of the fingers or hand that impair dexterity, grip strength, circulation, are symptomatic. H. Chronic or recurrent bursitis, tendinitis, and synovitis I. Varus or valgus deformities
2. Presence or history of inflammatory arthropathies requires specialist evaluation.
3. Intra-articular loose bodies in any joint (osteocartilaginous or foreign objects) requires specialist evaluation.
4. Joint instability (recurrent subluxations or dislocations of an articulation).
5. Non-union fractures
6. Retained orthopedic hardware requires specialist evaluation.
7. Inability to demonstrate normal active joint range of motion.
8. Spine disorders: A. Symptomatic disorders of the spine. B. History of disorders of the spine that are asymptomatic, including but not limited to, osteoarthritis, herniated nucleus pulposus, spondylolisthesis, spina bifida occulta, fractures and dislocations, scoliosis, kyphosis, and lordosis require specialist evaluation. C. Presence or history of herniated nucleus pulposus, fractures, or dislocations of the spine resulting in persistent neurologic deficit.
9. Disorders of the foot that compromise the wearing of equipment or interfere with performance of duties or are associated with chronic pain, including but not limited to, clubfoot, pes planus, pes cavus, hammer toes, hallux valgus, overriding digits, hallux rigidus, and bunions.
10. History of fragility fractures requires specialist evaluation.
M. SKIN DISORDERS
1. Any acute, chronic, progressive, or recurrent skin disorder that interferes with the performance of duties or performance of crew health countermeasures: A. Presence or history of disorders of the skin or nails that are severe. B. Extensive or deep scars, burns, keloids, or body piercings that interfere with muscular movements or that show a tendency to break down. C. Acne, furunculosis, atopic dermatitis, eczema, or other chronic dermatitis D. Hyperhidrosis, if chronic or severe E. Neurofibromatosis that is symptomatic
2. Cysts, nevi, or benign tumors of the skin of a size or location that interfere with the wearing of equipment, unless surgically corrected.
3. Infections of the skin if communicable, extensive, or not amenable to treatment. Chronic tinea pedis and onychomycosis require specialist evaluation.
4. Malignancies: A. Primary malignancies of the skin unless fully excised and without evidence of metastasis. Basal cell carcinoma may not require specialist evaluation, but squamous cell carcinoma and melanoma will require specialist evaluation. B. Secondary manifestations of systemic malignancies.
5. Pilonidal sinus:

A. History of inflammation or discharging sinus in the preceding 2 years. B. History of pilonidal sinus with surgery without post-operative signs or symptoms indicative of residual disease for < 2 years requires specialist evaluation.
6. Presence or history of psoriasis requires specialist evaluation and must be asymptomatic and stable over the past 12 months with current treatment.
7. Presence or history of pemphigus vulgaris, bullous pemphigoid, dermatitis herpetiformis, or other bullous disorders: History of secondary bullous disorders that are resolved require specialist evaluation.
N. NEUROLOGICAL
1. Any acute, chronic, progressive, or recurrent neurological disorder that interferes with the performance of duties or performance of crew health countermeasures: A. History of infection of the nervous system within 2 years, or with residual neurologic defects. B. Congenital or developmental abnormalities of the nervous system.
2. Primary or secondary malignancies of the nervous system. Benign tumors or history of benign tumors of the nervous system, including acoustic neuromas, require specialist evaluation.
3. Vascular disorders of the nervous system (e.g., arteriovenous malformation, intracranial aneurysms, Moya-Moya disease). Cavernous angiomas require specialist evaluation.
4. History of a cerebrovascular accident (stroke, Transient Ischemic Attack [TIA], subarachnoid hemorrhage). Asymptomatic disease of the carotid or vertebral arteries requires specialist evaluation.
5. Uncomplicated viral meningitis and other CNS infections without residual neurologic sequelae require specialist evaluation
6. History of encephalitis.
7. Peripheral or CNS demyelinating disease (e.g., multiple sclerosis). Acute inflammatory demyelinating polyneuropathy must not result in neurologic sequelae that interferes with performance of duties and requires specialist evaluation.
8. History of metabolic, toxic, or nutritional disorders of the nervous system without residual neurologic sequela requires specialist evaluation.
9. History of elevated intracranial pressure [>25 cm water (H_2O)].
10. Personal history of diseases of hereditary neurologic disorders or hereditary disorders with neurologic features (e.g., neurofibromatosis, Huntington's chorea, hepato-lenticular degeneration, spinocerebellar ataxia, muscular dystrophy, familial periodic paralysis, and congenital lower spastic paraparesis).
11. History of seizure disorders is considered disqualifying with the following exceptions: A. Febrile convulsions before the age of 5 years are not disqualifying. B. History of single seizure without neurologic sequelae after 5 years requires specialist evaluation. C. Benign age-related seizures (e.g., Juvenile Myoclonic Epilepsy) require specialist evaluation.
12. History of craniotomy or skull defects that interfere with the performance of duties. Craniotomy performed more than 5 years earlier with no skull defects requires specialist evaluation.
13. History of traumatic brain injury within the past 5 years associated with any of the following: A. Any loss of consciousness or amnesia requires specialist evaluation.

	B. Intracerebral and/or subdural hemorrhage. C. Penetrating injuries or laceration of the brain. D. Skull fractures require specialist evaluation. E. Imaging evidence of retained intracranial metallic or bony fragments. F. Absence of bony substance of skull. G. Parenchymal CNS injury with persistent neurologic deficits. H. Cerebral leptomeningeal cysts, arachnoid cyst, brain abscess, traumatic CNS infections, or arteriovenous fistula. I. Transient cerebrospinal fluid rhinorrhea or otorrhea requires specialist evaluation. J. Post-traumatic syndrome manifested by changes in personality, deterioration of higher intellectual functions, anxiety, headaches, or disturbances of equilibrium for more than 3 months. For less than 3 months requires specialist evaluation.
14.	Migraine headache with visual or motor involvement, or any continuous or incapacitating headache requires specialist evaluation.
15.	History of Electroencephalogram (EEG) abnormalities with historical, clinical, or supporting laboratory evidence of a neurologic abnormality requires specialist evaluation.
16.	Disorders or injuries of peripheral nerves that interfere with performance of duties: A. Uncomplicated Bell's palsy without sequelae after 6 months requires specialist evaluation. B. Cervical or lumbar radiculopathy. History of cervical or lumbar radiculopathy requires specialist evaluation.
17.	Movement disorders (e.g., Tourette's syndrome, dystonia, or chorea). Essential tremor requires specialist evaluation and must not interfere with performance of duties.
18.	Disorders of neuromuscular transmission (e.g., myasthenia gravis) and myopathies.
19.	Neurodegenerative disorders (e.g., Parkinson's and related disorders or Amyotrophic Lateral Sclerosis [ALS]).
20.	History of chronic pain syndromes requiring medical intervention or medical therapy within last 5 years; if greater than 5 years prior, requires specialist evaluation.
O. PSYCHIATRIC DISORDERS AND SUITABILITY FOR SPACEFLIGHT	
1.	The following psychiatric disorders meeting the criteria established in current Diagnostic and Statistical Manual of Mental Disorders: A. Any behavior or mental condition that, in the opinion of the examiner, makes or is likely to make, the individual a hazard to flight safety, crew coordination, or mission execution. B. Neurodevelopmental disorders that interfere with social or occupational functioning. C. Presence or history of schizophrenia spectrum and other psychotic disorders. D. Presence or history of bipolar and related disorders. E. Presence or history of depressive disorders. F. Presence or history of anxiety disorders. G. Presence or history of obsessive-compulsive and related disorders. H. Presence of trauma- and stressor-related disorders, or history of trauma- and stressor-related disorders that may interfere with the performance of duties. I. Presence or history of dissociative disorders. J. Presence or history of somatic symptom and related disorders. K. Presence or history of feeding and eating disorders.

