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CHAPTER 6.8 TEST SAFETY

6.8.1. Applicability of this chapter

6.8.1.1 You are required to follow this chapter if you:

- a. Conduct or participate in testing activities at JSC, Ellington Field, Sonny Carter or WSTF sites.
- b. Are involved in tests at other locations, foreign or domestic.

6.8.2. What this chapter covers

- a. This chapter outlines the essential safety requirements and references for tests conducted at JSC, as well as for tests performed at other locations that involve JSC personnel, JSC property, or activities sponsored by JSC. This includes Human in the loop (HITL) activities.
- b. HITL activities are those in which a human interfaces with hardware, software, or procedures and is exposed to varying occupational hazards associated with these interactions. Such activities span a range of operations, including testing, evaluations, training and demonstrations. While some HITL activities involve human subjects and therefore fall under Institutional Review Board (IRB) oversight, Non Institutional Review Board HITL activities (NIRB HITL) constitute a category in which the hardware is the primary focus of the study or research and the activity does not meet the criteria for IRB review.

The requirements in this chapter address equipment under test, test personnel, test facility interfaces with both personnel and equipment, and required test documentation. The term “testing” as used throughout this chapter, encompasses the full spectrum of HITL activities across varying levels of hazard, conducted to support training, demonstrations of hardware or procedures, data acquisition, and hardware evaluation, requirement validation or verification, human rating certification, qualification, or acceptance.

6.8.3. Exclusions from this chapter

- a. This chapter excludes testing of institutional systems and equipment (such as fire protection systems), diagnostic medical tests, or medical treatment procedures.
- b. This chapter also excludes laboratory analysis, research, and experimentation unless it involves human subjects, flight hardware, prototype hardware, explosives, and oxygen-enriched atmospheres.

6.8.4. Requirements for test operations

6.8.4.1 Testing organizations shall keep the Safety and Test Operations and Space Medicine Operations Divisions informed of upcoming test activities and test schedules by following these requirements:

- a. Complete the [Support Request](https://www9.jsc.nasa.gov/safety/TSO/) form at URL: <https://www9.jsc.nasa.gov/safety/TSO/>.
- b. Send a meeting invitation with test schedules and test documents to jsc-

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tsomail@mail.nasa.gov. A Test Safety Officer (TSO) will be assigned upon availability. Use encrypted email as needed to protect CUI information (i.e. commercial vendor testing). Even when assigned a specific TSO, continue to include the TSO mailbox in all meeting notices. Notify Space Medicine of planned HITL activities and support needs at jsc-sd-hitl-trr@jsc.nasa.gov.

- c. For nonhazardous tests, follow paragraphs 6.8.5 and 6.8.9 through 6.8.11 (operating procedures, test systems, and test team members) and other requirements from this chapter included by the testing organizations or the Safety and Test Operations Division. Also make test documentation available to the Safety and Test Operations and Space Medicine Operations Divisions on request.
- d. For hazardous tests, follow all the requirements in this chapter applicable to the tests. Testing organizations or the Safety and Test Operations or Space Medicine Operations Divisions may also decide to follow more stringent requirements.
- e. Include the applicable requirements of this chapter in requirements provided to test requestors.

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6.8.5. Test team members

The following personnel shall be present during each test as required below or in other sections of this chapter. These personnel may not be required to be present throughout the entire test. The testing organization's operating procedures or detailed test procedures (DTPs) specify when each member is to be present.

