General

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Safety Regulation for Launch Site Operation

19 April 2019 Revision E

Japan Aerospace Exploration Agency

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Chapter 1 General rules

1.1 Purpose

The purpose of this regulation is to specify regulations that shall be observed for safety to prevent mishaps and to minimize damage as a result of mishaps due to launch site operations for orbital insertion launch vehicle and payloads (hereinafter referred to as the “launch vehicle/payload”) at the Tanegashima Space Center (TNSC) and Uchinoura Space Center (USC) (hereinafter referred to as the “Center”).

1.2 Scope

This regulation establishes safety regulations, hazardous operation procedures, personnel to conduct the operation and their responsibilities, and safety requirements for safety inspection methods and procedures that shall be observed by contractors and each division of the Japan Aerospace Exploration Agency (hereinafter referred to as the “JAXA”), that plans and performs launch preparation operations and launch processing operations (hereinafter referred to as the “launch site operation”) and designing launch vehicles and payloads. Contractors and each division of the JAXA shall comply with Applicable Documents specified in section 2.2 in addition to this regulation.

Regulations other than for the Launch Site Safety Group and Flight Safety Group specified in this regulation are requirements for contractor and each division of JAXA; however, the Launch Site Safety Group shall confirm the status of their implementations. Operations at the Center other than specified above shall also be subject to this regulations as applicable.

1.3 Exemptions

Items related to safety that do not comply with this regulation shall be reviewed by the JAXA Safety Group and approved by the JAXA Safety Review Board. In emergency situations, activities that do not comply with this regulation can be performed after obtaining approval from the personnel responsible for launch safety control or designated personnel.

Chapter 2 Complying documents, etc.

2.1 Complying Documents / Not applicable

2.2 Applicable Documents

Safety in the Center shall be achieved based on the compliance with the Japanese domestic related laws (Industrial Safety and Health Law, High-Pressure Gas Safety Law, Fire Protection Law, Explosive Control Law, Electric Utility Law, Radio Law, Laws Concerning the Prevention of Radiation Hazards due to Radioisotopes and Others), this requirement document and the latest edition of the documents listed below.

(1) Satellite Launch Guidelines (JAXA internal document authorized by the Ministers.)

(2) Safety Control Rule (JAXA internal document)

(3) Safety Review Committee Rule (JAXA internal document)

(4) KSC (Kagoshima Space Center) Range Safety Control Rule (JAXA internal document)

(5) KSC Range Safety Control Rule, Detailed Rule (JAXA internal document)

(6) USC Hazard Prevention Rule (JAXA internal document)

(7) TNSC Osaki Water Pool Control Rule (JAXA internal document)

(8) TNSC High-Pressure Gas Hazard Prevention Rule (JAXA internal document)

(9) TNSC High-Pressure Gas (Freezing) Hazard Prevention Rule (JAXA internal document)

(10) TNSC Electrical Facility Safety Rule (JAXA internal document)

(11) USC Electrical Facility Safety Rule (Nagatsubo area) (JAXA internal document)

(12) USC Electrical Facility Safety Rule (Miyahara area) (JAXA internal document)

(13) TNSC Hazard Prevention Rule for Hazardous Materials (JAXA internal document)

(14) TNSC Radiation Disease Prevention Rule (JAXA internal document)

(15) Fire Prevention Rule

(16) Noise Measurement Method (JIS Z 8731)

(17) KSC Signal and Sign (KEX 06082)

(18) Preventive measure against damage caused by laser light (No.0325002 Ministry of Health, Labour and Welfare)

(19) Operation Guidelines for Launch Operation Safety Criteria etc. at Launch Site (KEN-07015)

(20) Explosives Handling Regulation (JERG-0-004)

(21) Hydrogen Gas Handling Regulation (JERG-0-005)

(22) Crude Petroleum Handling Regulation (JERG-0-006)

(23) Hydrazine (N2H4) Handling Regulation (JERG-0-007)

(24) Monomethyl Hydrazine (MMH) Handling Regulation (JERG-0-008)

(25) Nitrogen TetraOxide Handling Regulation (JERG-0-009)

(26) Iso-propyl Alcoholic Handling Regulation (JERG-0-010)

(27) Liquefaction Oxygen Handling Regulation (JERG-0-011)

(28) Liquefaction Nitrogen Handling Regulation (JERG-0-012)

(30) General Hazardous Operation Safety Regulation (JERG-0-014)

(31) Compliance Review Rule for High Pressure Gas Equipment For Space Use (Safety and Mission Assurance Department, Director Decision 16-1)

(32) Technical Standard For High Pressure Gas Equipment For Space Use (JERG-0-001)

(33) Launch Vehicle Development Safety Technical Standard (JERG-1-006)

(34) Launch Vehicle Payload Safety Standard (JMR-002)

2.3 Related Documents / Not applicable

Chapter 3 Definition of Terminology

The terms used in this regulation are defined in Attachment 1.

Chapter 4 Safety regulations of launch site operation

4.1 General criteria

4.1.1 Safety management requirement

4.1.1.1 Organization and function of safety operation

(1) Launch site operation shall be conducted under the supervision of a person overall responsible for launch site operation in cooperation with the Launch Site Safety Group.

(2) JAXA personnel ,launch provider, and satellite user engaged in launch operation of rocket and satellite shall establish the organizational structure including safety control organization for the launch site operation (hereinafter referred to as ”Launch Site Safety Organization”).

(3) Launch provider and satellite user engaged in launch operation of rocket and satellite shall prepare the launch site safety control plan including Launch Site Safety Organization in coordination with JAXA and obtain confirmation from the Launch Site Safety Group by the deadline ruled separately.

(4) When performing the following operations, qualified personnel (including those who have completed education or courses in accordance with provisions by laws) who perform each operation shall perform operations under the supervision of the Legal Person responsible for Safety and person responsible for handling of important JAXA facility equipment.

a. Storage and handling of hazardous products

b. Handling of Electrical Facilities and Radiation Generator at the non-destructive test building

c. Operations of crane, forklift, slinging, etc.

d. Operation of Radio Station

e. Handling of important facility equipment

f. Other operations specified by domestic laws (operations that may cause oxygen deficiency, and operations using organic solvent, etc)

(5) The Launch Site Safety Group shall control potential hazards for launch site operations and shall direct protective actions, and may halt operations if necessary at an appropriate time.

(6) Test equipment and measurement devices used shall be calibrated to ensure that applicable equipment is within the calibration limit by checking calibration labels, etc. Also, verify that test equipment and measuring devices conform with their usage configuration and that they function appropriately prior to use.

4.1.1.2 Hazardous operation

4.1.1.2.1 Identification of hazardous operation

Hazardous operations generally mean that operations may cause serious damages such as personnel death or injury or loss of a facility where a wide variety of factors associated with the causes of the mishap is present. Those operations are storage, temporary storage, handling and transportation listed below.

(1) Propellant operation
Handling of liquid propellants, solid propellants, and other propellants, as well as, systems using those propellants.

(2) Pressure system handling operation
Operation of high-pressure gases and pressure vessels, piping, equipment, and systems constructed from these.

(3) Operations of pyrotechnics and systems using pyrotechnics

(4) Operations performed within hazardous explosive atmosphere areas.

(5) Operations with toxic substances, deleterious substances, and harmful gases (including liquid vaporizing to harmful gases)

(6) Radio-isotope operations

(7) Operations of high-voltage electrical power

(8) Radiation operations (where emission intensity of radiation affects personnel health, pyrotechnics, and facilities)

(9) Operations performed in high acoustic noise environments

(10) Operations performed in tanks and enclosed spaces (operations in oxygen depletion environments or in harmful, explosive or flammable vapors)

(11) Handling of cryogenic materials and systems using these materials

(12) General hazardous operations (forklift, crane, slinging, operation in high locations, and heavy load transportation and transfer operations)

(13) Handling of other hazardous items, and operations determined to be hazardous by the Launch Site Safety Group.

4.1.1.2.2 Hazardous operation procedures

(1) All hazardous operations performed at the launch site shall be conducted in accordance with operating procedures approved by the Launch Site Safety Group. Also, approval of the Launch Site Safety Group is required for modification of operating procedures.

(2) Hazardous operation procedures shall be prepared considering the following.

a. Hazardous operation procedures shall be written in clear and precise language that can be correctly understood by operators.

b. Clear and detailed instructions for each step shall be included in the procedures. In addition, shutdown and reverse procedures in the event of emergency shall also be included.

c. The cover page of procedures shall clearly specify that the procedure contains hazardous operations. In addition, each step for the start and end of hazardous operation shall be specified as hazardous operations.

d. Notes such as warning and caution shall be placed in the procedures as necessary.

e. If the Launch Site Safety Group's participation and presence are specified for hazardous operations, the procedure shall include such information.

f. To protect operators from hazardous atmospheres, the hazardous operation procedures shall include descriptions of purge, contamination removal, ventilation, use of concentration measuring device and gas detector, buddy system, protective clothing, specific requirements for protective equipment and respirators, and fire preventing actions and devices.

4.1.1.2.3 General regulations for hazardous operation

The following shall be applied to all hazardous operations specified in section 4.1.1.2.1.

(1) All hazardous operations shall be performed by the minimum number of persons necessary, but at least two persons.

(2) In principle, the number of personnel entering to the operating area shall be limited below the maximum capacity. The maximum capacity for a room of normal size, excluding small rooms, shall be the number of people that can be calculated by the formula below assuming n as the number of exits including emergency exits. However, in determining the total

number of exits required, n can be increased in multiples when n=1 for 82 cm of the width.

Maximum number of personnel =8 + 5 × (n-2) person

n = width of the exit(cm)/82(cm)　(truncate decimal figures)

(3) Boundary of Access Restricted Area and Warning Areas shall be clearly defined with barricades, etc., if required. Persons entering the Access Restricted Area requiring personnel control, shall obtain a permit from Launch Site Safety Group and follow security guards.

(4) When hazardous operations are in progress or hazardous products are stored, those who other than minimum essential personnel for the operation shall leave the Access Restricted Area.

(5) Only a single hazardous operation is permitted in an operation restricted area. Only a single operation restricted area can be established in a single Warning Area. If multiple operation restricted areas are required in a specific Warning Area, the Launch Site Safety Group's permission shall be obtained.

(6) When handling or storing hazardous products, the operations shall be started after contacting the Launch Site Safety Group/Organization and confirming that signal lights are on, notices are appropriately posted at the entrances to buildings and operation rooms . The meanings of signal lights such as flashing light and traffic signal light are defined in each launch site's regulation.

(7) When performing hazardous operations specified in section 4.1.1.2.1, the responsible person for operation shall submit the list of operators of hazardous operation to the Launch Site Safety Group for obtaining permission one day prior to the operation.

(8) When hazardous operations are in progress or hazardous products are stored, every person that accesses an Access Restricted Area shall present their entrance cards at the security guard post and shall follow security guards' instructions.

(9) When an entrance card is required to enter or exit the facilities, each operator shall access the access control system using an entrance card.

(10) Smoking is prohibited outside of designated areas. Matches, lighters, batteries, cell phones or other non-explosion-proof electrical devices that may become ignition materials or ignition sources shall not be allowed in the specific designated areas or hazardous products handling areas.