L. Presence of sleep-wake disorders or a history of sleep-wake disorders that may interfere with the performance of duties or regular use of medications that are incapacitating. M. Presence of dysphoria, affective distress, or other affective states (e.g., elevated mood) of any etiology that may interfere with the performance of duties. N. Presence or history of disruptive, impulse-control and conduct disorders, or, if diagnosed with history of a substance use disorder, documented complete abstinence and sobriety for a minimum of 7 years prior to long duration spaceflight. O. Presence of neurocognitive disorders or history of neurocognitive disorders if there is a likelihood of recurrence or evidence of residual deficits of cognition, memory, judgment, insight, or behavior. P. Presence or history of personality disorders (an inflexible, maladaptive, and enduring pattern of personal interaction that has been present since early adulthood). Q. Presence or history of paraphilic disorders. R. Presence or history of abuse or neglect of a child or adult. S. Other conditions that may be a focus of clinical attention (V-Codes) that may interfere with the performance of duties.
2. The Psychiatrist/Psychologist ensures, based on available evidence from comprehensive assessment of mission-relevant spaceflight psychological competencies such as performance under stress, group living, self-management, teamwork, communication, judgment, and decision-making that an individual is deemed suitable for spaceflight: A. An individual can be deemed unsuitable for spaceflight for characterological behaviors or personality traits that represent lower levels of signs and symptoms than those required for a diagnosed disorder, if in the opinion of the examiner, such characteristics present risks to crew cohesion, flight safety, or mission execution. A determination of unsuitability is not a medical diagnosis. B. Difficulties functioning as a team member or crewmate in an operational setting. A history of poor or unstable work or interpersonal relationships or personality traits that interfere with the forming and maintenance of social connections or functioning cooperatively with others as a teammate or astronaut. This may include personality traits or characteristics such as self-centeredness (egocentrism), lack of concern for others, arrogance, entitlement, lack of empathy, insensitivity, and social avoidance or withdrawal. C. Poor self-management or regulation. A pattern of behavior or traits that suggest poor impulse control. Examples may include a history of arrests, illicit drug use, social "acting out," or other misconduct or irresponsible behaviors that indicate poor impulse control, lack of judgment, difficulty with authority, or disregard for social norms and rules; maladaptive internalizing behaviors such as self-damaging behaviors, and substance misuse. D. Limited or poor stress tolerance. A history of physical or psychological problems when under stress, evidence of poor stress-coping skills or resilience, emotional instability, or other traits or behaviors that suggest an impaired capacity to adapt to stressful situations. E. Poor self-awareness or emotion management. Poor insight or awareness into one's impact on others such as deficiencies in self-knowledge and emotional awareness, or in the ability to understand or manage emotions that disrupt personal relationships or team or crew cohesion and effectiveness.
P. OBSTETRICS AND GYNECOLOGY

1. Any acute, chronic, progressive, or recurrent disease or disorder of the gynecologic system that interferes with the performance of duties or performance of crew health countermeasures:
A. Dysmenorrhea or other irregularities of the menstrual cycle such as premenstrual syndrome
B. Disorder of the uterus and/or adnexa
C. Infections or inflammation of the endopelvic organs
2. Any chronic dermatologic condition of the vulva and/or vestibule requires specialist evaluation.
3. History of any chronic disorder of the uterus and/or adnexa that is adequately managed requires specialist evaluation.
4. History of recurrent abnormal uterine bleeding or menorrhagia require(s) specialist evaluation.
5. History of a single episode of pelvic inflammatory disease requires specialist evaluation.
6. History of gynecological malignancies. History of carcinoma in situ of the cervix requires specialist evaluation.
7. History of recurrent, symptomatic ovarian cysts or history of recurrent corpora hemorrhagica unless definitively resolved.
8. History or presence of polycystic ovarian syndrome, anovulation, or disorders of the hypothalamic-pituitary-ovarian axis requires specialist evaluation.
9. Obstetrical:
A. All candidates are examined while not pregnant. Pregnancy itself will not be a cause to deny appointment as a candidate.
B. Pregnancy until complete post-partum recovery.
Q. DENTAL
1. Any dental defects that interfere with clear speech or cause changes in the contours of the face that interfere with the performance of duties.
2. Complete edentulism in either the mandible and/or maxilla or insufficient number of natural healthy teeth to masticate a normal diet or enunciate clearly.
3. Dental prostheses:
A. Any removable dental prosthesis, which if lost or broken, would not leave enough natural healthy teeth to masticate a normal diet or enunciate clearly.
B. Any unilateral removable dental prosthesis that could be swallowed.
4. Diseases and abnormalities of the jaws or associated structures, including periodontal disease, that are not easily remedied or may interfere with the performance of duties.
5. Severe malocclusion that interferes with the mastication of a normal diet or clear enunciation.
6. Any dental defects such as dental caries, dental dysplasia, enamel dysplasia, symptomatic cracked teeth, defective restorations, defective prosthesis, and defective implants until resolved.
7. Partially erupted or impacted third molar teeth with the potential to cause erosion of adjacent teeth, pericoronitis, or periodontal defect until corrected.
8. Infections of endodontic or periodontic origin until resolved.
9. Active orthodontic treatment requires dental consultation.
R. INFECTIOUS DISEASE

1. Acute or chronic infectious disease until appropriately treated that might compromise mission operations, performance of duty, or crew health and safety.
2. Tuberculosis: A. Active tuberculosis. B. History of active tuberculosis, unless 2 years have elapsed following appropriate therapy (as per current Centers for Disease Control and Prevention [CDC] guidelines) and evaluations show the individual free from active disease. C. Documented conversion of the TST or positive IGRA. Specialist evaluation required following treatment with anti- tuberculosis drugs as per current CDC guidelines.
3. History of malaria or other blood-borne parasites, unless adequately treated and cured.
4. Clinical or laboratory evidence of HIV infection or Acquired Immune Deficiency Syndrome (AIDS).
5. Lyme disease, unless adequately treated.
6. Viral hepatitis: A. History of Hepatitis B unless laboratory evidence of seroconversion and at least 1 year has passed since full recovery. B. Chronic Hepatitis B carrier state g. C. History of Hepatitis C until 1 year after completion of CDC-approved treatment with eradication of viral load.
7. Herpes Simplex Virus Type I or Type II that may interfere with performance of duties or compromise crew health.
8. Herpes zoster, unless resolved for greater than 1 month and without post-herpetic neuralgia.
9. Helicobacter pylori carrier state, until completion of one cycle of standard treatment protocol. No repeat testing is required.
10. Syphilis, gonorrhea, and chlamydia, unless adequately treated and without sequelae.
11. Non-immune status or lack of documented vaccination status against the following: measles, mumps, rubella, tetanus, polio, diphtheria, pertussis, meningococcus, and pneumococcus.
S. ANTHROPOMETRY CRITERIA
1. Failure to satisfy anthropometric criteria, including height and weight, which should be compatible with human factors for specified crewed space vehicles.

5.0 MINIMUM CLDS CREWMEMBER MISSION MEDICAL AND BEHAVIORAL HEALTH EVALUATIONS

[5001] The Commercial Provider **shall** identify and implement preflight and in-flight mission medical evaluations for non-USG and USG crewmembers that include the items in Table 5.0-1, Mission Medical Evaluations for Non-USG Crew, Table 5.0-2, Mission Medical Evaluations for Non-USG Crew with Safety-Critical Duties, and Table 5.0-3, Mission Medical Evaluations for USG Crew.

Table 5.0-1, Mission Medical Evaluations for Non-USG Crew, represents the minimum set of Mission Medical Evaluations (MMEs). Additional MMEs required for non-USG crew with safety-critical duties are outlined in Table 5.0-2. The Provider is responsible for the management of non-USG crew medical data.

Table 5.0-2, Mission Medical Evaluations for USG Crew, includes the minimum set from Table 5.0-1 as well as additional MMEs that include fitness for duty assessments and occupational surveillance for USG crewmembers. These represent best practices for non-USG crew should the Provider choose to adopt these for non-USG crew. NASA is responsible for management of USG crew medical data. The Provider is responsible to transfer USG crew medical data that is collected in-flight to NASA, subject to the controls, regulations, provisions, and penalties of the Privacy Act of 1974, as amended.

NASA will implement its own postflight MMEs for USG crew, which are included for reference in Appendix E, Postflight Mission Medical Evaluations for USG Crew.

CLDS crews will maintain their medical and behavioral certification per Section 4.2 Certification Process. The type and timing of such testing may overlap with mission medical requirements. In cases where there is duplication of testing, preflight mission medical evaluation requirements may be met by coincident medical and behavioral certification evaluations.