<i>If you are the . . .</i>	<i>Your duties are . . .</i>	<i>Your certification requirements are . . .</i>
Test Director (TD)	To be the central authority and have overall responsibility for all aspects of the test.	The responsibility of the testing organization.
Test Conductor (TC) (Optional)	Described in the testing organization's operating procedures or DTPs.	The responsibility of the testing organization.
Test Safety Officer (TSO)	To monitor all phases of test activities for certain human or especially hazardous tests, and to advise the TD of any activities deemed to be hazardous to JSC personnel or property. To advise the Safety and Test Operations Division of any safety concerns that surface during the test. To advise the Medical Representative if any health concerns surface during the test.	The responsibility of the Safety and Test Operations Division
Medical Representative (MR)	Person designated to conduct the review of test documentation and assign the medical monitoring level.	The responsibility of the Space Medicine Operations Division or Space and Occupational Medicine Branch
Medical Monitor (MM)	As described in paragraph 6.8.6.1 below.	Defined by Space Medicine Operations Division's HITL Medical Review Group (MRG)
Facility or Test Support Personnel Facility or test support personnel include all other personnel necessary to support a test, such as console operators, divers, test article support personnel, audiovisual personnel, or pressure suit engineers.	Listed in the testing organization's operating procedures, test plan, or DTPs.	Specified in the testing organization's operating procedures, test plan, or DTPs.

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Test Subject (the human subjected to the test environment)	Inform the TD if you feel that you may be in danger and desire to stop the test.	Specified in the operating procedures, test plan, or DTPs.
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6.8.6. Other requirements for test team members

6.8.6.1 The MR, MM and TSO shall observe the following additional requirements:

- a. For Level 1 Testing, the MM, shall check the fitness of the Human-In-The-Loop (HITL) to participate before any hazardous testing begins.
- b. An MM shall monitor the medical conduct of tests under the following conditions unless excluded by HITL Medical Review Group (MRG):
 - (1) Personnel in hypobaric, hyperbaric, and oxygen-enriched environments.
 - (2) Suited underwater neutral buoyancy operations.
 - (3) Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid (pounds per square inch differential).
 - (4) As deemed necessary by Space and Occupational Medicine Branch or designee.
- c. The MM and TSO shall:
 - (1) Review test documentation and participate in TRRs as required.
 - (2) Make sure that there is adequate and functional bioinstrumentation on each test subject when required.
 - (3) Keep in communication with the TD at all times when their presence is required during the test.
- d. A TSO shall monitor the following tests:
 - (1) Personnel in hypobaric, hyperbaric, and oxygen-enriched environments.
 - (2) Suited underwater neutral buoyancy operations.
 - (3) Testing or training involving personnel at heights greater than 10 feet above the ground or on a platform.
 - (4) Ambient pressure suit operations using other than ambient air or where the suit pressure is greater than 8.8 psid (pounds per square inch differential).
 - (5) Other tests as recommended by Operational Readiness Inspection (ORI), Use Readiness Review (URR), or Test Readiness Review (TRR) Board with concurrence of Safety and Test Operations Division.

6.8.7. Training and certification for test team members

Test team members or support personnel shall be trained for their jobs as described in the facility operating procedures. Never fill a position without being trained or certified as required in the facility operating procedures. See Chapter 5.8, "Hazardous Operations: Safe Practices and Certification," for more requirements on certification. See Chapter 4.1, "Safety and Health Training," and JPR 8550.1, "JSC Environmental Compliance Procedural Requirements," for more requirements on training.

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6.8.8. Operating procedures for testing

Testing organization shall have operating procedures that meet paragraph 10.2.6 of Chapter 10.2, “Safety and Health Requirements for Test, Vacuum, and Oxygen-enriched Facilities.” The operating procedures may contain more stringent requirements than those of this JPR if the testing organization and the Safety and Test Operations and Space Medicine Operations Divisions believe they are required.