(11) Emergency rescue and first aid kits and equipment shall be ready to use at all times in areas where a hazardous operation is in progress.

4.1.1.3 Emergency procedures

4.1.1.3.1 General

The Operation Organization personnel responsible shall report and confirm the following information and instructions with operators before starting operations to protect operators from worst-case emergency situations such as fire and explosion.

(1) Evacuation plans (including refuge areas, areas needed to be evacuated, and emergency procedures) for facilities/areas, emergency exits, and evacuation route

(2) Allocation of roles and responsibilities of conductors and operators

(3) Communication methods

(4) Locations of fire alarms, fire extinguishers, and fire hydrants

(5) Emergency devices, and protective devices for operators

(6) Alarms for evacuation by signals, voice messages, etc.

(7) Evacuation routes and detours of vehicle

(8) Point of contact for emergency situations and how to contact.

4.1.1.3.2 Responding to mishap

When a mishap occurs, the person responsible for operations or the first person who detect the mishap shall take the following actions.

(1) When a mishap occurs, the person responsible shall check whether there are casualties, and, if any, the person responsible shall make a full effort to rescue them and administer first aid.

(2) The first person who detect a mishap shall report the incident/accident to the Firehouse and Launch Site Safety Group immediately.

(3) The person responsible shall perform activities to suppress fire in the early stage, as well as to prevent a secondary disaster. However, if fire occurs inside a facility where hazardous products are stored, all operators shall immediately evacuate to a safe area.

(4) When a mishap occurs, the person responsible shall report it to the Launch Site Safety Group by using the format. The person responsible shall cooperate with the Launch Site Safety Group in investigating the mishap cause or preventing the recurrence of similar mishaps.

4.1.1.3.3 Recovery from an emergency situation

The person responsible for operations shall take the following actions to recover from emergency situations after a mishap.

(1) For recovery, the person responsible shall confirm that all safety-related devices and equipment remain operational properly and security devices and equipment remain properly operational, and shall report this information to the Launch Site Safety Group.

(2) Restoration activities can be conducted after obtaining permission of the Launch Site Safety Group.

4.1.1.4 Weather regulations

4.1.1.4.1 Lightning

Handling of hazardous products (including transportation and transfer operations), outdoor operations, operations at high elevations, crane operations, and other Launch Site Safety Group's specified operations shall not be started if a lightning warning has been issued. If a lightning warning is issued or lightning occurs during the above operations, evacuate to a lightning protected building where hazardous products are not stored after taking required measures. Also take the following steps. The location of evacuation sites shall be confirmed prior to starting of operations.

(1) Close windows and doors and turn the power off except for harmful gas detectors, fire detectors and security devices upon leaving the hazardous products handling building. Also unplug the power supply cables of devices.

(2) Disconnect grounding wires from launch vehicles or payloads when the vehicles are inside a facility. If this is not feasible due to the vehicle or payload configuration, ground the launch vehicle or payload to a single point.

(3) Operators shall evacuate to the nearest building equipped with a lightning arrester, a large steel framed building, or into a motor vehicle, if there is not sufficient time to evacuate to the designated building equipped with a lightning arrester where hazardous products are not stored. They shall not remain outside under any circumstances.

4.1.1.4.2 Storm

If a Typhoon Warning is issued, all operations shall not be started. Also, if a Typhoon Warning is issued during operations, personnel shall evacuate to a safe area after taking prespecified protective measures for storms.

(1) No outdoor operation shall be started if the average wind velocity exceeds 15m/s (instantaneous wind speed 22m/s to 25m/s). Also, if the average velocity of wind exceeds 15m/s during outdoor operations, the operation may be terminated depending on the situation, and necessary measures for storms shall be taken.

(2) For outdoor operations at high elevations, the operation shall not be started if the instantaneous wind speed exceeds 15m/s. High-elevation operations shall also be stopped if they are determined to be hazardous due to strong wind gusts even in case of the wind speed less than 15m/s.

4.1.1.4.3 Heavy rain

No outdoor operation shall be started if a heavy rain warning has been issued. Also, if a heavy rain warning is announced during operations, prespecified protective measures shall be taken.

(1) No outdoor operations shall be started if the rainfall exceeds 40mm/h. If the rainfall shall exceed 40mm/h during an outdoor operation, the operation may be terminated depending on the situation, and prespecified measures for rain shall be taken.

(2) Outdoor operations at high elevations shall not be started if the rainfall exceeds 15mm/h. Operations at high elevations shall be terminated if determined to be hazardous due to slippery conditions on the steps of high elevations even in case of the rainfall less than 15mm/h.

4.1.1.4.4 Tidal wave and earthquake

When tidal wave and earthquake warnings are issued, personnel will evacuate to safe areas after termination of operation depending on the situation and emergency measures taken.

4.1.1.4.5 Handling of harmful propellants and weather condition

Harmful propellant shall be handled in accordance with the following procedures, etc., because the operations hazard level depends on the weather conditions.

(1) Obtain permission from the Launch Site Safety Group for transporting, moving, and handling harmful propellants.

(2) Check the downwind area prior to transporting, moving, and handling harmful propellants. Launch Site Safety Group/Organization shall prepare measures to evacuate operators from the keep-out area and downwind area at all times.

(3) Gas venting shall be approved by the Launch Site Safety Group through prior coordination, including confirmation of weather conditions.

4.1.1.5 Personnel restricted area

4.1.1.5.1 Restriction at Personnel Restricted Area, etc.

For hazardous product stowage and handling areas and the designated areas of those perimeters, restricted areas will be established to control personnel entry, and the following restrictions shall be applied during launch operation and launch processing operation. Personnel Restricted Area are classified into two categories: “Warning Areas” where entry is restricted to personnel other than launch operation team members and “Operation Restricted Areas” where entry is restricted to launch site operators.

(1) Warning Area

Only launch operation team members who usually work in areas other than launch pad area, satellite facility area, or hazardous products storage handling area shall enter the Warning Area. However, launch operation team members, guests, visitors, and journalists who submit an entry permission application to the Launch Site Safety Group and are authorized may enter.

(2) Operation Restricted Areas

Operation Restricted Areas are classified into the following three categories:

a. Access Restricted Area

Specified area where only operators who are listed on the operators list may enter.

b. Keep Out area

Specified area where no personnel may enter.

c. Total Evacuation area

Specified area where all personnel shall evacuate, except for operators who have been designated or approved to remain within designated buildings (such as the Blockhouse and Second Spacecraft Test and Assembly Building (STA2)), during launch operation, etc..

(3) Other restrictions

In addition to (1) and (2), all personnel shall observe regulations issued by the Launch Site Safety Group.

4.1.1.5.2 Entry/Exit Control System

The launch site operator shall follow access control implemented by the Launch Site Safety Group. Personnel access control is executed by the access control system and by security guards.

4.1.1.5.3 Warning Area regarding harmful gas diffusion

In the event of harmful gas leakage during processing, implement personnel access control, using IDLH values developed by the National Institute for Occupational Safety and Health (NIOSH) as the threshold. In the event of harmful gas leakage during launch operation, designate a ground Warning Area using IDLH values as the threshold. In addition, any area outside of ground Warning Area and has a harmful gas concentration of 1/10 IDLH value shall be considered to be Notification Area.

4.1.1.6 Safety training

The launch site operators shall receive the following safety training held by Launch Site Safety Group/Organization. This training is intended to teach operators hazard control practices and emergency procedures, etc. in various places, as well as characteristics and operating procedures of equipment to be used, and protect personnel, facilities and equipment from disaster.

(1) Launch site safety training

a. General safety training for operators

b. Hands-on training for operators at their operation site

c. Hands-on training for operators in accordance with their function

(2) Special training

a. Training in evacuating personnel remaining in buildings during launch

b. Handling of personal protective equipment (PPE)

c. Handling of fire extinguish equipment

d. Evacuation training for gas leakage

4.1.1.7 Application for delivery of hazardous products

Legal processing such as approval for domestic law may be required when systems containing hazardous products are delivered to the Center. In this case, the operation organization shall coordinate with the JAXA Launch Site Safety Group as soon as the possibility of delivery of such hazardous products becomes clear.

The operation organization shall submit an application for approval to JAXA three months prior to scheduled delivery date. The application shall include the following.

(1) Name and quantity of hazardous products.

(2) Characteristics and applications of hazardous products.

(3) Material safety data sheet.

(4) System description.

(5) Hazard level and scope of hazardous products.

(6) Route for transporting, transferring, moving hazardous products.

(7) Period of time and location of storage

(8) Address of person delivering the hazardous products and name of person responsible for receiving the products

(9) If applicable, regulations such as laws, and description of the regulations. (If discussed with JAXA in advance, include result of the discussion.)

(10) Identification of approvals if regulations are applicable. (If discussed with JAXA in advance, include result of the discussion.)

4.1.2 Hazardous atmosphere

4.1.2.1 Explosion hazard atmosphere

a. Explosion hazard atmosphere area of flammable liquid propellants

Electrical equipment including photographic lighting equipment used in explosion hazardous atmosphere areas of flammable liquid propellants as well as in the environment which is potentially explosive due to other vapor from flammable substances, flammable gas or dust shall be explosion-proof. If use of explosion-proofed electrical equipment is not possible, explosion protection shall be established by potting, hermetic sealing, and pressurization using inert gas. Alternatively, electrical equipment shall be installed in a pressurized explosion-proofed room at pressure exceeding 25Pa. If these explosion protections and using of pressurized explosion-proofed room cannot be implemented for the electrical equipment, approval of the Launch Site Safety Group is required for use after taking appropriate measures e.g. the use of monitoring systems having master switch to terminate the operation of all non-explosion-proof equipment in an applicable area and the use of leak detectors. Use of any non-explosion-proof equipment shall be approved by the Launch Site Safety Group prior to use.

The followings are explosion hazard atmosphere areas of flammable liquid propellants including oxidizers.

・15 meters radially from containers or payload tanks filled with a liquid propellant.

・15 meters radially from vent ducts of liquid propellant.

・8 meters radially from equipment, GSE, and transfer lines containing a liquid propellant.

・31 meters radially from launch vehicles containing a liquid propellant.

・Liquid propellant handling room and its air conditioning systems and room adjacent to the air conditioning systems in a building where liquid propellants are being handled or stored.

b. Explosion hazardous atmosphere area for solid propellants and pyrotechnics and its location

In the places where solid propellant or pyrotechnics are present and explosion or fire may occur, no electrical equipment that may sparkle or generate ark or reach high temperature and potentially be source of fire may be used. Electric devices including photographic lighting equipment brought in the area with explosion hazard atmosphere due to existence of solid propellant shall be explosion-proofed. In case that non-explosion-proofed electric devices need to be used in the area, use of non-explosion-proofed equipment shall be approved by Launch Site Safety Group prior to use.

Following is the Explosion hazard atmosphere area for solid propellants and pyrotechnics.

・Within three meters radially from propellant, when solid propellants and pyrotechnics are exposed to the area.