TABLE 5.0-1 MISSION MEDICAL EVALUATIONS FOR NON-USG CREW (2 PAGES)

MME ASSESSMENT	PREFLIGHT	IN-FLIGHT	DESCRIPTION
CLINICAL ASSESSMENT AND MONITORING			
Preflight Physical Exam for Long-Duration Crews	L-21/14 days (d) L-2/1 d		Clinical history and physical examinations by a crew surgeon to assess the medical status, interval history, and flight readiness of crewmembers for missions.
Private Medical Conference		Launch plus (L+)1-3 d, weekly, at least one between return minus (R-)5 d and R-0 d	Health status evaluations in-flight by ground-based crew surgeon to assess the medical status of the crewmember. Requires private communications link between destination and surgeon.
Hearing Assessment	Once prior to flight	ACI	Preflight hearing assessment establishes a baseline for comparison to ACI in-flight measurements and is to be conducted using the same modality as will be used in flight. This assumes that in-flight hearing assessment relies on semi-quantitative methods rather than pure tone audiometry.
Ophthalmology/Optometry and Specialized Ocular Assessments	L-6/3 months (m) To include visual acuity (near and distant – corrected and uncorrected), Amsler grid, retinal photographs, optical coherence tomography (OCT) with multicolor imaging (MCI), pupillary reflexes, extraocular muscle balance, biomicroscopy (slit lamp exam), dilated fundoscopic exam, tonometry, and optical biometry	Ocular questionnaire, Visual Acuity (near and distant – uncorrected and corrected), and Amsler grid at L+ 30 d and ACI Two-dimensional (2-D) Ultrasound, OCT with MCI ACI	Ophthalmology exams by qualified Ophthalmologist and/or Optometrist before flight to assess preflight readiness and establish baseline measurements for comparison to in-flight changes, and to assist in planning for in-flight eyecare and need for corrective lenses. In-flight exams performed by crew to diagnose, track, and treat ocular pathology with potential for mission impact; may require remote guidance and private communications link between destination and eyecare provider.
LABORATORY			
Methicillin-Resistant Staphylococcus Aureus (MRSA)	L-6/3 m		Nasal screening using a single swab, both nostrils sampled and cultured for MRSA organisms. MRSA positive crewmembers will undergo topical treatment with mupirocin intranasal three times daily and anti-staphylococcal body wash daily for 5 days, followed by repeat MRSA screening after the course of eradication, and if positive, appropriate antibiotics will be manifested.
Group A Beta-Hemolytic Streptococcus (GABHS)	L-90/30 d		Testing by pharyngeal swab, either classic throat culture or “rapid strep” testing using Enzyme Linked Immunosorbent Assay (ELISA) to identify the carrier state of GABHS. If identified and confirmed, treatment with antibiotics and re-testing performed to confirm clearance of the carrier state.

TABLE 5.0-1 MISSION MEDICAL EVALUATIONS FOR NON-USG CREW

MME ASSESSMENT	PREFLIGHT	IN-FLIGHT	DESCRIPTION
EXERCISE AND FITNESS			
Cycle Ergometer Test for Aerobic Fitness Capacity	L-90/30 d	L+14, L+90, R-14 d	Maximal load cycle ergometer protocol preflight to assess fitness for flight and to tailor in-flight countermeasures by defining crewmember's maximum heart rate and maximum workload.
PSYCHIATRIC/PHSYCOLOGICAL/BEHAVIORAL			
Preflight psychiatric/psychological status check	L-90/30 d		L-90/30 d: Psychiatric / Psychological Assessment of behavioral readiness for flight; and assessment of life events that may impact the astronaut's fitness for launch and/or direct countermeasures.
Private psychological conference (PPC)		Every 14 days	PPC performed by behavioral health (BH) Specialist (Psychiatrist or Psychologist) to address behavioral health, mood and performance issues, such as personal and group dynamics issues, and ground-crew interactions. Elements of the behavioral health countermeasures will be coordinated in part through these conferences.
Cognitive Assessment	Baseline prior to flight	At a frequency to ensure results remain valid throughout flight. Frequency dependent on test method chosen.	Preflight baseline cognitive assessment to assist in evaluating the impacts of in-flight events such as head injury, decompression sickness, atmosphere contamination, high CO2 levels, a change in normal behavior, and any other indication of reduced cognitive performance state. Performance functions to be assessed include, but are not limited to memory, attention, reasoning, and spatial processing.
Behavioral Observation of Training	At least 2 sessions between crew assignment and launch		Behavioral Health Specialist observation of integrated training events with USG and non-USG crews to assess crew interactions and determine mitigation or training strategies necessary to achieve mission success. NASA psychologists will observe for USG crew and Provider psychologists will observe for non-USG crew. Psychological data will be exchanged between NASA and the Provider as needed for purposes of certification.

TABLE 5.0-2 MISSION MEDICAL EVALUATIONS FOR NON-USG CREW WITH SAFETY-CRITICAL DUTIES

MME ASSESSMENT	PREFLIGHT	IN-FLIGHT	DESCRIPTION
Screening for Deep Vein Thrombosis (DVT) and Venous Flow Anomalies	L-12/3 m	R-42 d, ACI	Each crewmember shall be screened for DVT and flow anomalies of the internal jugular veins as a baseline and in-flight prior to return. Primary DVT of the left internal jugular vein has been observed at elevated rates in microgravity. Flow anomalies are observed in a significant subset of crewmembers examined for both research and surveillance purposes, and likely represent a risk for DVT development, which is a significant mission impact and poses an acute risk to crewmember health. Using an ultrasound device, duplex ultrasound of the bilateral extracranial internal jugular veins, with breathing and compression maneuvers, is performed preflight. For in-flight, onboard ultrasound device will be used with teleguidance and/or autonomously with just-in-time training.

TABLE 5.0-3 MISSION MEDICAL EVALUATIONS FOR USG CREW (6 PAGES)

MME ASSESSMENT	PREFLIGHT	IN-FLIGHT	DESCRIPTION
CLINICAL ASSESSMENT AND MONITORING			
Pre- and Postflight Physical Exam for Long-Duration Crews	L-9/6 m, L-21/14 d, L-2/1 d		Clinical history and physical examinations with the Crew Surgeon to assess the medical status and flight readiness of crewmembers for long-duration missions
Private Medical Conference		L+1-7 d, weekly, R-5 d, daily to R-0 d	Health status evaluations in-flight by ground-based crew surgeon to assess the medical status of the crewmember.
Neurovestibular Functional Assessment	L-9/3 m		Objective testing of postural stability, gait stability, or other measures of neurovestibular function will be performed. The platform test is one way to accomplish this. Other modalities can also be used. The testing sequences will be tailored to the individual crewmembers' level of deconditioning and rate of recovery.
Hearing Assessment	L- 90/30 d	L+ 60 d, L+ 240 d; if hearing threshold shift is seen in either exam, perform follow-up exam after 60 days. Supplemental hearing assessments may be requested by crewmember or Crew Surgeon based on noise environment or other medical concerns	Conventional Audiometry is performed before and after flight to determine hearing sensitivity with pure-tone, air conduction audiometry. On-orbit hearing assessment is performed in-flight with pure-tone audiometry, using a calibrated audiometer with earphones that can attenuate onboard noise levels. The condition of the middle ear and mobility of the eardrum (tympanic membrane) is determined with tympanometry, an objective test of middle-ear function.

Dental Examination	L-90/30 d		Brief dental exam to assess dental health, flight readiness, obtain baseline measurements, and to identify and mitigate dental health risks of each crewmember before launch.
Dental Orthopantomogram or Full Mouth X-Ray Series	L-21/18 m		A full dental orthopantomogram x-ray or full mouth x-ray series to fully assess the underlying dental health of the crewmember in order to correct any potential dental problems well in advance of mission launch.
Ophthalmology/ Optometry	L-90/30 d - Conducted by an eye specialist L- 21/18 m - Retinal photographs and OCT		Ophthalmological exams before flight to establish baseline measurements for comparison to in-flight visual changes, assess preflight readiness, and assist in planning for in-flight eyecare and need for corrective lenses. OCT capability will be provided by NASA.
Specialized Ocular Assessments	L-21/18 m • MRI brain and orbits [Spaceflight Associated Neuro-Ocular Syndrome (SANS)proto col] L-21/18 m and L- 9/6 m • Visual acuity, distance and near • Refraction – manifest and cycloplegic • Threshold visual fields • Amsler grid • Pupil reflexes • Extraocular muscle balance • Biomicroscopy (slit lamp) • Dilated fundoscopic examination • Retinal photography • Tonometry • Optical coherence tomography (high resolution) including Spontaneous Venous Pulsations	L+ 30 d, L+90 d, L+180 d, L+270 d, R- 30 d, ACI • Ocular questionnaire • Visual acuity distance and near • Amsler grid • Threshold visual fields 3. -D imaging - ultrasound Optical coherence tomography (high resolution) and MCI	In-flight exams performed to diagnose, track, and treat ocular pathology with potential for mission impact. OCT capability will be provided by NASA for USG crew.