6.8.9. Requirements for test systems

6.8.9.1 The following requirements apply to hazardous and nonhazardous test systems.

- a. Test systems shall be designed and constructed so a single-point failure, loss of utilities, fluctuation of utilities, or software command can’t cause injury, property damage, or uncontrolled environmental spill, release, noncompliance, or nonconformance. Follow reliability and fault-tolerance requirements in paragraph 1.7 of NPR 8715.3, “NASA General Safety Program Requirements.”
- b. Test systems used in oxygen-enriched, high-vacuum, or enclosed environments shall undergo materials scrutiny as defined by the testing organization’s material control process.
- c. The test system’s materials shall follow the material control requirements of Chapter 10.2 if the facility does not have a materials control process.
- d. Safety and environmental instrumentation shall be calibrated and certified before the test and as required by the test documentation or the testing organization’s operating procedures.
- e. Test systems are approved for testing after the Test Readiness Review Board (TRRB) approval sheet is signed by all mandatory TRRB participants defined in 6.8.13.c, and all constraint action items are determined closed by the TRRB Chair (see paragraph 6.8.13).
- f. Software that interfaces with test systems shall meet NASA-STD-8719.13, “NASA Software Safety Standard.”
- g. Make sure no test team member can be exposed to hazardous materials used in the system.
- h. Clearly identify test controls in test and facility system drawings.

6.8.10. Requirements for Human in the Loop (HITL) test systems

6.8.10.1 In addition to the requirements above, Human in the Loop (HITL) test systems shall:

- a. Meet the requirements in paragraph 3.19 in NPR 8715.1.
- b. Be designed for safe test termination and removal of test subjects if a power failure, fire, or other emergency occurs.
- c. Either be approved by the Institutional Review Board (IRB, <https://eirb.jsc.nasa.gov/>) for use of human subjects in research or obtain an exemption from IRB review. This assessment shall comply with NPD 7100.8 and NPR7100.1, “Protection of Human Research Subjects”. An IRB exemption can be obtained via one of the two following processes:

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- (1) Application for exemption to the Exemption Determination Review Official (EDRO). Contact the EDRO via email at: JSC-EDRO@mail.nasa.gov and include in the email the activity's objectives and test planning materials for review.
- (2) Fill out the Human Research Program (HRP) Not Human Subjects Research (NHSR) Questionnaire (available at <https://eirb.jsc.nasa.gov/>), which includes two pathways for exemption. Investigators can take either path, both of which start with filling out the first portion of the NHSR Questionnaire, and then either:
 - a. Include the NHSR form indicating the investigation is not human subject research with a submittal to the IRB requesting an exemption, with the IRB then issuing an agreement that the work is not human subjects research and is exempt from IRB review or,
 - b. Self-declare that the work is not human subject research, and not file for IRB exemption. This path comes with risk for the investigator, though it is a technically legal option. The risk that the investigator takes is that if the activity when performed experiences a close call or incident or in some other way triggers closer scrutiny, then an incident investigation may note that it was human subject research and should have had an IRB review. IRB would then issue a non-compliance assessment against the investigator, and then mitigation steps would need to be taken.

6.8.11. Documentation requirements for tests

6.8.11.1 Testing organizations shall complete the following documentation as part of the test process. Complete everything but the test report and the mishap report before the test:

- a. The test plan is a top-level summary of the test. A test plan needs to be written for each new test. The test plan shall include the following as a minimum:
 - (1) Test objectives.
 - (2) Safety, occupational health, and medical planning provisions and known medical issues.
 - (3) Test requirements.
 - (4) Special safety, occupational health, and environmental considerations for test.
 - (5) Other items as required by the testing organization; test plans containing final DTPs (as described below) shall be approved in the same manner as a DTP document.
- b. The DTP describes the steps to run the test. Write test procedures in a step-by-step sequential format. DTPs shall include the following as a minimum:
 - (1) Operating procedures to accomplish the test.
 - (2) Measures to prevent mishaps.
 - (3) Emergency procedures to be taken in the event of systems failure or malfunction, such as fire, smoke, power outages, environmental spills and releases, and system failure.
 - (4) Test rules defining equipment and instrument limits, operating limits, off-nominal conditions, and operational situations that would require abort, hold, or proceed decisions for each test

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or checkout operation.