4.1.2.2 Other requirements for hazardous atmosphere area

When operators perform operations in the hazardous atmospheres listed below, each area shall be confirmed not to exceed the safety threshold. Also, procedures shall include usage of gas detectors or concentration measuring devices used for purging, removal of contamination, ventilations and samples, specific requirements for protective clothing, protective devices and respirators, and instructions for fire prevention measures and devices.

(1) Harmful hazardous atmospheres

Concentration levels of harmful gas shall be below the allowable concentrations listed in Table 4.1.2-1.

(2) Explosive hazardous atmospheres

Allowable concentrations of explosive vapor shall be 1/4 or less of the minimum ignition limit of each item. However, a possible exponential increase of concentration shall be considered. Factors such as type and quantity of each item and lead-time to complete emergency actions shall also be considered. For reference, the minimum ignition limits are listed in Table 4.1.2-2.

(3) Oxygen deficient hazardous atmosphere

When operators are required to enter an enclosed volume or area where oxygen could become deficient, the volume ratio of oxygen shall be greater than 19.5% .

Table 4.1.2-1 Allowable concentration of harmful vapor

Item	Allowable concentration (ppm)
Monomethyl Hydrazine	0.01
Hydrazine	0.01
Isopropyl alcohol	200
Nitrogen tetroxide	1.5
Nitrogen dioxide	3

Average value, when operated 8 hours a day, 40 hours a week.

Table 4.1.2-2 Minimum ignition limit of explosive vapor

Item	Minimum ignition limit % (volume ratio)
Hydrogen gas	4.1
Hydrazine	4.7
Isopropyl alcohol	2
Monomethyl Hydrazine	2.5

4.1.3 Material

Material Safety Data Sheets (MSDS) shall be stored readily available for reference and for operation instructions.

4.1.4 Operation of RF radiation

(1) Equipment that emits RF radiation shall be licensed as a radio station in accordance with Japanese laws. The operation organization shall coordinate with the Frequency Control Section prior to operations.

(2) The person responsible for handling radio equipment shall confirm that the RF radiation from such devices and equipment is below the level considered harmful to the human body.

(3) Areas where the electrical intensity (electromagnetic-field intensity, magnetic field intensity, and electric power density) exceeds the value specified in Enforcement Regulation for Radio Law, Ordinance Regulating Radio Equipment, or any related guidelines and notices shall be partitioned and marked as “keep-out areas” to prevent personnel from entering.

(4) The person responsible for handling the device shall confirm that there are no personnel in the “keep-out area” before operating it.

(5) The person responsible for handling the device shall take appropriate action to ensure transmitters or antennas turn only in pre-planned directions.

(6) RF radiation transmission at the launch site shall be started only after it has been confirmed that there are no restrictions such as RF silence and that transmission will not cause radio frequency interference.

a. Restriction from liquid propellant: Refer to paragraph 4.3.1 (1).

b. Restrictions for pyrotechnics installed on launch vehicle or payload

Pyrotechnics installed on launch vehicle or payload are designed so that the induced electrical power of ignition circuit for pyrotechnics will be attenuated at least 20 dB below the maximum no-fire electric power for the pyrotechnics against RF environment from the launch vehicle, payload, GSE and launch site. RF radiation equipment shall be operated at the planned area at launch site only after confirmation that the radiation intensity meets the interface condition. When installing or removing of pyrotechnics and mating or demating the connectors, follow paragraph 4.5(4),

c. Restrictions for pyrotechnics not installed on launch vehicles or payloads: Refer to paragraph 4.5(6).

4.1.5 Optical system

(1) Personnel engaged in testing optical and laser systems shall wear protective glasses, clothing and other PPE as required.

(2) A low-energy light source for testing shall be used for adjusting the optical path, focus and other parameters of the optical system.

(3) The focal point of lasers and optical systems shall be checked through an indirect means such as a monitor camera.

(4) When the operator is absent, laser and optical systems shall be turned off and safety measures such as covers shall be provided.

(5) The operation organization planning to use a laser or optical system equipment shall take measures complying with 2.2(3) “Preventive measure against damage caused by laser light”.

4.1.6 Acoustic noise

There are two types of noise, continuous noise and impact noise. Continuous noise is defined as noise that occurs at intervals of one second or less. Noise levels shall not exceed 80 dBA for continuous noise and 140 dBA for impact noise. Furthermore, continuous operation with a noise level of 80 dBA shall be limited to eight hours a day. If noise cannot be reduced to an allowable level, PPEs such as soundproof headsets shall be used.

4.1.7 Use of ionizing radiation etc.

This paragraph applies if a radiation source is handled or radiation is used. Operations shall be supervised by a Legal person responsible for safety and shall meet the following.

(1) Radiation exposure doses of personnel shall be maintained below the allowable levels specified in Ordinance on Prevention of Ionizing Radiation Hazards, and any related guidelines and notices.

(2) Space dose and radioactive contamination of operational environments shall be maintained below the applicable standards. Take the following precautions and safety measures.

a. Contain radiation sources in as small space as possible.

b. Use the minimum required amount of radiation.

c. Carefully manage ionizing radiation emitted from the radiation source.

(3) Establish control areas necessary for ionizing radiation.

(4) Mark the controlled areas by designated signs, post notices in clearly visible places, and separate them by fences or ropes to prevent unauthorized entry.

(5) Measure the following radiation.

a. Areas (operation environment, exhaust, and waste water drainage)

b. Operator exposure dose

c. Around the facilities

(6) Personnel shall have a health check prior to entering the controlled area for the first time. Personnel who enter the control areas shall receive periodic health checks at least once a year after the first entrance.

(7) Start the radiation equipment only after confirming that no one remains inside the equipment or the irradiation room and that doors are securely closed.

(8) Personnel shall observe the “In Operation” or “Irradiating” lamp and not enter the irradiation

room while the lamp is lit.

(9) Before entering an irradiation room after irradiation is terminated, operators shall obtain approval of the Legal person responsible for safety first and then enter along the specified route. Protective measures shall be provided for inadvertent radiation.

(10) Confirm the beam shutter operates normally.

(11) Pay attention to residual radiation on irradiated subjects, slits and beam catches.

(12) Operators shall always wear body exposure measuring devices, etc. while they are in the controlled areas. Measuring devices such as film badges and pocket dosimeters shall be attached to the chest or abdomen. Female operators are required to attach them to their abdomen.

(13) Operators handling non-enclosed radioactive materials shall not take any food or drink in the controlled areas in order to prevent internal exposure.

(14) Personnel shall receive safety training prior to entering the controlled areas.

4.1.8 Other requirements

4.1.8.1 Humidity control

Solid Rocket motor, pyrotechnics or flammable propellant handling operations shall be terminated to eliminate electrostatic hazards when the relative humidity falls to 40% or less.

4.1.8.2 Protective equipment (PPE)

Protective equipment shall be used in accordance with the following guidelines, unless otherwise directed or instructed for specific facilities or equipment.

(1) Operators shall employ handholds or use safety belts, or other appropriate protective measures when working at high elevations (2 m and above).

(2) Operators shall wear closed-toe shoes. Sandals shall not be worn.

(3) Operators handling heavy loads shall wear safety shoes.

(4) Operators in the areas where solid propellant or pyrotechnics are present shall wear anti-electrostatic shoes.

(5) Operators shall wear hardhats to prevent head injury when they work where articles may drop from high places or they may bump into beams, ceilings and other overhead obstructions.

(6) Operators shall wear anti-electrostatic shoes and flameproof antistatic clothing in explosive hazardous atmosphere areas.

(7) Operators shall wear sound-blocking headsets, etc. when noise levels exceed the levels specified in paragraph 4.1.6.

(8) Operators shall wear appropriate protective clothing for specific operations (e.g., handling cryogenic fluids, propellants or pyrotechnics). The operation organization may use protective clothing of its own if approved by the Launch Site Safety Group in advance.

4.1.8.3 Protection for hazardous objects

Appropriate protection (either direct protection and/or warning by signboard, depending on the hazard level) shall be provided in the following cases.

(1) Protrusions that may cause cuts or injuries

(2) Part with a possibility of electrical shocking

(3) Radiation

(4) Heat sources (45°C or above) or cold sources (0°C or below)

4.1.8.4 Tool control

Tools shall be securely attached to the operator’s body or clothing or to a tether to prevent them from falling and damaging equipment or injuring personnel or to prevent them from being left inside equipment and causing hazards later. In addition, effective control measures shall be taken for requisitioning and returning tools. Similar precautions shall be taken for eyeglasses and wristwatches. In addition, pockets above the hip shall not be used during operations near flight hardware.

4.1.8.5 Photography

Use of photographic equipment e.g. cameras in Launch Site shall be approved in advance by the Launch Site Safety Group/organization. Mechanical or explosion-proofed cameras shall be used for photographing in explosive hazardous atmosphere areas When photographing pyrotechnics using strobe light, confirmation shall be needed that the induced electrical power of ignition circuit for pyrotechnics will be attenuated at least 20 dB below the maximum no-fire electric power for the pyrotechnics against RF environment. In addition, the following safety measures are applied to photographing in the hazardous areas .

(1) Environment measurement shall be performed to confirm that no leakage occurs in explosive hazardous atmosphere areas of liquid propellant prior to photographing.

(2) When photographing solid-rocket motors and pyrotechnics, photographic equipment and accessories shall not be fallen within 3 m of the solid-rocket motors and pyrotechnics regardless of how it topples or falls.

(3) Do not charge or replace batteries in explosive hazardous atmosphere areas.

(4) Apply fall prevention measures such as tether.

4.1.8.6 Restriction on ignition materials

Equipment or materials capable of ignition, such as matches, lighters, watches equipped with batteries, electronic desk calculators, and cellular phones, shall not be brought into specifically designated locations and/or areas.

4.1.8.7 Operation at high elevation

(1) Proper clothing is required, and unsafe behavior unrelated to the operation shall not be conducted.

(2) Safety belts or other fall protection are required during operations at places where personnel could fall.

(3) Ladders shall be equipped with skid-proof devices.

(4) Personnel shall not ascend or descend carrying heavy objects or hazardous products.

(5) Fall protection shall be provided to prevent tools from dropping.

4.2 Transporting, transferring, and handling equipment

4.2.1 Forklift operation

(1) Safety devices, brakes, and other functions shall be inspected without loading prior to operations.

(2) Freight loading condition shall be inspected to ensure that the freight is safely and surely loaded on the palette before starting transportation. Items that exceed rated weight or could fall shall not be loaded.

(3) Designated speed limits shall be observed, and rapid starts, stops or turns are prohibited.

(4) When the operator’s view is obstructed by large objects, the forklift shall be driven backwards or a guiding assistant shall be assigned.

4.2.2 Crane operation

(1) Hoisting loads that exceed the rated load is prohibited.

(2) Safety devices, brakes, and warning devices, etc. shall be inspected without loading prior to operations.

(3) Operation shall be conducted in accordance with the conductor’s signals, and loads shall

not be pulled horizontally or hoisted diagonally.

(4) Personnel shall not ride on suspended loads.

(5) In principle, persons shall not be allowed to enter the beneath or approach the circumference of the suspended load. When transferring the loads, the route of travel and destination point shall be established prior to the operations, and access shall be controlled to restrict personnel entry.