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	(SVP) videography and MCI Optical biometry L- 9/6 m 2-D imaging ultrasound		
Bone Densitometry	L-21/18 m; L-180/30 d (as close to launch as feasible)		Bone Mineral Density is used to track individual skeletal integrity (loss and recovery) caused by spaceflight. BMD will be measured by Dual Energy X-ray Absorptiometry (DXA) to provide accurate measures of whole-body lean mass and fat mass, in addition to localized measurements of bone density. Quantitative Computer Tomography (QCT) distinguishes between cortical and trabecular bone compartments, which can allow for improved assessment of fracture risk, and therefore may be used as a supplemental tool.
Ultrasound Imaging (Sonography)	Thyroid – L-21/18 m Abdominal/retro peritoneal/pelvic – L- 21/18 m Carotid ultrasound – L-21/18 unless completed within the previous 5 years		Assessment is conducted using abdominal/retroperitoneal/pelvic ultrasound, and thyroid ultrasound. A heart ultrasound (echocardiogram) is obtained periodically as part of the annual physical examination. Carotid artery ultrasound utilizes ultrasound techniques to assess for atherosclerosis, and should include assessment of intima-medial thickness (IMT) and carotid plaque burden (volume or area).
Anthropometric Measurement	No later than L-30d	L+7d, then Monthly	Baseline anthropometric measurement for comparison to assess health status changes in long duration missions. In-flight implementation methods can include body mass measurement or waist/hip/extremity circumference measurement.
MRI Cervical and Lumbar Spine (non-contrast)	L-21/18 m		MRI protocols and imaging sequences will be conducted to assess for spinal or pathology that: a) May pre-dispose crewmembers to in-flight changes on long-duration missions that could lead to crewmember pain, dysfunction, or performance decrements during the mission b) Will inform decision making of management and exercise prescriptions for preflight and in-flight conditioning tailored to the needs of the crewmember based on their unique baseline c) Will assess for space related changes and inform decision making of exercise prescription for postflight conditioning to rehabilitate crewmembers and minimize risk of postflight injury
Screening for Deep Vein Thrombosis and Venous Flow Anomalies	L-12/3 m	L+30 d; L+60 d, R-42 d, ACI	Ultrasound screening for DVT and flow anomalies of the bilateral extracranial internal jugular veins using a duplex ultrasound with breathing and compression maneuvers, as a baseline preflight and during flight. Primary DVT of the left internal jugular vein has been observed at elevated rates in microgravity. Flow anomalies are observed in a significant subset of crewmembers examined for

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			both research and surveillance purposes, and likely represent a risk for DVT development, which is a significant mission impact and poses an acute risk to crewmember health. For in-flight, onboard ultrasound device with teleguidance and/or autonomously with just-in-time training.
LABORATORY			
MRSA	L-6/3 m		Nasal screening for all CLDS crewmembers. Using a single swab, both nostrils sampled and cultured for MRSA organisms. MRSA positive crewmembers will undergo topical treatment with mupirocin intranasal three times daily and anti-staphylococcal body wash daily for 5 days, followed by repeat MRSA screening after the course of eradication, and if positive, appropriate antibiotics will be manifested.
GABHS	L-90/30 d		Testing by pharyngeal swab, either classic throat culture or "rapid strep" testing using ELISA (Enzyme Linked Immunosorbent Assay) will be performed to identify the carrier state of GABHS. If identified and confirmed, it will be treated with antibiotics and re-testing performed to confirm clearance of the carrier state.
RADIATION			
Personal dosimetry		Continuous	In-flight crew personal dosimeter will be worn to monitor, limit, and document crew exposure to radiation and to keep crew exposures as low as reasonably achievable. Comprehensive risk assessment for a crewmember requires detailed monitoring of the radiation exposure during a mission and analytical evaluation of the history of all radiation exposures before, during, and after a mission. Personal dosimeter capability will be provided by NASA for USG crew.
EXERCISE AND FITNESS			
Aerobic Fitness Capacity Test	With ECG & volume of oxygen (VO ₂) max: L-21/18 m, L-90/30 d	With heart rate & max workload only: Flight Day (FD)14, FD75, FD165, FD255, R-14 d	Maximal aerobic load protocol to assess fitness for flight and to tailor in-flight countermeasures by defining crewmember's maximum heart rate, maximum workload, and maximum oxygen consumption (VO ₂ max), and monitoring fitness in-flight.
Functional Fitness Assessment	L-9/6 m, L-90/30 d		Functional fitness will be assessed to establish flight readiness and baseline individual norms; to guide individual physical training regimens leading up to flight, in-flight, and for postflight reconditioning; and to assess a crewmember's ability to perform strength and endurance tasks. Assessment will be done by "in the gym" exercises that measure key performance indicators including but not limited to muscular strength, endurance and power, and sensorimotor integration.
On-Orbit Strength & Conditioning Monitoring		Recurrent in-flight: - Weekly downlink and review of exercise device data - Video downlink of resistive exercise	Individual exercise data and video are downlinked from activities on exercise devices, which will be evaluated by ground exercise specialists so that crewmembers can be provided with individual recommendations regarding strength and conditioning exercises.

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		session within L+14 days [no earlier than (NET) 3rd session], then every 30 days Real-time audio instructional session during resistive exercise up to 3 times (and ACI) in conjunction with video downlink sessions; Private Exercise Conference NET 5 days following 1st resistive exercise video downlink session, then monthly	Real-time audio/video instruction sessions will be performed to prevent injury and to optimize performance during exercise. A private exercise conference will be conducted to allow for direct, efficient and comprehensive exchange of information between ground exercise specialists and crewmembers.
PSYCHIATRIC/PHSYCOLOGICAL/BEHAVIORAL			
Preflight psychiatric/psychological status check	L-12 m L-240/180 d L-90/30 d		Confirmation of behavioral readiness for flight: (a) Psychiatric/Psychological Assessment of behavioral readiness for flight (b) Specialist review of individual and crew psychological support (c) Check of life events that would have an impact on the astronaut's fitness for launch. (d) Baseline assessments needed for in-flight monitoring to be completed between L-12 months and launch: - Neurocognitive baseline - Behavioral health baseline (e) Performed by specialist
Private psychological conference		Every 14 days	PPC performed by BH Specialist (Psychiatrist or Psychologist) to address behavioral health, mood and performance issues, such as personal and group dynamics issues, and ground-crew interactions. Elements of the behavioral health countermeasures will be coordinated in part through these conferences.
Cognitive Assessment	Training (3 sessions): L-12m, L-9 m, L-6m; Baseline: L-9m, L-6m, L-3m	Standard Schedule: 1/month and ACI Experienced Crewmember Schedule (previously flown, long-duration): Schedule first test at FD30; if results are nominal (per Behavioral Health and Performance (BHP)/Human Behavior and Performance (HBP) clinical assessment), schedule every 90 days and as indicated, with final test at R-30 days.	Preflight training and baseline cognitive assessment to assist in evaluating the impacts of in-flight events such as head injury, decompression sickness, atmosphere contamination, high CO2 levels, a change in normal behavior, and any other indication of reduced cognitive performance state. Performance functions to be assessed include, but are not limited to memory, attention, reasoning, and spatial processing. Assessments consist of agency-specific or other validated cognitive assessment tests that require less than 30 min to complete.

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		Extended Mission Duration for either Novice or Experienced Crewmembers (greater than 7 months, including unplanned extensions): Standard Schedule for the first 6 months. After first 6 months, if prior results are nominal (per BHP/HBP clinical assessment), schedule every 90 days and as indicated, with final test at R-30 days.	
Behavioral Observation of Training	At least 2 sessions between crew assignment and launch		Behavioral Health Specialist observation of integrated training events with USG and non-USG crews to assess crew interactions and determine mitigation or training strategies necessary to achieve mission success. NASA psychologists will observe for USG crew and Provider psychologists will observe for non-USG crew.
NUTRITION			
Nutritional Assessments		Weekly food intake tracking	On-orbit dietary assessments via electronic food intake tracker in which crew inputs specific food and drink items consumed, and that can provide reports to medical support personnel on consumed micronutrient dietary composition.
FATIGUE COUNTERMEASURES			
Sleep Assessment	L-21/18 m: 2-week baseline period Starting L-7 d: Continuous	Continuously throughout mission	Before and after flight, crewmembers will provide a daily assessment of sleep quality and quantity to the Crew Surgeon. During flight, Crew Surgeon will solicit sleep feedback during Private Medical Conferences.
Sleep Medication Ground Testing	Any time before L-30 d		Preflight assessment of CLDP-approved sleep medications, to assess baseline response, significant side effects, and to rule out significant performance impacts of such medication use on emergent awakening.

6.0 MINIMUM CLDS MEDICAL CAPABILITIES

In-flight medical capabilities are intended to address planned and unplanned medical needs on the Commercial Destination. Planned medical needs include being able to perform mission medical evaluation required per **[5001]** in Section 5.0, Minimum CLDS crewmember Mission Medical and Behavioral Health Evaluations. Unplanned medical needs include being able to respond to contingency medical scenarios requiring diagnosis/treatment/monitoring and that may be plausible and/or of significant risk to warrant in-flight mitigation. In-mission capabilities will vary by vehicle mass, volume, and power limitations and design reference mission considerations; thus in-mission healthcare is to be tailored to specific mission needs and will subsequently affect risk assessment and pre-mission preventive care accordingly. Crew and ground personnel training requirements for capabilities described below are defined in CLDP-STD-1150, Commercial Low-Earth Orbit Development Program Operations Standards.