- (5) The safety requirements, individual tasks, and personnel involved in hazardous operations.
 - (6) Special considerations and procedural steps addressing specific hazards identified during the hazard analysis process; these, and steps containing actions critical to the protection of life or property, shall be flagged as safety-critical steps for easy identification by test team personnel.
- c. A safety, health, and environmental assessment identifying the safety and health hazards associated with the test, the hazards' controls, and verification. Facility operating procedures shall outline the assessment process and identify specific assessment subjects. The process should begin in the early phases of test planning and operations and should involve the Safety and Test Operations Division, the Environmental Management Office, Space and Occupational Medicine Branch, and Occupational Health at every step. Eliminate, control, or close all hazards, or accept the risk before testing begins:
- (1) Operating procedures stating how to document the results of safety and health assessments. Update the assessments for changes to the hardware or operations.
 - (2) Chapter 2.3, "Hazard Analysis," describes hazard analysis requirements.
- d. Test reports should include any anomalies; safety, health, or environmental implications; and safety or health lessons learned. Send a copy of the report to the Safety and Test Operations Division, the Environmental Management Office, Space and Occupational Medicine Branch, and Occupational Health. Send lessons learned by means other than the report.
- e. A mishap report (JSC form 1627) when required by chapter 2.6 and a close call report per chapter 2.5.

6.8.12. Requirements for certain test documents

6.8.12.1 To allow adequate time for review, comments, and dispositions, testing organizations shall provide the minimum required test documentation per section 6.8.11 to TRRB members at least two weeks before the TRR. Incomplete or late submissions may delay the test team from receiving authority to proceed with the TRR. Testing organizations shall also follow these rules:

- a. DTPs containing safety-critical steps shall state that on the cover.
- b. Emergency procedures shall be immediately available to personnel at their duty stations unless it isn't practical (such as divers).
- c. Have the Safety and Test Operations Division sign the Test Hazard Analysis. The Safety and Test Operations Division representative's signature on the TRRB summary sheet shall indicate that other test documentation is approved for testing on closure of all constraints to test action items.

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Expedited, high priority, or nonhazardous testing may utilize a shorter review timeframe with approval from the TRRB Chair and Safety and Test Operations Division but shall be no less than three business days before the TRR. For repeat, real-time, and quick-turnaround tests, see section 6.8.15.

6.8.13. Test readiness reviews (TRR)

6.8.13.1 The following requirements apply to TRRs:

- a. Testing organizations shall schedule TRRs at least one week in advance to allow enough time for support organizations to schedule resources. Refer to sections 6.8.11 and 6.8.12 for submitting test documentation.
- b. Testing organizations shall hold a TRR for each test involving HITL and for other hazardous tests or series of tests. An annual TRR is acceptable for an undefined number of tests where the tests are similar, involve no significant changes to the hardware, are low risk (RAC 4 with the concurrence of the Safety and Test Operations Division), and are individually approved by the branch chief. The Facility TRR Board shall have a process in place for vetting incoming requests seeking coverage under the annual TRR to verify no additional integrated hazards are introduced. A TRR determines:
 - (1) The readiness of the test facility, test team, test documentation, and the test article.
 - (2) The adequate completion of the safety, health, and environmental assessments.
 - (3) The status and closure of key issues.
 - (4) The test constraints.
 - (5) The open items.
 - (6) The qualification or certification of the test team.
 - (7) Confirmation of either IRB approval or exemption from IRB review via the processes as described in Section 6.8.10.1.c.
- c. The TRRB will be chaired by a management official or designee from the testing organization who is not personally involved with the test. The board membership shall include:
 - (1) A Safety and Test Operations Division representative.
 - (2) An Occupational Health, Medical, Radiation Safety, or Industrial Hygiene representative (as appropriate) from Occupational Health to assess exposures.
 - (3) A Space Medicine Operations Division representative for tests and hardware evaluations involving HITL. Specific organizational or program requirements for additional medical personnel at TRR's or HITL testing may be necessary.
 - (4) A Quality and Flight Equipment Division representative (for tests supported by the Quality and Flight Equipment Division).
 - (5) An Environmental Management Office Representative (if appropriate).
 - (6) A representative from each organization providing hardware or personnel for the performance of the test.