(6) Criteria specified in paragraph 4.3.2(3)d shall be applied when lifting explosives.

(7) The height of the hook when it's not used shall be set properly (2.5m or higher above the floor surface) to prevent hazards to personnel and interfering with other operations.

(8) When lifting a load with two cranes, the maximum load for each crane shall be below 75 percent of the rated load except for a case that all the following conditions are satisfied.

1.Mass of suspended loads is clarified.

2.Mass of lifting equipment is clarified.

3.Center of gravity considered margin of manufacturing and welding mass error is clarified.

4.Working forces to lifting equipment are clarified and the equipment has sufficient strength.

5.Working forces caused by operation properties and brake setting are minimized

6.Working forces angle and intensity in jib point are monitored and optimized.

(9) The crane hook shall be operated from the console panel. It shall not be operated by hand.

4.2.3 Slinging operation

(1) Designated spreader beams for slinging operations shall be used and shall be inspected prior to operations to ensure no anomalies.

(2) The load center of gravity shall be measured accurately. The center of gravity shall be kept as low as possible, and hoisted load shall not to be inclined.

(3) Loads shall not be lifted with twisted or kinked wire rope.

(4) Eyebolts for shackles shall be inspected to ensure they are fully fastened.

4.2.4 Transporting and transferring heavy load

(1) Transportation vehicles or cranes shall be used for heavy loads; transporting by manpower shall be minimized. Heavy loads shall be transported with a special caddie when there is dedicated transportation vehicle.

(2) Drum cans and gas cylinders shall not be trundled except when using designated carriages for drum cans to prevent any damage.

(3) A conductor shall be assigned for operations conducted by two or more persons and communications shall be maintained in the group..

(4) When conducting a team operation, be careful to prevent pinching of hands and feet by heavy articles

4.2.5 Use of elevators and shutters

(1) Do not attempt to prevent elevator doors from closing by grabbing them with your hands.

(2) Do not exceed the rated capacity and load of elevators.

(3) Elevator operation may be limited in emergencies.

(4) Confirm that personnel are clear before actuating shutters.

4.3 Propellant operation

4.3.1 Liquid propellants

(1) Handling, transporting, and loading liquid propellants

a. The Launch Site Safety Group may supervise handling, transporting, and loading operations of liquid propellant to assure the safety of operators and personnel around the operation area and may suspend the operations if the operations are determined to be improper or unsafe.

b. The operation organization shall conduct performance checks of showers, eyewash fountains, water taps, etc. prior to transferring and loading liquid propellants. Water pipes shall be cleaned by purging if water is muddy.

c. Store equipment, materials, and tools not required for the operation in an appropriate location prior to start of filling of liquid propellant.

d. Operators who handle liquid propellant or adjust equipment, etc., shall wear protective clothing and equipment. Also, operators shall use environmental measuring devices, etc., if necessary. Protective clothing, protective equipment, or measuring devices shall be inspected for appearance, functions etc. prior to use to assure no anomalies.

e. Operators who connect or disconnect loading lines of harmful liquid propellants such as hydrazine or NTO and load or unload such propellants shall use breathing apparatuses (e.g., air-line masks, respirators, or gas masks) that are consistent with the type of operation and harmful properties. Operators who handle corrosive liquid propellants, such as hydrazine or NTO, shall wear specified anti-corrosion suits, hoods, gloves, and boots. These protective equipment shall be approved by Launch Site Safety Group prior to use. Each operation shall be preceded with constant safety inspection by monitoring gas concentrations in the ambient air at an appropriate interval. For operations requiring breathing apparatuses, the maximum continuous work duration, etc., shall be established for each operation based on the operation and the type of breathing apparatus used; operators shall not work beyond the established work duration. For operations that require the use of a self-contained atmospheric protective ensemble (SCAPE) suite, the maximum continuous work duration shall be 3 hours per operator; one-hour rest is required between the tasks; total operation time for one day per operator shall not exceed 6 hours. The same operator shall have at least 8 hours of non-working period before presuming to work the next day.

f. For liquid propellant operations in hazardous atmosphere areas, operators shall use non-spark tool. Additional attention is necessary since even non-spark tools (brass, aluminum bronze, beryllium copper, etc.) do not able completely eliminate sparks. When there is no risk for ignition, commonly used tool can be used with prior approval from the Launch Site Safety Group. Fire-proof, anti-electrostatic clothing that is grounded by wrist stats or anti-electrostatic shoes or other methods shall be worn. When operators are unable to conduct the above because they need to wear protective clothing, the operators shall keep the protective clothing and proper anti-electrostatic measures, such as humidity control, shall be established. Electrical grounding for operators shall be confirmed as follows.

(a) Confirm by inspection that resistance of the wrist stats or leg stats between the fingertip and grounding terminal is between 10^5 to $10^6\,\Omega$.

(b) Confirm that the resistance of anti-electrostatic shoes for handling propellants is between 10^5 and $10^8\,\Omega$, and resistance for operation of propellants having the lowest ignition energy of 0.1mJ or less (e.g. hydrogen) is between 10^5 and $10^7\,\Omega$.

g. Check electrical leakage, electrical insulation, etc. before lifting equipment containing a flammable liquid propellant by crane.

h. Tank trucks or other equipment shall be grounded prior to transporting flammable liquid

propellants such as liquid hydrogen. Also, when the operation is performed on concrete surface, electrical conductivity shall be increased by wetting of the concrete surface by water sprinklers or other appropriate measures.

i. Conductive parts such as nozzle or flange of drum cans, rubber hoses, and plastic hoses, etc., shall be grounded.

j. Decontaminate facilities, equipment, and personnel in an emergency under Launch Site Safety Group's instructions.

k. Materials that could result in ignition if they contact other materials, such as a combination of propellant and the oxidizer, shall not be operated simultaneously. Equipment and devices for each material shall be prevented from contacting each other by indicating materials to be used or other methods.

l. Do not transport or load liquid propellants within RF radiation areas where the peak electrical power density exceeds $5W/cm^2$.

m. Load liquid propellants or cryogenic fluid such as liquid nitrogen to the launch vehicle, etc. as late as possible within the specified time schedule.

n. All personnel and vehicles not directly engaged in the operations shall evacuate from the work site prior to starting transfer and loading of liquid propellants. After the launch vehicle/payload is loaded with propellants and oxidants, personnel entry to the work site by wheeled vehicles shall be minimized. Also, when loading cryogenic liquid propellants into the launch vehicle, this operation shall be performed after All Personnel Evacuation has been completed.

o. Personnel transporting and/or transferring cryogenic liquid propellants or repairing and adjusting related facilities or equipment shall wear necessary protective clothing..

p. Before harmful liquid propellants are transported, transferred, or handled, the person responsible for the operation shall confirm weather conditions and confirm that emergency procedures, evacuation routes, and area evacuations have been implemented to protect personnel from harmful gases, in emergencies such as leakage, in accordance with paragraph 4.1.1.4.5.

(2) Emergency procedures for liquid propellant leakage at launch pad

If liquid propellants leak from payloads at the launch pad, the operation organization shall coordinate with the Launch Site Safety Group to determine if propellant is depressurized and unloaded under the condition of payload uninstalled from launch vehicle or is depressurized and unloaded in the condition of payload installed in launch vehicle, and shall take safing action in accordance with the coordinated procedure.

(3) Spills and leaks of liquid propellant

a. Use appropriate protective clothing and equipment when cleaning up liquid propellant spills and leaks.

b. A large spill or leak could result in hazards to operators or personnel outside the operation areas. The corrective action shall depend on the size of the spill or leak and will be implemented so as to minimize loss of life or injury to personnel as well as loss or damage to facilities or equipment. Operators shall perform the following procedures.

(a) Depressurize depressurized systems associated with the liquid propellant.

(b) Take all reasonable measures to prevent spilling liquid propellants. If a liquid propellant creates an explosive hazardous atmosphere, verify that the atmosphere concentration in the operation area is below the safety threshold specified in section 4.1.2.2.

(c) Personnel rescue

(d) Report the incident to the Launch Site Safety Group, evacuate personnel from downwind of the mishap area and the mishap location itself, and issue warnings to

adjacent areas.

(e) Evacuate to the windward; personnel downwind shall make a detour towards the windward side.

(f) Participate in the emergency resolution group and provide necessary information to support the group.

(g) A person responsible for the operation shall confirm that all personnel are safe and report the result to the Launch Site Safety Group.

(h) Do not spray water directly on liquid hydrogen when leakage of liquid hydrogen has occurred. For details refer to the handling standard and MSDS.

(i) Do not apply straight stream of water on hydrazine when leakage of hydrazine has occurred. For details refer to the handling standard and MSDS.

(j) Spilled harmful, corrosive liquid propellants or liquids that adversely affect the environment shall be flushed away with water, collected into tanks, and then be treated such as by neutralizer as a general rule. The treated waste, etc. shall be disposed of as directed by the Launch Site Safety Group.

(k) For handling of spill and leakage of propellants other than listed above, refer to respective handling standards and MSDS.

(l) Operators shall wear proper protective equipment when large amounts of harmful or corrosive liquid propellants have spilled and when personnel shall be medically treated and washed to remove the spilled fluid.

(m) If harmful liquid propellant contacts a victim’s skin or eyes, flush the skin or eyes with a large volume of water for a minimum of 15 minutes and seek medical treatment from a physician as soon as possible.

(n) If a large amount of harmful liquid propellant has leaked, evacuation area shall be established taking into account weather conditions and necessary action shall be conducted to minimize damage propagation, such as monitoring environmental conditions in border line.

(4) Storage and transportation of liquid propellant

a. Liquid propellants shall be stored in designated storage facilities.

b. Storage tanks shall not be filled to more than 90% of capacity.

c. While liquid propellants are stored, post signs defined by each launch site.

d. Diesel engine vehicles with flame arresters or vehicles that do not present ignition sources shall be used for liquid propellant transportation. Turn off vehicle engines when loading or unloading liquid propellants.

e. The Launch Site Safety Group escort car with a yellow flashing light and loudspeaker is required and designated routes shall be used when transporting harmful, corrosive or flammable propellants such as hydrazine or NTO. Additional precautionary measures shall be taken as required, such as traffic restriction and warning by using a public announcement system at the launch site.

f. Mixed loading of incompatible materials such as oxidants and propellants (except for loading on the payload) to transporter or storage of incompatible materials in the same storage area is prohibited.

g. The speed limit in the launch site is 20 km/h or less.

h. When handling and transporting liquid propellants, obtain permission of the operation and weather information from the Launch Site Safety Group prior to operations.

4.3.2 Solid rocket motors

For solid rocket motor, the followings are applied. See 4.5 for pyrotechnics attached to solid rocket motor.

(1) Handle solid rocket motors only at designated locations and facilities. Also, use only specifically designed equipment and devices for checkout. Electric devices handled under the presence of solid rocket motor shall comply with 4.1.2.1(b).

(2) Do not repair or refurbish solid rocket motors at the launch site.