[6001] The Commercial Provider **shall** provide a CLDS medical system that includes the following minimum medical capabilities:

1. Sufficient quantities to support all crewmembers for the duration of the mission, and to manage a medical emergency through handover to ground-based definitive medical care.
2. Transport vehicle kit to include treatments to manage space motion sickness, minor infection, nasal congestion, urinary retention, corneal foreign body, minor pain, fatigue, trauma management and anaphylaxis.
3. Diagnostic capabilities/tools:
 - A. Diagnostic kit that measures blood pressure, heart rate, pulse oximetry, and body core temperature.
 - B. Ultrasound device capable of diagnosis of Venous Thrombosis, Musculoskeletal (MSK) injuries, renal assessment, abdominal assessment, ocular assessment, and focused assessment of trauma.
 - C. Electrocardiogram capabilities to include rapid rhythm assessment (e.g., 3-lead, 2-lead, handheld device, or similar) and 12-lead.
 - D. Capabilities to assess intraocular pressure, visual acuity, and visual field.
 - E. Capabilities to assess ear canal, tympanic membrane, and oral cavity. The tools should have the ability to take a static picture and/or video.
 - F. Diagnostic kit to assess urine for signs of infection, blood, and pregnancy.
4. Medications/capabilities to treat and manage the following emergency conditions:
 - A. Acute cardiac emergencies such as acute coronary syndrome, hypertensive emergency, and arrhythmias. Must include aspirin, a second alternative antiplatelet, and nitroglycerin. It must also include an Automated External Defibrillator (AED).

- B. Acute bronchospasm to include both Short-Acting Beta Agonist (SABA) and Long-Acting Beta Agonist (LABA).
 - C. Anaphylaxis – Must include epinephrine via auto-injector, epinephrine via Intravenous (IV) formulation.
 - D. Benzodiazepines and narcotic overdose – Must include flumazenil and naloxone if benzodiazepines and opioids are selected per Table 5.0-1, Minimum Medications List.
 - E. Acute angle closure glaucoma.
5. Medications/capabilities to treat and manage the following psychiatric conditions:
- A. Acute anxiety – Must include 2 classes of medications.
 - B. Acute psychosis – Must include both oral and intramuscular administration.
 - C. Depression – Must include 2 classes of medication.
6. A device that is capable of restraining a crewmember and the person providing Cardiopulmonary Resuscitation (CPR) that is electrically isolating, and capable of maintaining in-line cervical spine immobilization.
7. Medications as listed in Table 5.0-1, Minimum Medications List.

TABLE 5.0-1 MINIMUM MEDICATIONS LIST (2 PAGES)

Medication
1. Decongestant – at least 2 types to include a nasal spray and oral systemic; must include Nasal Oxymetazoline.
2. Antibiotics to treat: A. Urinary tract infections – at least 2 classes. B. Bacterial pneumonia – at least 2 classes. C. Bacterial skin infections to cover Methicillin-Susceptible Staphylococcus Aureus (MSSA), MRSA, and streptococcus – at least 2 classes. D. Infectious colitis and other bacterial infections of the GI tract.
3. Common fungal infection treatment – topical and systemic antifungal therapies.
4. Space Motion Sickness (SMS) treatment – at least 2 types. Include oral, Intramuscular (IM), and Intravenous (IV) formulations. Must include both oral and IM Promethazine. Must not include scopolamine (any form).
5. DVT and Pulmonary Embolism (PE) treatment including appropriate anticoagulant reversal agent.
6. Antihistamines to treat minor allergic reaction – at least 2 classes.
7. Cough treatment.
8. Sleep aids – at least 2 different classes. Must include melatonin.
9. Stimulants – at least 2 different classes.
10. Treatments for common ocular problems to include corneal abrasions, dry eye, allergic conjunctivitis, and bacterial conjunctivitis.
11. Treatment for symptoms of nausea, vomiting, and diarrhea.

Medication
12. Treatment of fever – at least 2 different classes.
13. Systemic treatments for mild/moderate pain - at least 2 different classes.
14. Systemic treatment for moderate/severe pain - at least 2 different classes.
15. Corticosteroid – Low potency and high potency.
16. Outer ear infection treatment/capabilities.
17. Constipation treatment.
18. Dysfunctional uterine bleeding treatment.
19. Antiviral treatment for common outbreaks related to herpes and/or varicella.
20. Acute seizure management – at least 2 classes.

8. Medical equipment and consumables in a variety of sizes to accommodate all the anticipated crewmembers as applicable for the duration of the mission:
 - A. Personal Protective Equipment (PPE).
 - B. Biohazard waste management equipment to include sharps management.
 - C. Capability to treat and manage wounds, such as burns, abrasions, minor lacerations, or abscesses.
 - D. Capability to administer medications via intraosseous, intravenous, and intramuscular routes.
 - E. Emergency dental care capabilities to treat conditions, such as acute tooth fracture, loss of crown, or dental abscess.
 - F. Laceration repair capability.
 - G. Cerumen disimpaction capability.
 - H. Trauma management supplies to include tourniquet and splinting materials.
 - I. Intravenous fluid administration and resuscitation capabilities.
 - J. Capability to treat urinary retention – Must include Foley catheters and straight catheters and respective urine containment systems.
 - K. Advanced respiratory support capability to include nasal and oral airway, supraglottic airway, and ventilator support.
 - L. Supplies for the administration of supplemental oxygen up to 15L / min.
 - M. Capability for fluid loading with oral hydration salts prior to landing.
 - N. Orthostatic intolerance garments.
9. Any additional equipment not already mentioned above with quantities needed to conduct the non-USG and USG crew Mission Medical and Behavioral Evaluations listed in Section 5.0, including ACI evaluations, except where it is denoted in Section 5.0 that NASA will provide a capability (i.e., OCT).

APPENDIX A - ACRONYMS AND ABBREVIATIONS

°	Degree
%	Percent
2-D	2-Dimensional
ACI	As Clinically Indicated
ACLS	Advanced Cardiac Life Support
AED	Automated External Defibrillator
AGE	Arterial Gas Embolism
AIDS	Acquired Immune Deficiency Syndrome
ALP	Alkaline Phosphatase
ALS	Amyotrophic Lateral Sclerosis
ALT	Alanine Transaminase
AMB	Aerospace Medicine Board
aPTT	Activated Partial Thromboplastin Time
ASCVD	Atherosclerotic Cardiovascular Disease
ASD	Atrial Septal Defect
AST	Aspartate Aminotransferase
Astro-CHARM	Astronaut Cardiovascular Health and Risk Modification calculator
ATLS	Advanced Trauma Life Support
AV	Atrioventricular
BH	Behavioral Health
BHP	Behavioral Health and Performance
BLS	Basic Life Support
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulation
CLD	Commercial Low-Earth Orbit Destination
CLDP	Commercial LEO Development Program
CLDS	Commercial LEO Destination System
cm	Centimeter
CNS	Central Nervous System
CO2	Carbon Dioxide
CPR	Cardiopulmonary Resuscitation
CR	Change Request
CRF	Cardiorespiratory Fitness
CT	Computed Tomography
CXR	Chest X-Ray

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d	Days
dB	decibel
DCI	Decompression Illness
DCS	Decompression Sickness
D.O.	Doctor of Osteopathic Medicine
DQA	Document Quality Assurance
DSM	Diagnostics And Statistical Manual
DVT	Deep Vein Thrombosis
DXA	Dual Energy X-Ray Absorptiometry
EAR	Export Administration Regulations
ECG	Electrocardiogram
EEG	Electroencephalogram
EFF	Effective
e.g.	For Example
ELISA	Enzyme Linked Immunosorbent Assay
ENT	Ears, Nose and Throat
EtOH	Ethyl alcohol
EVA	Extravehicular Activity
FD	Flight Day
FOIA	Freedom of Information Act
GABHS	Group A Beta-Hemolytic Streptococcus
GGT	Gamma-Glutamyl Transferase
GI	Gastrointestinal
H ₂ O	Water
HbA1c	Hemoglobin A1c
HBP	Human Behavior and Performance
hCG	Human Chorionic Gonadotropin
HDL	High-Density Lipoproteins
HIPAA	Health Information Portability And Accountability Act
HIV	Human Immunodeficiency Virus
HMTA	Health and Medical Technical Authority
hs-CRP	high-sensitivity C-Reactive Protein
HUS	Hemolytic Uremic Syndrome
Hz	hertz
i.e.	That Is
IGRA	Interferon Gamma Releasing Assay
IM	Intramuscular