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- (7) A crew representative (or other designated representative from the Flight Operations Directorate) if the test or test campaign being reviewed will include astronaut subjects/participants at any point during the test campaign under this TRR.
- (8) Other members who might be selected by the board chairman or the testing organization for their special knowledge.
- d. The TRRB members will sign a TRRB summary sheet to indicate their approval to proceed with the test pending closure of all constraint action items as determined by the TRRB Chair. A TRRB summary sheet generally will include:
 - (1) The test objective.
 - (2) A statement covering test article readiness.
 - (3) The test schedule.
 - (4) Approval of the staffing, operation, procedures, and safety, health, and environmental assessments.
- e. A TRR shall assess hazards of all hardware and procedures involved in the test, to include:
 - (1) Other procedures embedded in the test protocol, such as standard assessments.
 - (2) The rationale for approval of previously approved test protocols to determine whether they are still valid.
 - (3) Procedures developed for operational use and being adopted for test use to determine whether they are appropriate for the test environment.

6.8.14. Other test reviews

6.8.14.1 Testing organizations shall have the following reviews unless they are indicated as “optional.”

- a. A pre-test briefing conducted by the TD or TC for each series of tests. The intent is to make sure all test team members understand the test’s normal and emergency operations and all test hazards.
- b. Pre-test checkout operations, using approved test procedures. Conduct this before each series of tests to make sure the test personnel will function effectively as a team and the facility and test equipment are compatible. Pre-test checkout operations shall include:
 - (1) Verification that all critical systems are functional.
 - (2) A “dry run” for complex tests, if practical, to exercise the facility and equipment for final compatibility and provide training and familiarization for the test team.
 - (3) Simulated emergency drills unique to the specific test.
- c. A post-test debriefing (optional) by the TC or TD for HITL or complex tests. The intent is to discuss the test results and any facility or test system anomalies with the test team and subjects (if appropriate).

6.8.15. Repeat, real-time, and quick-turnaround tests

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6.8.15.1 Testing organizations shall follow these requirements:

- a. Repeat testing may use previously approved configurations and procedures without another TRR as long as the test complies with the constraints of the original TRR and the paperwork has not changed. Modifications to the hardware or procedures will require a new TRR. Retests, modified procedures, and safety analyses shall be approved as described in the testing organization's operating procedures.
- b. Real-time and quick-turnaround testing refers to testing required in real time to support a mission or pre-mission testing for a space mission. This testing is essential for timely start or safe continuation of the mission. For this type of testing, testing organizations may streamline the test process. As a minimum, testing organizations shall:
 - (1) Have test procedures and hold a TRR.
 - (2) Notify the Safety and Test Operations Division and Space Medicine Operations Division (for HITL) as soon as possible.
 - (3) Have a Safety and Test Operations and Space Medicine Operations Division (for HITL) Division representative present for any procedure reviews, the TRR, and the test, if required.

6.8.16. Requirements for test operations

6.8.16.1 You shall follow these requirements during any phase of hazardous and non-hazardous test operations including buildup and teardown:

- a. Follow limits on work shifts for test team members and personnel supporting tests found in Chapter 5.8, "Hazardous Operations: Safe Practices and Certification."
- b. Keep test data records for at least 14 days after the test to help investigation and analysis of any mishaps or anomalous conditions. Safety may require keeping the records longer.
- c. Follow the approved procedures. Each testing organization shall have a form for test deviations.
- d. Document deviations from approved procedures on a deviation sheet. Deviation sheets require signature approval by the Safety and Test Operations Division if the deviation affects hazard closure or creates a new hazard. Signature approval from the Space Medicine Operations Division is also required if the deviation affects test subject health or safety.
- e. The TD and any appropriate engineers shall approve the deviation by signature along with the TSO and MR, if on station for the test. *Never make deviations from test rules during the test.*
- f. Make sure the TD maintains voice contact with all critical test team members. Communication requirements shall be specified in the operating procedures, test plans, or test procedures.
- g. Follow these requirements as a TD:
 - (1) Redirect the test to a safe position or stop the test if advised to stop the test by a TSO or anyone. Resume the test only after resolving the safety issues with the TSO.
 - (2) Follow the MR's direction if the MR declares a medical emergency following established procedures.
 - (3) Give the TSO access to any area of the test facility whenever the TSO deems it necessary

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after coordinating with the TD provided, it doesn't create any additional hazard, and the TSO is certified for the environment.

6.8.17. Requirements for tests involving HITL

6.8.17.1 In addition to the requirements in paragraphs 6.8.5 through 6.8.16, test operations involving human subjects shall meet the following:

- a. Either be approved by the Institutional Review Board (IRB, <https://eirb.jsc.nasa.gov/>) for use of human subjects in research or obtain an exemption from IRB review. This assessment shall comply with NPD 7100.8 and NPR 7100.1, "Protection of Human Research Subjects". An IRB exemption can be obtained via one of the two processes as described in Section 6.8.10.1.c.
- b. Keep in voice and visual contact with test subjects. Provide backup voice communications if feasible. Deliberate loss of voice or visual (but not both simultaneously) communications as part of a test is allowed if documented in the approved test procedures.
- c. Equip rescue crews with protective equipment suitable for the specific hazards of that test, such as breathing apparatus.
- d. Keep a hyperbaric treatment chamber on standby during the following test operations with HITL for:
 - (1) Pressure-suited operations in a vacuum or underwater environment.
 - (2) Ambient site pressure suit operations (14.7 psia at sea level) where the suit pressure is greater than 8.8 psi above ambient site pressure.
- e. Have an MR certify the fitness of each test team member to test subjects doing hazardous operations before a test.
- f. Stop the test when a test subject requests the test be discontinued.
- g. Use instruments on test subjects to monitor the critical physical parameters as the MR requires and agreed to during planning and TRR.
- h. Make sure appropriate emergency medical treatment is available, alerted, and on call.

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- i. Inform Human In The Loop (HITL) test subjects (volunteers), of the specific test hazards, S&H requirements and hazard controls during the TRR or review process.

6.8.18. Requirements for certain kinds of tests

6.8.18.1 Some tests need to meet other requirements besides those addressed in this chapter because of the hazards or the nature of the tests. Tests not covered here or by other chapters of this JPR should be coordinated with the Safety and Test Operations Division and Occupational Health at the earliest possible time to develop specific requirements in a timely manner. The following test operations shall follow these requirements:

- a. Observe the following additional requirements for hypobaric:
 - (1) Follow JPR 1830.6, “Requirements Applicable to Personnel Participating in Diving, Hyper/Hypobaric Chambers, and Pressurized Suit Operations” for hypobaric tests involving HITL.
 - (2) Monitor the oxygen level if the test isn’t approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.
 - (3) Maintain internal suit pressure at predetermined levels above ambient during pressure-suited operations.
 - (4) Take measures to prevent corona discharge.
- b. Observe the following additional requirements for hyperbaric tests at pressures above normal atmospheric pressure:

Note: This paragraph doesn’t apply to hyperbaric medical treatment.