(3) Checkout and installation.

a. For operations in the area within 3m distance from the surface of exposed solid propellants for all directions, operators shall wear fire-proof, anti-electrostatic clothing and shall be grounded with wrist stats and anti-electrostatic shoes.

(a) Resistance of wrist stats between the tip of a finger and ground terminal shall be verified to be within 10^5-$10^6\,\Omega$ by inspection.

(b) Resistance of electrostatic shoes shall be verified to be 10^5 to $10^8\,\Omega$ by inspection.

b. When equipment associated with solid rocket motors, such as handling apparatus or structure parts of launch vehicle, are grounded, electrostatic discharge energy shall be verified to be below the pyrotechnics ignition point.

c. Solder shall not be used to bond the grounding line.

d. When lifting solid rocket motors with a crane, measure stray voltage between the crane hook and ground prior to connecting the crane hook with the handling load and confirm that the stray voltage is 50mV or less. If the stray voltage exceeds 50mV, inspect the grounding line to confirm there are no anomalies, such as leakage current or defective crane insulation. If no anomalies are found, ground the hook and measure the stray voltage between the crane hook and ground again to confirm that stray voltage is 50mV or less. The crane can then be operated. Stray voltage (Vs) is calculated using the following formula.

$$Vs = \sqrt{(VAC)^2 + (VDC)^2}$$

VAC: AC component VDC: DC component

e. Use non-spark tools (brass, aluminum bronze, and beryllium copper) when working on solid rocket motors but use them carefully because non-spark tools do not eliminate all sparks.

f. Ground metal transportation containers prior to opening them.

(4) Storage and transportation

a. Store solid rocket motors in the solid propellant storage area. When transferring rocket motors into or out of the solid propellant storage area, coordinate with the Launch Site Safety Group and legally qualified person responsible and follow the pre-defined procedure.

b. Do not wear shoes with exposed metal parts when entering the solid propellant storage area.

c. Do not pack and unpack crates in the solid propellant storage area.

d. Store boxes containing solid rocket motors horizontally on wood slats at least 30cm from the interior wall of the solid propellant storage. Do not stack boxes over 1.8m (4m for installation equipment) from the floor.

e. Do not bring flashlights or electric appliances other than the portable safety light into the solid propellant storage.

f. The Launch Site Safety Group escort car with yellow flashing light and loudspeaker is

required when transporting solid rocket motors, and designated routes shall be used. Additional precautionary measures shall be taken as required, such as warning by using a public announcement system at the launch site.

g. Attach the "火" sign to the transporter. The speed limit in the launch site is 20 km/h or less.

h. Use diesel engine vehicles with flame arresters or vehicles that do not present ignition sources for solid rocket motors transportation. Turn off the vehicle engine when loading or unloading solid rocket motors.

4.3.3 Other propellants

Perform the following for ion engines.

(1) Clearly define conditions for handling and storing gaseous propellants.

(2) Take safety measure for leakage when loading propellants to prevent oxygen depletion.

(3) Prevent parts carrying high voltage from contacting other parts.

(4) Comply with procedures and methods for storing, handling, filling, and transporting propellants.

(5) Do not perform check-out operations that could release harmful or noxious gases or other materials into the atmosphere at the launch site.

4.4 Pressure system.

4.4.1 Pressure system classification

Handling operations for pressure systems such as pressure vessels are classified as hazardous if the system meets one or more of the following criteria.

(1) The vessels store compressed gas at a pressure of 1MPa (about 10kg/cm^2) or higher at normal operating temperature.

(2) The vessels store gases at pressures above 0.2MPa (about 2kg/cm^2) and have an internal volume exceeding 40 liters internal volume, or have an inside diameter exceeding 200mm and a length exceeding 1000mm.

(3) The vessels store gases or liquids that are hazardous and/or harmful materials at a pressure of 0.2MPa (about 2kg/cm^2) or higher.

(4) The vessels store liquefied gases with gage pressure no less than 0.2MPa (approx.2kg/cm^2) at its normal operating temperature, and the gage pressure is currently no less than 0.2MPa, etc.

(5) Other than listed above, class I pressure container and class II pressure container, etc that are stipulated under Industrial Safety and Health Law enforcement order.

(6) Other than listed above, containers that store high pressure gas stipulated in High Pressure Gas Safety Law.

4.4.2 Pressure system operation

(1) When performing operations for pressure systems, the operation organization shall contact and coordinate with the Launch Site Safety Group, establish entry-controlled areas, and notify personnel of the beginning and termination of hazardous operations over a public address system.

(2) Comply with the following safety requirements when operating pressure systems.

a. Be familiar with the locations and purpose of control valves and depressurization

procedures in the event of emergency.

b. Ensure hoses, piping, and components used in pressure system are proof-pressure tested and leak tested.

c. Depressurize the pressure system before starting work on piping.

d. Ventilate indoor areas.

e. During pressurization, post a warning sign at the entrance to prevent personnel from entering the operating area.

f. If necessary, pressure system operators shall wear face shields, goggles, and earplugs.

g. Ensure the pressure system remains clean and remove dust and debris.

h. If possible, use hard pipe instead of flexible hose. Fix the pipe at appropriate intervals along a straight line, near connection fittings, and at both ends of bends.

i. Use the minimum length of flexible hose. Fix flexible hose by clamping to fitting fixtures according to the requirements in the previous paragraph, or by putting lead bandoleers, sandbags, etc. at an interval of about 2 m or less in order to keep them in place if the hose breaks.

j. Consider ventilation when releasing nitrogen and helium gases inside a room and direct the discharge away from personnel.

k. Do not pressurize hoses above the maximum expected operating pressure. Hoses and their fittings shall meet applicable regulations. Seal hoses with plugs or caps when not in use and store them.

l. For hose and joint sealing, select a spec that is compatible with the operating temperature, such as cryogenic.

m. Do not step on piping.

n. Attach tags or other indications to connecting and disconnecting portions of piping to prevent misconnection.

o. Attach tags to supply valves to make them noticeable by personnel. When the operation sites are unmanned or on other occasions deemed necessary, the valves shall be protected against unintentional operation using chains, lock wires or locks.

p. Comply with “Technical Standard For High-Pressure Gas Equipment For Space Use” section 7 when pressurizing high-pressure gas equipment specified in the “Technical Standard For High-Pressure Gas Equipment For Space Use.”

q. Notify personnel in the area by public announcement system when loud acoustic noise are generated due to pressure venting or other causes.

(3) Comply with the following when repairing pressure systems.

a. Depressurize the section to be repaired. Depressurize the entire system if operationally possible.

b. Ventilate the pressure system through vent valves. It shall not be done by loosen or removal of fittings.

c. Open vent valves, etc. to prevent inadvertent pressure increases.

d. Do not torque bolts, fittings, or other pressurized components when they are under pressure.

(4) When pressure is suddenly and unexpectedly released from the pressure system, take necessary actions to stop the gas release or other actions specified in section 4.1.1.3.2.

4.4.3 Pressure system protection

When components are required to be removed from a pressurized system, take the following actions to prevent water or dirt particles from entering.

(1) If possible, maintain the entire pressure system at a positive pressure.

(2) Remove plugs or caps then pressurize or purge the entire system.

4.5 Operation of pyrotechnics (except for solid rocket motors)

(1) Only essential personnel may be present at operation area when pyrotechnics are being installed or electrically connected.

(2) Electric devices handled under the presence of pyrotechnics shall comply with 4.1.2.1(b).

(3) Do not perform electrical checks (conductivity or insulation resistance) for pyrotechnics installed in solid rocket motors. Electrical checks made from remote and at safe areas which have been approved by safety review may be accepted.

(4) Obtain permission from the Launch Site Safety Group before mating or demating connectors to pyrotechnics. Also confirm that launch vehicles, GSE, and the RF systems of pre-specified range systems are in RF silence mode prior to operations.

(5) Do not remove Faraday caps during installation and removal of pyrotechnics.

(6) Do not use transmitters within the minimum distance specified by the equations below from the site where pyrotechnics (electrical type) are operated. The distance is calculated by using the following equations, where the maximum no-fire electric power of pyrotechnics is denoted Q(W).

a. 2.0 MHz～48.5 MHz:

$$D = 2.0\sqrt{Pt \cdot Gt / Q}$$

b. 48.5 MHz～4.85GHz:

$$D = 97\sqrt{Pt \cdot Gt/Q}/f$$

c. 4.85GHz～45 GHz:

$$D = 0.02\sqrt{Pt \cdot Gt / Q}$$

where

D = distance (m)

Pt = transmitter power (W)

f = frequency (MHz)

Gt = output gain ratio of transmitting antenna = anti log (G dB/10).

These equation represents the distance at which the electric power density is equal to 1/10 the maximum no-fire electric power of pyrotechnics.

(7) .Turn control switches and ignition circuit switches of all pyrotechnics circuits OFF when electrically connecting pyrotechnics.

(8) Personnel shall be evacuated from the warning area when power of Flight Termination System and solid rocket motor’s ignition system are turned ON after pyrotechnics used for the destruction system or ignition of solid rocket motors are electrically connected.

(9) Confirm consistency with preparations for destructive command transmitter or obtain the

approval of the Launch Conductor and Launch Site Safety Group when turning Command Destructive Receivers to ON after completion of electrically connection of Flight Termination System‘s pyrotechnics.

(10) Do not issue destruct commands during processing operations without the direction from the launch vehicle division.

(11) Checkout and installation

a. All test equipment used for checkout of pyrotechnics shall not be used unless valid calibration seals are labeled on. A person responsible for the operation shall confirm that test equipment satisfies all configurations and all functions are performed properly.

b. Perform conductivity tests of pyrotechnic devices in a designated test room.

c. When conducting pyrotechnics continuity test and cable assembly or disassembly, wear flameproof antistatic clothing, wrist-stat, and anti-electrostatic shoes.

(a) Ensure resistance of wrist-stat is assured to be between 105-106Ω between fingertip and grounding terminal by test.

(b) Ensure resistance of anti-electrostatic shoes is assured to be between 105-108Ω by test.

d. Install pyrotechnics that have high sensitivity for ignition, especially initiators, as late as possible just prior to launch operations. Also connect electrical systems as late as possible during launch preparation operation.

e. Perform stray voltage checks for pyrotechnics ignition circuits that interface with pyrotechnics before electrically connecting pyrotechnics. There are two types of stray voltage checks, one performed with power on and one performed with power off

(a) Power on check for stray voltage shall be performed using a configuration equivalent to the final launch configuration and with the launch vehicle and payload powered and activated.

(b) Power off check for stray voltage shall be performed by using a stray voltage monitor with the launch vehicle and payload power turned to off prior to electrically connecting pyrotechnics. Stray voltage shall be monitored continuously until explosive devices in the pyrotechnics firing circuit have been electrically connected.

(c) Check for stray voltage between all terminals and between terminals and cases of connector halves installed in pyrotechnics firing circuits.

(d) Do not remove pyrotechnics Faraday caps and RF protection equipment until immediately before electrical connection.