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ISS	International Space Station
ITAR	International Traffic in Arms Regulation
ITP	Idiopathic Thrombocytopenic Purpura
IV	Intravenous
kg	Kilogram
L	Liter
L-	Launch Minus
L+	Launch Plus
LABA	Long-Acting Beta Agonist
LASEK	Laser Epithelial Keratomileusis
LASIK	Laser-Assisted In-Situ Keratomileusis
LDL	Low-Density Lipoprotein
LEO	Low-Earth Orbit
m	Months
MAB	Multidimensional Aptitude Battery
max	Maximum
MBMS/MBChB	Bachelor of Medicine, Bachelor of Surgery
MC	Medical Certification
MCI	Multicolor Imaging
M.D.	Doctor of Medicine
min	Minute
MIR	Magnetic Resonance Imaging
ml	Milliliter
MME	Mission Medical Evaluation
mmHg	Millimeters Of Mercury
MRI	Magnetic Resonance Imaging
MRSA	Methicillin-Resistant Staphylococcus Aureus
MRT	Modified Rhyme Test
msec	Millisecond
MSK	Musculoskeletal
MSSA	Methicillin-Susceptible Staphylococcus Aureus
NASA	National Aeronautics and Space Administration
NEO-PI-3	Neuroticism Extraversion Openness Personal Inventory-3
NET	No Earlier Than
NHANES	Third National Health And Nutrition Examination Survey
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
OCT	Optical Coherence Tomography

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ORG	Organization
OPR	Office of Primary Responsibility
PCB	Program Control Board
PDA	Patent Ductus Arteriosus
PE	Pulmonary Embolism
PFO	Patent Foramen Ovale
PFT	Pulmonary Function Tests
pH	Hydrogen-Ion Concentration (Alkalinity)
PIP	Pseudo-Isochromatic Plates
PPE	Personal Protective Equipment
PRK	Photorefractive Keratectomy
PPC	Private Psychological Conference
PT	Prothrombin Time
PVC	Premature Ventricular Contractions
QFT-G	QuantiFERON-TB Gold
QT	Qualification Test
QuickSCID-5	Quick Structured Clinical Interview for DSM-5
R-	Return Minus
R+	Return Plus
REV	Revision
Rh	Rhesus Factor
ROM	Range of Motion
RPR	Rapid Plasma Reagent
SABA	Short-Acting Beta Agonist
SADS	Schedule for Affective Disorders and Schizophrenia
SC	Sickle-Hemoglobin C
SD	Space Division
SMB	Space Medicine Board
SMS	Space Motion Sickness
SS	Sickle Cell
STI	Scientific and Technical Information
SVT	Supraventricular Tachycardia
TB	Tuberculosis
TBD	To Be Determined
TBR	To Be Resolved
TIA	Transient Ischemic Attack

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TMJ	Temporomandibular Joint
TSH	Thyroid-Stimulating Hormone
TST	Tuberculin Skin Test
TTE	Transthoracic Echocardiogram
TTP	Thrombotic Thrombocytopenic Purpura
U.S.	United States
USG	United States Government
USML	United States Munitions List
VDRL	Venereal Disease Research Laboratory
VO ₂	Volume of Oxygen
Vol	Volume
VSD	Ventricular Septal Defect
WPW	Wolff Parkinson White
y	Years

APPENDIX B - GLOSSARY

AS CLINICALLY INDICATED OR ACI

Indicates that a test should be performed if there is a clinical indication to perform the test (e.g., new symptoms or new findings on a screening test) or if terrestrial screening standards (such as those established by U.S. Preventive Services Task Force) indicate screening is indicated for the individual's age, sex, and risk factors.

HISTORY OF

This phrase typically means the individual disclosed something in his/her history that has happened in the past. At times this is a reference to a surgical procedure that happened in the past. Example – stapedectomy or LASIK (Items D.6 and E.6, respectively, on the Conditions List). At other times the history may disclose a prior medical diagnosis like “asthma” (see Item F.7). In any case, a “history of” necessarily needs an assessment that looks at current risk to the individual. For a surgical history, the questions include why the surgery was needed, what is the ongoing risk due to the surgery and does spaceflight pose a risk to the system in question. For a medical history, similar questions need to be addressed. What occurred to cause the diagnosis to be made? Was that the correct diagnosis? Is there any ongoing risk and does spaceflight impart any future risk. In short, a “history of” means the flight surgeon will need to look at current risks due to that “history of.”

INTERFERING WITH THE PERFORMANCE OF DUTIES

The individual being evaluated needs to be able to perform basic functions of the job of astronaut. Basic functions include successful completion of the ground-based training. An example is claustrophobia that prevents the person from wearing a fully enclosing helmet or getting into a space vehicle. Another example is joint Range of Motion (ROM) - the ROM must be sufficient to accomplish tasks required in mission. Ground-based training which closely mimics actual mission activities may show deficiencies in this area. If failure is experienced, it may lead to a medical inquiry evaluating the mental and physical status of the astronaut looking to eliminate conditions that may be the basic cause of the failure. Thus, any condition that may interfere with the performance of duties needs to be fully evaluated to ensure the individual can be expected to experience actual in-flight mission success. A person who cannot perform the necessary duties of the job due to a medical condition cannot be medically certified.

INTERFERING WITH THE WEARING OF EQUIPMENT

The individual being evaluated needs to be able to wear appropriate equipment (e.g., facemask, helmet, protective equipment) for routine or, in some cases, special work. Wear of such equipment is considered a necessary part of the job; therefore, it is a baseline work expectation that a person selected to be an astronaut can wear equipment that is routinely involved in training as well as job performance. Some missions may require special equipment use and the individual selected for such missions must be able to wear that specific/special equipment as well. If the individual cannot wear the necessary personal equipment, then they cannot be medically certified.

MEDICAL CERTIFICATION PACKAGE

The Medical Certification Package includes results of required physical examination data, laboratory analysis, and specialist evaluations as well as results of any additional testing performed to assess abnormal findings from medical history or required evaluations. The Package is to identify any abnormal findings or conditions not meeting standards, establish risk to crew safety or mission success based on prior spaceflight or terrestrial experience for those findings or conditions, and provide a summary of risk mitigations and rationale for risk acceptance.

NASA AEROSPACE MEDICINE BOARD

A NASA clinical and implementation body for addressing USG crew medical certification. The AMB also addresses establishment of, or modification of, health and medical policies and standards, and oversees surveillance of crew health including evaluating and recommending approval or disapproval of waivers related to medical standards for atmospheric and space flight for USG crew.

ON RECORD

Indicates that any prior study or evaluation performed for which reports and imaging are available are sufficient to meet the requirement.

PERFORMANCE OF CREW HEALTH COUNTERMEASURES

Health countermeasures are activities performed on-orbit to preserve physiological and psychological health and to counteract the effects of spaceflight. A simple example includes any countermeasure used to prevent muscle atrophy resulting from lack of exposure to gravity. Preserving muscle strength in the individual crew is necessary to ensure a safe return to Earth for the entire crew. Therefore, an individual being evaluated prior to a mission needs to demonstrate adequate ability to perform on-orbit health countermeasures to ensure personal and crew safety.

REQUIRES SPECIALIST EVALUATION

This occurs when a listed medical condition may be medically acceptable, but that decision cannot reasonably be made by an individual without specialty training/experience. Examples of areas needing specialty evaluation include endocrinology, orthopedics, and dermatology. Information provided by the specialist needs to address ways to treat the condition in question and whether the condition may be expected to worsen or not. The specialist cannot be expected to fully understand the stressors of space flight, but they can aid in answering the most pressing question noted above. The final recommendation for medical clearance is made by the Commercial Provider's flight surgeon with input from the specialist.

SPACE MEDICINE BOARD

Commercial Provider clinical and implementation body for addressing CLD crew medical certification, including approval or disapproval of waivers related to medical standards for CLD missions.

UNLESS SURGICALLY CORRECTED

The concept involved with this phrase indicates the individual has healed/recovered from the surgery. Therefore, an adequate amount of time has passed to ensure no recurrence is reasonably expected. Additionally, an adequate amount of time needs to have been allowed to ensure undesired side effects from the surgery are no longer reasonably expected.

Cholecystectomy is a reasonable example. Has the person healed from the surgery? Have symptoms resolved? Have retained stones been eliminated? Is diet adjusted and the person functionally normal? Are there any symptomatic adhesions? The final question gets down to the mission level – can the in-mission food system provide the necessary diet?

APPENDIX C - OPEN WORK

Table C-1 lists the specific To Be Determined (TBD) items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBD item is numbered based on the section where the first occurrence of the item is located as the first digit and a consecutive number as the second digit (i.e., <TBD E-1> is the first undetermined item assigned in Section 4 of the document). As each TBD is solved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above-described numbering scheme. Original TBDs will not be renumbered.