- (1) Monitor the oxygen level if the test isn’t approved for an oxygen-enriched atmosphere. Stop the test if the atmosphere becomes oxygen-enriched.
 - (2) Follow exposure times and decompression stops in accordance with JPR 1830.6.
 - (3) Never expose anyone who has been exposed to hyperbaric environments to any hypobaric conditions such as flying or altitude chambers in accordance with JPR 1830.6.
- c. Underwater neutral buoyancy operations shall meet and follow the following requirements and the requirements found in Chapter 6.5, “Underwater Operations Safety and Health.”:
 - (1) JSC neutral buoyancy operations are considered non-open-water operations that need to meet the requirements of Chapter 6.5 by the individual facility operating procedures.
 - (2) Meet requirements for oxygen-enriched environments if other than ambient air oxygen percentage is used in the suit or if the differential suit pressure exceeds 8.8 psid.
 - (3) Observe the restrictions on flying after diving of JPR 1830.6 (current version), “Requirements Applicable to Personnel Participating in Diving, Hyper/Hypobaric Chambers, and Pressurized Suit Operations.”
- d. Use fall protection if personnel involved are at a height greater than 4 feet.

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- e. Physiological training shall follow the requirements for hypobaric tests listed above.
- f. The requirements of subparagraph (b) above also apply to ambient pressure suit operations, except suits using ambient air at pressures less than 8.8 psid aren't considered oxygen enriched. Follow procedures or lesson plans for testing or training, or demonstrations involving personnel in pressure suits at ambient conditions.
- g. Develop handling procedures to protect high-cost and mission-critical flight hardware. Have new or modified procedures approved before handling the hardware.
- h. Meet the following additional requirements for test systems flown on JSC reduced zero-gravity aircraft:
 - (1) Avoid hazardous materials, including high-pressure gases, toxic, corrosive, explosive, and flammable materials, where possible. If such materials are necessary, use proper containment. You may also require provisions for dumping and purging in flight to include minimizing or controlling impact to the local environment.
 - (2) Never use wet cell batteries with free electrolyte, such as lead acid car batteries. Battery circuits require analysis by battery experts and battery circuit safety protection to avoid shock, shorts, or overheating. See Chapter 6.1.
 - (3) The maximum total volume of inert gases or gases on a flight is limited to one K-bottle (≈ 200 ft³ @ 14.7 psi).
 - (4) Airworthiness is determined by the JSC Aviation Safety Officer and the Aircraft Commander.
- i. Tests on air-bearing floors involving moving articles pose a threat of injury to personnel involved in the test. Take appropriate measures to prevent the impact of moving objects with personnel.
- j. When working in direct view of a bare (pressurized arc) lamp of a solar simulator, energized or not, wear eye and skin protection unless it is locked out, tagged out, and verified in a de-energized state.
- k. Tests involving lasers shall have approval and monitoring from the JSC Laser Safety Officer. See Chapter 7.5 for more requirements.
- l. Ground-based tests involving biological materials shall have an assessment by JSC Occupational Health, to ensure the appropriate facility controls, PPE, and proper handling techniques are implemented. See Chapter 7.4 for additional information on biosafety.

6.8.19. Requirements for off-site tests

6.8.19.1 Employees or organizations sponsoring an off-site test shall:

- a. Make sure, with help from the Safety and Test Operations Division, the intent of these requirements is met either by the test site or by JSC. The JSC sponsor shall notify the Safety and Test Operations Division of the test at the earliest possible time. New facilities or new applications in existing facilities will require more scrutiny by JSC than established facilities and operations.
- b. Make sure the safety requirements of the test site are followed. JSC may require the

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applicable provisions of this chapter be followed in addition to the test site requirement(s).

- c. Provide the following additional data to the Safety and Test Operations Division as needed:
 - (1) Test site safety requirements and a safety point of contact from the testing organization.
 - (2) Existing test facility documentation, such as drawings, specifications, hazard analyses, operating procedures, and emergency procedures necessary for an adequate review, if available.
- d. Make sure a TD or equivalent will be in charge of the test at all times. The TD may be from JSC or the testing organization.
- e. Coordinate access by the Safety and Test Operations Division personnel to all test areas. The Safety and Test Operations Division shall:
 - (1) Review and concur on the test setup.
 - (2) Coordinate JSC safety and medical monitoring with the HITL MRG, as required.