(e) The test result shall not equal or exceed the lower value of 1/10 the maximum no-fire current for the pyrotechnics or 50 mA.

f. The operation organization shall confirm that elevators located in dangerous areas are locked or powered off by the Launch Site Safety Group to minimize stray voltage while electrically connecting pyrotechnics or arming launch vehicles.

g. Protect pyrotechnics (electric type) at all times (including during installation/removal) with protective devices such as faraday caps, etc except during wire connection/disconnection, single continuity test and insulation test.

h. Do not use materials that could generate electrostatic electricity near the pyrotechnics.

i. When equipment associated with pyrotechnics, such as handling apparatus or structure parts of launch vehicle, are grounded, verify the level of electrostatic discharge to ensure that it is below the level of pyrotechnics ignition point.

j. The ground resistance of pyrotechnics shall not exceed 10Ω.

k. Do not use solder to bond the grounding line.

l. Pyrotechnics and each stage which already are installed pyrotechnics shall be grounded at all times. In this case, ground resistance shall not exceed 25Ω.

m. If pyrotechnics cannot be grounded for operational reasons (i.e., during checkout), place them on grounded and conductive table during handling.

n. When metal transportation containers are used, the container shall be grounded prior to opening.

o Use non-spark tools when working around pyrotechnics. However, even non-spark tools shall be used carefully because they do not completely prevent sparks.

p. Ground the crane hook and measure stray voltage between the crane hook and ground prior to lifting pyrotechnics and items that are installed on pyrotechnics with a crane; confirm that stray voltage is 50mV or less. If stray voltage exceeds 50mV, inspect the grounding line for anomalies, such as leakage current or defective crane insulation. If no anomalies are found, ground the hook again, measure stray voltage between the crane hook and ground again, and confirm that stray voltage is 50mV or less. The crane can be operated when stray voltage is 50mV or less. Stray voltage (Vs) is calculated using the following formula.

$$Vs = \sqrt{(VAC)^2 + (VDC)^2}$$

VAC: AC component VDC: DC component

(12) Operation of laser-initiated pyrotechnics

Inhibits for pyrotechnics initiated by laser shall be enabled as indicated below. One inhibit shall be to interrupt the explosive train. Requirements of section 4.1.5 shall be met when optical testing and adjustment are performed.

a. Three verifiable inhibits shall be enabled when personnel may easily access the operation area during testing.

b. When operators must attend the operation during testing, two inhibits shall be enabled.

c. When operators do not need to attend the operation during testing, one inhibit shall be enabled.

(13) Storage and transportation

a. Pyrotechnics shall be stored in the solid-propellant storage. Also, the operation organization shall coordinate with the Launch Site Safety Group and legally qualified person responsible and shall follow the pre-defined procedure when transferring pyrotechnics into or out of solid-propellant storage.

b. Do not wear shoes with metal exposed parts when entering the solid-propellant storage area.

c. Do not pack or unpack boxes in the solid-propellant storage area.

d. Store boxes containing pyrotechnics horizontally on wooden slats at least 30cm away from the interior wall of the solid-propellant storage; the height of stacked boxes shall not exceed 1.8m (4m when using installation equipment) from the floor.

e. Use only portable safety lights in the solid propellant storage.

f. Attach the "火" sign to the transporter. The speed limit in the launch site is 20 km/h.

g. Obtain permission for the operation and weather information from the Launch Site Safety Group prior to handling and transporting pyrotechnics.

h. Transport pyrotechnics using dedicated pyrotechnic transportation containers. When dedicated containers are not available, the boxes used to deliver pyrotechnics to the launch site may be used.

(14) Disposition

The operation organization shall coordinate with the Launch Site Safety Group when disposing of pyrotechnics within the launch site.

4.6 Electricity/electron related operation

4.6.1 General requirement

(1) Do not mate or demate connectors, conduct internal inspections, or repair powered electrical devices and circuits. When operations for powered electrical devices and circuits must be conducted, conduct them in accordance with procedures are based on assessment, such as investigation of circuits and assuring that no hazardous condition exists.

(2) Set the working voltage to less than 50 V (DC or AC effective value) in wetted areas, areas without protective mats (insulated protective device), or areas where devices have exposed grounding wires.

(3) In general, do not leave voltage beyond 50V (DC or AC effective value) electrical facilities exposed. When necessary to leave such a facility exposed condition, protect areas that might cause electrical shock by insulated protective devices or display a sign that shows the powered condition and warns personnel to keep a safe distance.

(4) Protect electrical cables that must be routed across the operating area, the cables shall be protected with cover, or shall be routed through overhead lines to avoid interrupting traffic such as personnel and transporters.

(5) When operating circuits, place a "作業中につき通電を禁ず(Work Underway: Do Not Turn on Power)" sign at switches of the power distributing panel.

(6) Repair or replace insulation materials of electrical cables that have worn off or are missing.

(7) Replace fuses only with those having the proper rated capacity.

(8) Insulate open ends of electrical cables.

(9) Before working on unpowered equipment, safely discharge all residual electrical charge and ground equipment in case of power cables, capacitors, etc. are installed in the electrical path. Check voltage prior to operation, check for reverse voltage due to improper power generator connection, , and ground the electrically-conducting path by bonding or grounding devices because an electrically conducting path may be charged if a power generator or uninterruptible power supply is connected to it.

(10) Maintain electrical motors in proper condition. Remove dust or oil from the electric motors by vacuum cleaning or wiping.

(11) Emergency shut-off devices shall be identified with signs.

4.6.2 Grounding

(1) Connect grounding wires of devices to the ground rod before using the devices.

(2) Protect the connection point of the grounding wires from unintentional disconnection by traffic.

(3) Launch vehicle grounding wires shall be copper and have an electric resistance less than 0.2Ω and current capacity exceeding 1A unless otherwise specified.

(4) Defects found in grounding wire insulation shall be repaired and replaced immediately.

4.6.3 Protective devices

(1) Operators working around electrical circuits shall wear proper working clothing with minimum exposure of skin and shall not wear conductive metallic objects such as rings and watches.

(2) Operators who perform voltage beyond 50V (DC or AC effective value) wiring or work in its proximity shall use insulated gloves and insulated boots (insulated protective guard). Also, areas near electrically charged systems or grounding portion shall be protected by protective mats (insulated protective equipment). This protection shall even be considered for areas powered under 50V.

(3) Personnel operating voltage beyond 50V (DC or AC effective value) equipment shall not use electrostatic grounding devices such as wrist stats.

4.6.4 Maintenance operation

(1) Safely discharge residual electric charge that may shock operators prior to operation when systems include power cables or capacitors.

(2) Insulated gloves and insulated boots (insulated protective guard) shall be used during operations.(3) Establish procedures for installing tags on control switches and circuit breakers and for releasing locking devices.

(4) Ensure grounding wires are securely connected to the grounding point.

4.6.5 Battery

(1) Establish emergency procedures and wear proper protective devices, such as rubber gloves, prior to handling the electrolyte.

(2) Refill batteries with electrolyte or activate for the first time in a site separate from other launch site operations before loading them into the rocket.

(3) When recharging battery in explosive hazardous atmosphere, it shall be done by remote control without any simultaneous operation in the same area and shall be defined as keep-out area.

(4) Battery cells that are considered as pressure vessels, such as nickel-hydrogen batteries, shall meet the requirements in 4.4.

(5) When recharging or discharging the battery, use a device with a function to prevent overcharge and over discharge.

(6) When recharging or discharging the battery, monitor voltage, current and recharging/discharging time.

4.7 Requirements for operations after launch abort

4.7.1 Requirements for operations after liquid propellant launch vehicle abort

This section specifies requirements for the launch vehicle operation associated with launch termination or misfiring/hang-fire after starting of liquid propellant loading of the launch vehicle.

(1) Launch abort

Operation shall be in accordance with following;

a. Turn Safe and Arm Device (hereinafter referred to as the “SAD”) for Ignition device of propellant/separation system to the SAFE position as required.

b. Vent liquid propellants.

c. Depressurize the liquid propellant tank and pressurant bottle (gas reservoir for pressurizing liquid propellant) to a safe level.

d. Replace the propellant in the propellant tank with an appropriate gas.

e. Restrict personnel from entering the launch complex until the launch complex is inspected and safety is confirmed after the above actions are completed.

f. Disarm pyrotechnic ignition circuits and remove pyrotechnics as required.

(2) Misfire and hang-fire

a. Turn SAD for Ignition device of propellant/separation system to the SAFE position as required.

b. Maintain the Flight Termination System in the ARM condition until it is confirmed that the launch vehicle will not inadvertently launch.

c. Turn off power to the Command Destructive Receiver.

d. Unload liquid propellants.

e. Depressurize the liquid propellant tank and pressurant bottle to safe levels.

f. Replace the propellant in the propellant tank with an appropriate gas.

g. Restrict personnel from entering the launch complex until the launch complex is inspected and safety is confirmed after the above actions are completed.

h. Turn the rotors of SAD for destruction system and Ignition device of propellant/separation system to the SAFE position. Reinstall and inspect safety pin.

i. Disarm pyrotechnic circuits and remove pyrotechnics as required.

4.7.2 Requirements for operation of solid propellant launch vehicle abort

This section specifies requirements for the launch vehicle operation associated with launch termination or misfiring/hang-fire after turning the ignition circuit to FIRE.

Respond to solid propellant launch vehicle abort as follows.

(1) Launch abort

a. Perform emergency operation to stop timer and confirm that the timer has stopped as required.

b. Turn the SAD for Ignition device of propellant/separation system to the SAFE position and disconnect the ignition cable at the operation console.

c. Confirm that the Solid Propellant Gas Generator internal pressure drop and thermal battery temperature drop if required.

d. Turn off all onboard equipment including the command destruct system.

e. Prevent personnel access from entering the launch complex until the launch complex is inspected and safety is confirmed after the above actions are taken.

f. Return the launcher to the VAB.

g. Inspect for hydrazine leakage.

h. Disconnect control cables to onboard equipment at vehicle side.

i. Turn the flight plug to the SAFE position and disconnect the ignition cable at the vehicle side.

(2) Misfiring and hang-fire

a. Perform emergency operation to stop the timer and confirm timer has stopped.

b. Turn the SAD for Ignition device of propellant/separation system to the SAFE position and disconnect the ignition system cable at the operation console side.

c. Confirm that the Solid Propellant Gas Generator internal pressure and the thermal battery temperature have dropped as required.

d. Turn off all onboard equipment including the command destruct system.

e. Prevent personnel from entering the launch complex until the launch complex is inspected and safety is confirmed after the above actions have been taken.

f. Return the launcher to the VAB.

g. Inspect for hydrazine leakage.

h. Disconnect control cables to onboard equipment at the vehicle side.

i. Inspect the firing circuit.

j. Turn the flight plug to the SAFE position and disconnect the ignition cable at the vehicle side.

Chapter 5 Requirements for the Launch Site Safety Group

5.1 Pre-operational inspection

(1) Perform safety inspection and/or ensure that the safety inspection has been conducted of launch vehicle, payload, GSE, and associated facilities or equipments before launch vehicles and payloads are delivered to the launch site.

(2) Perform inspection of and/or confirm that Launch Site Safety Organization has inspected all systems associated with hazardous operations and areas adjacent to the operating area to ensure that they comply with requirements for hazardous operations and are in suitable and safe condition, immediately prior to performing such operations.