TABLE C-1 TO BE DETERMINED ITEMS

TBD	Section	Description	Status
None			

Table C-2 lists the specific To Be Resolved (TBR) issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBR issue is numbered based on the section where the first occurrence of the issue is located as the first digit and a consecutive number as the second digit (i.e., <TBR 4-1> is the first unresolved issue assigned in Section 4 of the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above-described numbering scheme. Original TBRs will not be renumbered.

TABLE C-2 TO BE RESOLVED ISSUES

TBR	Section	Description	Status
None			

APPENDIX D - BEHAVIORAL HEALTH ASSESSMENT REPORT GUIDANCE

It is important that the CLD crew behavioral health assessment process includes consistent expectations for relaying the findings and results of those assessments in the form of a comprehensive report meeting the intent of the guidance in the below tables, as based on NASA's extensive experience with both USG and non-USG crewmembers.

TABLE D-1 PSYCHIATRIC ASSESSMENT REPORT

1. Integrated summary of findings with explicit diagnostic statement, and the psychiatrist's opinion(s) and recommendation(s) for treatment, medication, therapy, counseling, rehabilitation, or monitoring.
2. Any characterologically based behaviors or personality traits that represent subclinical signs and symptoms that present risks to crew cohesion, flight safety, or mission execution, including, but not limited to: a. A history of poor or unstable work or interpersonal relationships or personality traits that interfere with the forming and maintenance of social connections or functioning cooperatively with others as a teammate or crewmember. b. A pattern of behavior or traits that suggest poor impulse control. c. Evidence of poor stress-coping skills or resilience, emotional instability, or other traits or behaviors that suggest an impaired capacity to adapt to stressful situations.
3. Opinions regarding clinically or aeromedically significant findings and the potential impact on operational and flight safety, consistent with the medical conditions listed in Table 3.4.2-1, Medical Standards, Section O, and strictly limited to the psychiatrist's area of expertise

TABLE D-2 PSYCHODIAGNOSTIC ASSESSMENT REPORT

1. Results and interpretation of the battery of psychological tests, including scoring sheets, supporting documentation, and/or computer-generated reports, if requested.
2. Integrated summary of findings with explicit diagnostic statement, and the psychologist's opinion(s) and recommendation(s) for treatment, medication, therapy, counseling, rehabilitation, or monitoring.
3. Any characterological behaviors or personality traits that represent subclinical signs and symptoms that present risks to crew cohesion, flight safety, or mission execution, including, but are not limited to: a. A history of poor or unstable work or interpersonal relationships or personality traits that interfere with the forming and maintenance of social connections or functioning cooperatively with others as a teammate or crewmember b. A pattern of behavior or traits that suggest poor impulse control
4. Evidence of poor stress-coping skills or resilience, emotional instability, or other traits or behaviors that suggest an impaired capacity to adapt to stressful situations.
5. The test report should be made available to the examining psychiatrist for review as part of Psychiatric Assessment.

TABLE D-3 PSYCHOLOGICAL SUITABILITY ASSESSMENT REPORT

1. Assess whether the individual possesses sufficient levels of critical attributes (competencies) to: a. Complete training. b. Respond adaptively to environmental and psychosocial challenges and stressors. c. Does not present risks to crew cohesion, flight safety, or mission execution.
2. Assess whether the individual is competent, at a minimum, to: a. Function as a team member or crewmate in an operational setting and is free of personality traits that interfere with the forming and maintenance of social connections or functioning cooperatively with others as a teammate or crewmember. This may include personality traits or characteristics, such as self-centeredness (egocentrism), lack of concern for others, arrogance, entitlement, lack of empathy, insensitivity, and social avoidance or withdrawal. b. Regulate and manage emotions, behaviors, and impulses and is free of behaviors and traits that suggest poor impulse control, emotional instability, lack of judgment, difficulty with authority, or disregard for social norms and rules. c. Tolerate high levels of stress and effectively cope with and adapt to stressful conditions including dangerous or rapidly changing operational situations.

d. Apprehend the impact of one's emotions or behaviors on others and is free of deficiencies in self-knowledge and emotional awareness, or in the ability to understand or manage own emotions that disrupts personal relationships or team or crew cohesion and effectiveness. e. Live cooperatively with others in austere and confined conditions and is tolerant of others' differences, and aware and respectful of others' personal needs and boundaries in those living conditions.
3. If individuals are deemed not to meet the above competencies for suitability, determine if there are mitigations that could lead to acceptable risk for flight.

APPENDIX E - POSTFLIGHT MISSION MEDICAL EVALUATIONS FOR USG CREW

TABLE E-1 POSTFLIGHT MISSION MEDICAL EVALUATIONS FOR USG CREW

MME ASSESSMENT	POSTFLIGHT	DESCRIPTION
CLINICAL ASSESSMENT AND MONITORING		
Postflight Physical Exam for Long-Duration Crews	R+0 d, R+3 d, R+7/14 d, R+60 d	Clinical history and physical examinations with the Crew Surgeon to assess the medical status and recovery of crewmembers following long-duration missions
Neurological Assessment	R+0 d, R+1/7 d, and ACI	A brief, spaceflight-focused neurological assessment completed by either the Flight Surgeon or a neurology specialist, typically including evaluating signs and symptoms of motion sickness, orthostatic intolerance, and neurovestibular instability.
Neurovestibular Functional Assessment	R+ 1/7 d, R+ 7/14 d, and ACI until stable	Objective testing of postural stability, gait stability, or other measures of neurovestibular function will be performed. The platform test is one way to accomplish this. Other modalities can also be used. The testing sequences will be tailored to the individual crewmembers' level of deconditioning and rate of recovery.
Hearing Assessment	R+ 3 d, (If abnormal, R+ 10/14 d, R+ 60 d)	Conventional Audiometry is performed postflight to compare to preflight baseline and determine hearing sensitivity with pure-tone, air conduction audiometry.
Ophthalmology/Optometry	R+0/1 d - Conducted by Flight Surgeon and includes ophthalmoscopic exam R+3 d - Conducted by an eye specialist R+1/10 d - Retinal photographs and OCT	Ophthalmological exams postflight to follow up on changes and guide recovery plan as needed
Specialized Ocular Assessments	R+1/3 d, follow abnormal findings ACI • Ocular questionnaire • Visual acuity, distance and near • Refraction – manifest and cycloplegic • Threshold visual fields • Amsler grid • Pupil reflexes • Extraocular muscle balance • Biomicroscopy (slit lamp) • Dilated fundoscopic examination • Retinal photography • Tonometry • Optical coherence tomography (high resolution) including SVP videography and MCI • Optical biometry • 2-D imaging ultrasound MRI brain and orbits [special visual impairment and intracranial pressure (VIIP) protocol]	Specialized ocular exams performed postflight to follow up on changes and guide recovery plan as needed

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Bone Densitometry	R+ <30 d, R+ 1 y, then ACI to assess BMD recovery	Bone Mineral Density is used to track individual skeletal integrity (loss and recovery) caused by spaceflight. BMD will be measured by Dual Energy X-ray Absorptiometry (DXA) to provide accurate measures of whole-body lean mass and fat mass, in addition to localized measurements of bone density. Quantitative Computer Tomography (QCT) distinguishes between cortical and trabecular bone compartments, which can allow for improved assessment of fracture risk, and therefore may be used as a supplemental tool.
MRI Cervical and Lumbar Spine (non-contrast)	R+1-14 d, then ACI (Consider at R+ 180 d, R+ 360 d to confirm resolution and prevent injury related to spaceflight-related changes)	MRI protocols and imaging sequences will be conducted to assess for spinal or pathology that will assess for space related changes and inform decision making of exercise prescription for postflight conditioning to rehabilitate crewmembers and minimize risk of postflight injury.
Screening for Deep Vein Thrombosis and Venous Flow Anomalies	R+0/45 d	Ultrasound screening for DVT and flow anomalies of the bilateral extracranial internal jugular veins using a duplex ultrasound with breathing and compression maneuvers, as a comparison to preflight baseline and any changes seen during flight. Primary DVT of the left internal jugular vein has been observed at elevated rates in microgravity. Flow anomalies are observed in a significant subset of crewmembers examined for both research and surveillance purposes, and likely represent a risk for DVT development, which is a significant mission impact and poses an acute risk to crewmember health.
LABORATORY		
Laboratory Testing	R+3/7 d	To evaluate crewmember postflight recovery by analysis of clinical specimens.
CARDIOVASCULAR		
Active Postural Stand Test	R+0 then daily until stable	To test for orthostatic intolerance, a common feature of re-adaptation to gravitational fields following microgravity exposure, via standardized clinical procedure of obtaining blood pressure and pulse in supine position and again in specified intervals in seated and standing positions.
EXERCISE AND FITNESS		
Cycle Ergometer Test for Aerobic Fitness Capacity	With ECG & VO ₂ max: R+5 d, R+30 d	Maximal load cycle ergometer protocol postflight to compare to preflight and in-flight measurements, to guide rehabilitation back to baseline.
Functional Fitness Assessment	R+5/7, R+30 d	Functional fitness will be assessed for postflight reconditioning based on a crewmember's ability to perform strength and endurance tasks. Assessment will be done by "in the gym" exercises that measure key performance indicators including but not limited to muscular strength, endurance and power, and sensorimotor integration.
PSYCH/BEHAVIORAL		
Postflight psychiatric/psychological status check	R+3 d, R+10 d, R+14 d, R+30/60 d	Postflight psychiatric/psychological evaluation of the crewmembers: (a) Initial clinical interview by a specialist regarding behavioral re-adaptation, [30 min each crewmember at R+3 d] (b) Initial review of behavioral health and performance mission support, [30 min each crewmember at R+3 d]