6.8.20. Test readiness reviews and facility reviews for off-site tests

6.8.20.1 The following requirements apply:

- a. If a TRR is held at JSC, it will be chaired by a JSC management official who is not personally involved with the test.
- b. A specially appointed JSC committee may review an off-site test facility and operations, and then grant approval for JSC participation via a letter for off-site facilities where testing with JSC personnel or hardware will occur on a regular basis. JSC may hold an operational readiness inspection for the facility and grant approval. JSC personnel and hardware may be involved in operations at approved facilities that follow the conditions of JSC approval. Modification of the facility or operating procedures will require JSC review before resuming operations with JSC personnel or hardware.

6.8.21. Off-site users of JSC test facilities

Personnel from other NASA centers, NASA contractors, and others often use JSC test facilities. Off-site users shall follow this chapter and the testing organization’s operating procedures.

6.8.22. For more information on testing

- a. 29 CFR 1910, “Occupational Safety and Health Standards, General Industry,” applicable subparts
- b. JPR 1710.13 (current version), “Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems”
- c. JPR 5322.1, “Contamination Control Requirements Manual”
- d. NFPA 70, “National Electric Code”
- e. Other appropriate standards, such as NFPA, American Society for Testing and Materials (ASTM), ANSI, etc.
- f. Individual JSC test facility operating procedures and safety plans

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g. Paragraph 3.18 of NPR 8715.1, “NASA Safety and Health Programs”

6.8.23. Responsibilities for test safety

a. Testing organizations are responsible for:

- (1) Ensuring compliance with facility safety, health, test, environmental, and operational requirements.
- (2) Maintaining personnel and facility documentation as required by this chapter and Chapter 10.4, “Facility Baseline Documentation Requirements for Hazardous or Critical Facilities.”
- (3) Informing the Safety and Test Operations Division of planned test activities by email as per paragraph 6.8.4. This includes informing the Space Medicine Operations Division for HITL.
- (4) Informing directorate-level management of any additional risks before starting each new or non-routine test or test series, where there is the potential during test operations for serious injury, loss of life, environmental spill or release, or loss of critical high dollar value hardware.
- (5) Making sure potential environmental impacts have been considered before or during the TRR, and coordinating with the Environmental Management Office as needed.

b. Test requesting organizations are responsible for following test and facility safety, health, and environmental requirements and for preparing and submitting test documentation required by your operating procedures.

c. The Space Medicine Operations Division is responsible for:

- (1) Providing medical support, surveillance, and monitoring as required by paragraph 6.8.6.
- (2) Providing industrial hygiene support as required.
- (3) Making sure appropriate emergency medical treatment facilities are available.

d. The Safety and Test Operations Division is responsible for:

- (1) Making sure a program is implemented to provide a safe and healthful workplace for test operations and test team personnel, and protecting government resources from loss, damage, and destruction.
- (2) Helping testing organizations, test requesting organizations, and resident Safety and Mission Assurance Offices, starting early in a project’s life cycle to identify potential safety issues and suggest mitigation plans.
- (3) Providing safety surveillance via a certified TSO as required by paragraph 6.8.6.
- (4) Reviewing and critiquing test equipment designs and documents to ensure appropriate safety requirements are included.
- (5) Providing concurrence on hazardous test operations.
- (6) Making sure mishaps and anomalies are investigated, that results are reported to appropriate offices, and that proper controls are in place to prevent recurrence.
- (7) Providing Safety Technical Expertise to the IRB.

e. Site Specific Safety and Mission Assurance Offices are responsible for:

- (1) Coordinating with, and fulfilling the responsibilities of, the Safety and Test Operations

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Division at JSC remote sites.

- (2) Developing local test safety requirements and procedures that follow this chapter and Chapter 10.2.
- f. The Institutional Review Board is responsible for reviewing all testing involving human research per NPD 7100.8 and NPR 7100.1, "Protection of Human Research Subjects."