(3)If the inspections or confirmation above indicate that safety of operations would be affected or additional operations are needed, Launch Site Safety Group shall immediately coordinate with the appropriate organization and take corrective action.

5.2 During processing

(1) The Launch Site Safety Group shall assign personnel to the designated areas at time specified in the operation schedule and procedure of each task to control personnel.

(2) The Launch Site Safety Group shall perform the following during processing.

(a) Grant permission for handling and starting delivery of hazardous products.

(b) Grant permission for starting transferring propellants to launch vehicles and payloads.

(c) Grant permission for simultaneous operations within the area where simultaneous operations are restricted

(d) Issue termination instructions to the director of operations when operations violate safety requirements or in the event of an emergency

(e) If necessary, order termination of RF radiation and confirm its termination.

(f) Establish Operation Restricted Areas and implement personnel access controls for hazardous operations.

(g) Establish Warning Areas and implement personnel access controls.

(h) Conduct safety training at appropriate times.

(i) Supervise and manage security guards, rescue crews, ambulance staff, firefighting teams, and security boats.

(j) Review and approve use of non-explosion-proofed electrical equipment

(k) Review and approve use of protective equipment provided by the Operation Organization.

(l) Provide instructions for actions to be taken in emergencies.

(m) Confirm statuses of protective actions, personnel evacuation, and equipment associated with launch site safety when lightning warning is issued or lightning strikes.

(n) Confirm safety of operating areas.

(o) Provide other instructions required for safety.

5.3 During countdown

(1) The Launch Site Safety Group shall assign personnel to the designated areas at scheduled time specified in the operation schedule and countdown procedure.

(2) The Launch Site Safety Group shall perform the following during countdown operation, etc.

(a) Grant permission for handling and starting delivery of hazardous products.

(b) Grant permission to start filling launch vehicles and payloads with propellants.

(c) Grant permission for simultaneous operations within the area where simultaneous operations are restricted.

(d) Request Launch Control Director to terminate operations or issue operation termination instructions to the director of operations when operations violate safety requirements or in the event of an emergency,

(e) Confirm actions taken in emergency situations and related requirements.

(f) Confirm the function of the operation termination system on the console associated with the Launch Site Safety Group.

(g) Monitor and confirm operations or electrical inspections of SAD for Ignition device of propellant/separation system.

(h) If necessary, order termination of RF radiation and confirm termination.

(i) Establish Operation Restricted Areas and implement personnel access controls during hazardous operations.

(j) Establish Warning Areas and implement personnel access controls.

(k) Review and approve for use non-explosion-proofed electrical equipment.

(l) Review and approve use of protective equipment provided by the Operation Organization.

(m) Confirm status of operators in the event of an emergency, and provide instructions and guidance to evacuate personnel from the remaining buildings.

(n) Issue instructions for decontaminating facilities, equipment, and operators in the event of an emergency.

(o) Activate fire extinguishing equipment for launch pad or its adjacent area (ex. post-launch fire suppression gun for around launch pad) and ensure it is standing by after transferring LP of launch vehicle

(p) Ventilate the emergency evacuation tunnel before issuing the All Personnel Evacuation order

(q) Issue no-smoking order in the launch control building 10 minutes before launch.

(r) Close air-conditioning system intake and exhaust ducts in the launch control building and all doors to the building.

(s) Supervise and manage security guards, rescue crews, ambulance staff, firefighting teams, and security boats.

(t) Issue lightning warnings, confirm statuses of protective actions taken, evacuate personnel, and inspect for damage of equipment associated with launch site safety.

(u) Perform initial fire fighting.

(v) Monitor command destruction system’s SAD.

(w) Sound siren in the event of an emergency.

(x) Monitor sea and sky and confirm that all personnel have been evacuated from the All Personnel Evacuation area.

(y) Shut down power to non-explosion-proof devices (at TNSC, shut down “Shaten B-kei Dengen” (:power supply line B to VAB))

5.4 Launch abort and misfire/hang-fire

If a mission is aborted immediately before launch, if there is a misfire, or if there is a hang-fire, the Launch Site Safety Group shall conduct and confirm the following procedures. When a judgement of misfire or hang-fire is difficult, hang-fire to be considered.

5.4.1 Liquid propellant launch vehicle

(1) The Launch Site Safety Group shall require and confirm that SAD for ignition devices of propellant/separation systems is in the SAFE position and that propellant tanks and pressure vessels (gas reservoirs for pressuring fuel) are depressurized to a safe level.

(2) The Launch Site Safety Group shall continue to require and confirm that the Flight Termination System is maintained in the armed condition until it is confirmed that the launch vehicle will not inadvertently launch.

(3) The Launch Site Safety Group shall prohibit all personnel from entering the All Personnel Evacuation area until it is confirmed that engine start signals have not reached the firing system in the case of misfiring or until 30 minutes have elapsed in the case of hang-fire.

(4) After ensuring that the above actions have been conducted and that the command destructive receiver is in the power-off position, the Launch Site Safety Group, along with the operation organization, shall inspect the launch pad to verify launch pad safety.

(5) The Launch Site Safety Group shall confirm that destruction systems and SAD for Ignition devices of propellant/separation systems are in the SAFE position and that safety pins have been reinstalled.

(6) The Launch Site Safety Group shall confirm that pyrotechnics wiring has been disconnected and, if required, that pyrotechnics have been removed.

(7) The Launch Site Safety Group shall monitor the unloading of propellants.

5.4.2 Solid propellant launch vehicle

(1) Order the timer emergency stop operation and confirm that the timer has stopped.

(2) Order that the ignition circuit including SAD be turned to the SAFE position, that the cable of ignition system be disconnected at the operation console side, and confirm these actions.

(3) Confirm that the internal pressure of the Solid Propellant Gas Generator and the temperature of thermal battery have dropped to a safe level.

(4) Order that all onboard equipment including command destruct device be turned off and confirm that action.

(5) Prohibit personnel from entering the launch pad until all the above tasks have been completed, or after confirmation of unreaching engine start signal to the ignition system when misfire case, or until 30 minutes passage from ignition when hang-fire case.

(6) Confirm that the launcher can be returned to the VAB safely.

(7) Order an inspection for hydrazine leakage and confirm that action.

(8) Order onboard equipment control cables on the vehicle’s side to be disconnected and confirm that action.

(9) Order the ignition system circuit to be inspected in case of misfire or hang-fire and confirm that action.

(10) Order that the flight plug be turned to the SAFE position and that the ignition system cable of vehicle side be disconnected and confirm those actions.

5.5 After launch

(1) Immediately after the launch, the Launch Site Safety Group shall inspect the launch pad to determine if it has been contaminated, the high-pressure gas equipment has been damaged, and hazards to operators (such as fire) have been identified.

(2) The Launch Site Safety Group shall not rescind the All Personnel Evacuation order and shall not give permission for all operators to leave the remaining building until the Group shall have confirmed launch-pad safety themselves.

(3) The Launch Site Safety Group shall keep nearby roads closed; shall keep fire engines, rescue crews and ambulances on standby; and shall keep fire extinguishing equipment for the launch pad or its adjacent area (ex. post-launch fire suppression gun for around launch pad) in readiness until safety is verified at the launch pad.

Attachment 1 Definition of Terminology

The terms used in this regulation are defined below.

All Personnel Evacuation: During launch operations, only designated or authorized operators are allowed to remain in the designated building; all unauthorized personnel shall evacuate the designated area.

Approval: To accept any matter as justifiable according to JAXA 's prespecified procedures and to sign operational procedures or other documents after confirmation between JAXA and the contractor.

Buddy System: A work system that requires a group of operators consisting of at least two persons to protect operators during hazardous operations. (If one operator is incapacitated in a hazardous incident, the other can take necessary action, such as rescue.)

Contract: A legal commitment, such as arrangement between JAXA and a counterpart or an agreement associated with launch, made between JAXA and individual, organization, or contractor involved with launch vehicle, payload, or related GSE (herein described by the term "launch vehicle/payload"). The term "organization" described herein includes the foreign government space development agency, private space development agency, or Japanese and foreign universities or research institutes.

Contractor: An individual, organization, or contractor developing launch vehicles or payloads or performing launch site operations under contract to JAXA.

Controlled Area: A designated area for protecting health of personnel against radiation hazards resulting from the use of a Radiation Generator.

Decibel A-scale (dB(A)): A unit of noise level measured using A characteristic of sound level meter's level weighting circuit.

Failure: The inability of a system, subsystem, component or part to perform its required function within specified constraints, under specified conditions and for a specified duration.

Flame Arrester: Also called a flame trap. A device equipped with a wire net to prevent flames from propagating through pipes and ducts. The flame arrestor shall be installed on the exhausts of motor vehicles authorized to enter the solid-propellant storage area, hazardous materials storage area, and the like.

Ground Support Equipment: Ground equipment necessary for handling, testing, and inspecting launch vehicle/payload.

Hang-fire: A condition in which a launch vehicle does not lift off even though the engine ignited.

Harmful Propellant: Propellant whose vapor or gas causes physical disorders such as skin disorder or nerve disorder, is an asphyxiant or carcinogenic, or is otherwise harmful.

Hazard: An existing or potential condition that can result in a mishap.

Hazardous Area: An area where hazardous operations are conducted or hazardous products are present, or an area designated by JAXA.

Hazardous Atmosphere: An atmosphere where harmful or explosive gas/vapor is present, or an atmosphere expected to become oxygen deficient such as a closed volume.

Hazardous Atmosphere Area: An area where explosive gas or vapor may leak or be released.

Hazardous Materials: Material, including hazardous products, whose biological, physical, or chemical characteristics may injure people or damage property, and which are sampled, cultured and refined, combined, processed, and assembled for specific purposes. Also, materials determined to be handled as hazardous materials as a result of discussion between JAXA and contractor(s). Examples of hazardous materials are listed below:

Ignition Combustible Material (flammable gas, flammable vapor, flammable powder, antiposic substances, flammable liquid, explosive material, spontaneously igniting material, flammable solid material, oxidized material, contact sensitive material, etc.), harmful material (toxic or poisonous material, carcinogenic substance, organic solvent), strong alkaline substance, strong acid substance, corrosive material, chemical, petroleum material, pyrogenetic material, living organisms, biochemical substances, microbes, pathogens, radioactive material, cryogenic material, noxious organisms, energy sources, etc. From the perspective of the Fire Prevention Law, material that could be a serious obstacle to fire suppression activity, material where fire suppression activity is extremely difficult because fire expands quickly, and highly ignitable and flammable materials that could cause fire are defined as hazardous materials. Materials are classified as oxidizing solid material, combustible solid material, pyrophoric and antiposic solid materials, flammable liquid, autoreactive material, and oxidizing liquid.

Hazardous Operations: Any operation handling hazardous products or a JAXA-designated operation in a hazardous environment.

Hazardous Product: Hazardous products include explosives, toxic materials, high-pressure gases and hazardous materials as well as materials similar to hazardous materials.

Hazardous: A term “hazardous” is used when equipment, systems, operations, or situations have potential hazards.