		(c) Review of behavioral health and performance mission support, [60 min each crewmember at R+10 d] (d) Clinical Interview by specialist regarding behavioral re-adaptation, [60 min each crewmember at R+14 d] (e) Supplemental assessment ACI (f) Psychiatric/Psychological assessment regarding behavioral re-adaptation, [60 min each crewmember at R+45/60 d] (g) Performed by specialist
Cognitive Assessment	R+30 d	Postflight cognitive assessment to assist in evaluating the impacts of in-flight/landing events that could lead to reduced cognitive performance state. Performance functions to be assessed include, but are not limited to memory, attention, reasoning, and spatial processing. Assessments consist of agency-specific or other validated cognitive assessment tests that require less than 30 min to complete.
FATIGUE COUNTERMEASURES		
Sleep Assessment	Until R+7 d: Continuous	After flight, crewmembers will provide a daily assessment of sleep quality and quantity to the Crew Surgeon.

APPENDIX F - MEDICAL EVALUATIONS FOR NON-USG CREW FOR SHORT DURATION MISSIONS

This section provides the medical evaluations for testing of non-USG crew that do NOT perform safety-critical tasks (e.g., piloting of a vehicle, extravehicular activities (EVAs), robotic operations, etc.) and are in mission planned for 30 days or less. The testing is based on NASA experience and the risk of not completing these tests should be considered for each mission to ensure that safety, health, and mission success is not compromised.

F.1 MEDICAL HISTORY AND EXAM

TABLE F.1-1 - MEDICAL HISTORY AND EXAM

1. Comprehensive medical questionnaire ^{1, 2}
2. Full aeromedical physical examination

1 -May be completed using the NASA Medical Survey or other similar questionnaire. The following areas should be included: Past medical history and background information; psychosocial and psychiatric history including alcohol-related and drug-related convictions; personal habits/lifestyle issues; travel history (past year); medication review, including non-prescription and herbal medications, food supplements, vitamins, and minerals; systems review; physical activities and sports.

2 – A medical survey or questionnaire may be used to acquire any known allergies and adverse reactions.

F.2 LABORATORY DUTIES FOR USG CREW WITH NO CRITICAL DUTIES AND ON MISSION 30 DAYS OR LESS

The following are required laboratory assessments for non-USG crew with NO critical duties and on missions 30 days or less stratified by those assessments required prior to the first flight versus those required prior to subsequent flights. Validity periods for each test are with respect to the mission end date (e.g., valid within 1 year of mission end date). As clinically indicated tests are expected to address U.S-based national screening standards and guidelines, as applicable, and any applicable evaluation for off nominal findings identified during the evaluation process.

TABLE F.2-1 - LABORATORY TESTS FOR NON-USG CREW WITH NO CRITICAL DUTIES AND ON MISSIONS 30 DAYS OR LESS*

Hematology/Thrombophilia Screen	Initial	Periodic
Complete blood count – to include hemoglobin, hematocrit, red blood cell count, red blood cell indices, white blood cell count, differential count, platelet count	✓	✓
PT, aPTT	✓	On record

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ABO blood group and Rh type	✓	On record
Biochemistry	Initial	Periodic
Comprehensive metabolic panel – to include glucose, calcium, Sodium, potassium, chloride, and bicarbonate, albumin, total protein, ALP, ALT, AST, bilirubin, and blood urea nitrogen.	✓	✓
TSH	✓	✓
HbA1c, fasting blood glucose	✓	✓
Cardiovascular profile – Fasting total cholesterol, HDL, LDL, triglycerides, hs-CRP	✓	✓

**TABLE F.2-2 - LABORATORY TESTS FOR NON-USG CREW WITH NO CRITICAL DUTIES
AND ON MISSIONS < 30 DAYS (CONTINUED)***

Infectious Disease Screen	Initial	Periodic
Hepatitis B (hepatitis B surface antigen, hepatitis B core antibody, hepatitis B surface antibody)	✓	✓
Hepatitis C	✓	✓
Serologic screen for syphilis (VDRL or RPR or equivalent)	✓	On record
HIV	✓	On record
TB screening utilizing a TST or IGRA (either QuantiFERON-TB Gold® (QFT-G) or T-SPOT®).	✓	✓
MRSA Swab	L-3/1 month	L-3/1 month
Group A beta hemolytic strep	L-3/1 month	L-3/1 month
<i>Helicobacter pylori</i> breath test	✓	On record
Urinalysis	Initial	Periodic
Routine (specific gravity, glucose, protein, pH, ketones, blood), microscopic reflex	✓	✓
hCG (females) (urine)	✓	On record
Drug screen for drugs of abuse	✓	On record

* Check marks indicate that the evaluation is required. Boxes with text are to be interpreted as written.

F.3 SPECIALIST EVALUATIONS

The following are required specialist assessments for non-USG crew with NO critical duties and on missions less than 30 days stratified by those assessments required prior to the first flight versus those required prior to subsequent flights. Validity periods for each test are with respect to the mission end date (e.g., valid within 1 year of mission end date). As clinically indicated tests are expected to address U.S.-based screening standards as applicable and any applicable evaluation for off-nominal findings identified during the evaluation process.

TABLE F.3-1 - SPECIALIST ASSESSMENTS FOR NON-USG CREW WITH NO CRITICAL DUTIES AND ON MISSIONS 30 DAYS OR LESS (2 PAGES)*

Optometrist or Ophthalmologist	Initial	Periodic
Uncorrected and corrected near and distance visual acuity (Snellen or Landolt-C)	✓	✓
Color vision (computer-based test, Ishihara, or equivalent pseudo-isochromatic plates [PIPs] to include red-green and blue-yellow)	✓	✓
Tonometry	✓	✓
Fundoscopy exam	✓	✓
Perimetry	✓	On record
Otolaryngology/ENT	Initial	Periodic
Audiometry (pure tone audiogram and speech audiogram, if indicated)	✓	✓
Tympanogram	✓	✓
Dental	Initial	Periodic
Special Assessment by Dentist	✓	✓
Full orthopantomogram or full mouth X-ray series	✓	On record
Cardiopulmonary	Initial	Periodic
Resting 12-lead ECG	✓	✓
Direct or indirect measurement of CRF in ml/kg/min or METS) on maximum exercise stress test	✓	✓
24-Hour ECG monitoring	✓	On record
Coronary calcium scoring (males > 40 years. old; females >50 years old)	✓	Within 5 years

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Atherosclerotic Cardiovascular Disease Risk Calculator (i.e., Astronaut Cardiovascular Health and Risk Modification [Astro-CHARM], Atherosclerotic Cardiovascular Disease [ASCVD])	✓	✓
Gastroenterology	Initial	Periodic
Colonoscopy	ACI	ACI
Neurology	Initial	Periodic
MRI of brain, MRI angiogram	✓	On record
Carotid ultrasound study (to include intima-medial thickness and/or carotid plaque area)	ACI	ACI
Behavioral Health Evaluation	Initial	Periodic
Psychiatric evaluation (See Section 3.4.1.4 for details) <i>Based on the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders, the American Psychiatric Association</i>	✓	✓
Psychodiagnostic evaluation (See Section 3.4.1.5 for details)	✓	On record
Psychological suitability evaluation (See Section 3.4.1.6 for details)	✓	On record
Radiological/Ultrasound Procedures	Initial	Periodic
CXR (PA and lateral)	✓	Within 5 years
Thyroid ultrasound	ACI	ACI
Abdominal and pelvic ultrasound	✓	Within 5 years
Bone mineral density – DXA scan	ACI	ACI

* Check marks indicate that the evaluation is required. Boxes with text are to be interpreted as written.