Heavy Rain Warning: A warning issued by JAXA for the launch site when damage is expected due to heavy rain.

Immediately Dangerous to Life and Health (IDLH) values: Values developed by National Institute for Occupational Safety and Health (NIOSH), where the 30 min exposure to the

equivalent concentration of airborne contaminants results in irreversible health effects.

Launch Site Safety Group: A section that is responsible for safety of equipment, equipment operations, and other operations in the Center.

Launch Site Operation: Launch processing operation of launch vehicles or payloads performed at the Center, and operations of facilities or equipment relating to launch processing and launch operation.

Launch Vehicle/Payload: Orbital insertion launch vehicle and payloads.

Legal Person responsible for Safety: For high-pressure gas safety, a person responsible for manufacturing safety, person responsible for safety supervision, person responsible for safety engineering, and safety manager or safety member, who are appointed in accordance with the Ministry of International Trade and Industry (MITI) ministerial ordinance. For consumption of explosives, a person responsible for explosives handling safety, who is appointed in accordance with MITI ministerial ordinances. For others, a person responsible for safety, who is appointed in accordance with domestic law.

Lightning Warning: A warning issued by JAXA for the range site when developed thunderclouds are expected to arrive at the perimeter of range site within one hour and to cause damage due to lightning.

Maximum Expected Operating Pressure (MEOP): The maximum pressure that is expected to be applied to components of a pressure system under the operational environment.

Misfire: A condition in which an engine is not ignited even though the firing circuit is energized.

Mishap: An event that results in injury, death or illness to person and/or loss or damage to property, launch vehicles, payload, or related GSE.

Mishap, etc.: Mishap or non-conformance that affects safety.

Non-conformance: A condition where one or more characteristic of parts, materials, or services used for components does not comply with specified requirements. It includes failure, discrepancy, defect, and functional abnormality.

Notification Area: An area where evacuation to indoors (including inside the vehicle) is requested in case of mishap, etc.

Operation restricted Area: An area where operators or the general public are prohibited access or have limited access when specific hazardous operations are being performed.

Operator: A person who is involved in launch site operations, such as JAXA or contractor

personnel.

Payload: An unmanned cargo launched into space by JAXA launch vehicle. In this regulation, subsystems or components that comprise payloads are called payloads.

Person Responsible for Launch Site Operation: A person authorized to perform launch site operations related to launch vehicles, etc. at the Center. In case of rocket, the Person Responsible for Launch Site Operation will be assigned by JAXA for JAXA launch, and by a company for their commercial launch.

Pressure System: A system consisting of a pressure vessel, components and piping to connect these.

Pressure Vessel: A vessel storing high-pressured gas. High-pressure gas is one of the following.

(1) Compressed gas, the pressure of which is not less than 1 MPa at its normal operating temperature and which is currently not less than 1 MPa, or compressed gas, the pressure of which is not less than 1 MPa at a temperature of 35 degrees Celsius (except compressed acetylene gas in both cases)

(2) Liquefied gas, the pressure of which is not less than 0.2 MPa at its normal operating temperature and which is currently not less than 0.2 MPa, or liquefied gas, the temperature of which is 35 degrees Celsius or less in the event that the pressure is 0.2 MPa. .,

Pyrotechnics: Products processed from explosives and high explosives in accordance with the purpose of use.

Radiation Generator: Equipment installed in Center nondestructive examination building to generate x-rays with an acceleration energy below 12 MeV.

Safe: The condition in which factors related to mishaps or accidents are controlled to prevent the spread of the mishap or accident.

Safe and Arm Device(SAD)) : Safety device of ignition system that ignite pyrotechnics and ensure safety in ground operation. SAD protect failure of pyrotechnics blocking off the route

“mechanically detonation/electrical continuity” in the safe mode, and SAD put pyrotechnics into the state that ignition is possible in the arm mode.

Safety Group: Launch Site Safety Group and Flight Safety Group

SCAPE Suit (Self-Contained Atmospheric Protective Ensemble Suit): A special working garment with a respirator that protects a propellant-handling operator from exposure to harmful propellants such as hydrazine.

Stray Voltage: Voltage measured to confirm stray current.

Typhoon Warning: A warning issued by JAXA for the launch site when a storm with wind speeds exceeding 25 m/s is expected to pass over the launch site within 15 to 20 hours.

Warning Area: An area where access by unauthorized personnel is restricted or prohibited to ensure safety, and a JAXA-designated area. Details are provided in Appendix Data-II.

Wrist Stat: A tool used to remove the electrostatic charge accumulated on the human body through a grounding wire to prevent hazardous products, etc. from igniting due to electrostatic sparks. It is worn during operation. Also called a wrist strap. Leg stats are also used for the same purpose.

Appendix Data-I Flight Safety Requirement related to Orbit Injection Vehicle Launch (Deleted)

Appendix Data-II Evaluation Standard for designation of warning area

1. Designation of warning area

For each phase leading up to rocket launch, warning area shall be designated to restrict access to unauthorized personnel as below. When installing or loading items not listed below, necessary distance shall be calculated using an appropriate TNT equivalence conversion rate.

(1) Warning area during processing operation

For each phase of rocket assembly etc., to minimize the effect of the mishap, etc., warning area shall be a circle whose radius is either *R* calculated from the following equation, or quantity distance taken from Table 1, and whose center is placed at the point of operation.

A) For pyrotechnics:

$R = 2 \times 2.5 \times (W_{p1} \times 0.5 \times W_{p2})^{1/3}$

R: the radius (m)

W_{p1}: the weight of low explosives (kg)

W_{p2}: the weight of high explosives (kg)

B) For the case only liquid propellant (such as hydrazine, nitrogen tetroxide (hereafter referred as NTO)) is used

a. For the case only hydrazine is used

Quantity distance taken from Table 1.

In case of static storage, relevant domestic fire protection laws and regulations, such as Fire Service Act, shall also be referred.

b. For the case only NTO is used

Quantity distance taken from Table 1.

In case of static storage, relevant domestic fire protection laws and regulations, such as Fire Service Act, shall also be referred.

c. For the case where both hydrazine and NTO exist

Longer quantity distance between the following two values shall be used

- Quantity distance taken from Table 1 for hydrazine
- Quantity distance taken from Table 1, column A, using TNT equivalent weight, which is acquired by taking the sum of the weight of both propellant, and taking the product of the sum and TNT equivalence conversion rate($T_e = 0.1$).

C) For the case where solid and liquid (such as hydrazine, NTO) propellant coexists

a. For the cases of highly dangerous operations at the launch complex, such as count down, integration of satellite into the rocket.

Quantity distance taken from Table 1, column B, using the sum of TNT equivalent weight of both propellant. When calculating TNT equivalent weight of each propellant, $T_e = 0.05$ shall be used for solid propellant, and $T_e = 0.1$ shall be used for liquid propellant.

b. For the cases of storage, as well as low risk operations.

Quantity distance taken from Table 1, column A, using the sum of TNT equivalent weight of both propellant. When calculating TNT equivalent weight of each propellant, $T_e = 0.05$ shall be used for solid propellant, and $T_e = 0.1$ shall be used for liquid propellant.

c. For the cases of cryogenic inspection, launch rehearsals

Quantity distance that is equivalent to “Warning area with respect to ground

safety" in (2)

(2) Warning area during launch

Warning area during launch shall include all areas that meet any of the following criteria, at minimum.

- Warning area with respect to ground safety: An area that is a circle whose center is the launch complex, and whose radius is the longest quantity distance among *R*, *D*, *F* calculated from A), B), C) below for the blast, fragments and debris, and heat radiation from the fireball.
- Warning area with respect to air safety

A) Quantity distance against the blast:

Quantity distance against the blast shall be calculated based on the following equation and Annex 1.

$R = (74/\Delta P^{1/1.41}) \times \{ \Sigma (T_e \times w_p)\}^{1/3}$

R: quantity distance against the blast (m)

ΔP: standard blast pressure (kPa)

W_p: the weight of the propellant (kg)

Note:

T_e for solid propellant = 0.05

T_e for LOX/LH_2 = $6.7/ w_p^{1/3}$

Calculation shall be performed separately for each stage (the 1st stage, 2nd stage, liquid booster, etc.), and combined altogether.

T_e for hydrazine /NTO = 0.1

T_e for pyrotechnics = 1

Depending on the type of the rocket, the weight of appropriate propellants may be combined for the calculation.

B) Quantity distance against fragments and debris:

Quantity distance against the blast shall be calculated based on the following equation.

a. For the case of solid propellants and pyrotechnics

$D = 117 \times w_p^{0.21}$

D: quantity distance against the fragments and debris (m)

W_p: the weight of the propellant (kg) (The total sum of all the propellant in all stages)

b. For the case of liquid (LOX/LH_2 or hydrazine/NTO) propellants

$D = 59 \times w_p^{0.21}$

D: quantity distance against the fragments and debris (m)

W_p: the weight of the propellant (kg) (The total sum of all the propellants in all stages)

c. For the case where both solid and liquid propellants exist

$D = 117 \times w_p^{0.21}$

D: quantity distance against the fragments and debris (m)

W_p: the weight of the propellant (kg) (The total sum of all the propellants in all stages)

C) Quantity distance against the heat radiation from the fireball:

To be calculated as described in Annex 2.

Annex 1

Standard Blast Pressure ΔP (kPa), which is used to calculate quantity distance against the blast, shall be calculated in the equation below

$\Delta P = 1.379$ ($I \leqq 140$ Pa・s)

$\Delta P = 1.379 \times (140/I)^{0.24}$ ($140 < I < 400$ Pa・s)

$\Delta P = 1.073$ ($I \geqq 400$ Pa・s)

I: Impulse (Pa・s)shall be calculated using following 2 equations.

$I = \{ \Sigma (T_e \times w_p) \}^{1/3} \times 367 \times Z^{\{-1.08+0.0072 \times \ln(Z)\}}$

$Z = R / \{ \Sigma (T_e \times w_p) \}^{1/3}$

R: quantity distance against the blast (m)

W_p: the weight of the propellant (kg)

T_e for solid propellant = 0.05

T_e to calculate the impulse for $LOX/LH_2 = 7.8/ w_p^{1/3}$

Calculation shall be performed separately for each stage (the 1st stage, 2nd stage, liquid booster, etc.), and combined altogether.

T_e for hydrazine-based liquid propellant/NTO = 0.1

T_e for pyrotechnics = 1

Depending on the type of the rocket, the weight of appropriate propellants may be combined for the calculation.

Annex 2. Quantity distance against fireball

Quantity distance against fireball shall be calculated as follows:

(1) For the case of solid propellants and pyrotechnics

Where I_S stands for irradiance (W/m^2) from the fireball, t_S stands for the duration (s) of the fireball, and *F* stands for the quantity distance (m):

$$I_S = 2.69 \times 10^7 \times \{ \Sigma (T_e \times w_p)\}^{0.65} / F^2 \qquad \text{Equation (1)}$$

$$t_S = 0.258 \times \{ \Sigma (T_e \times w_p)\}^{0.349} \qquad \text{Equation (2)}$$

$$t_S \times (I_S /1{,}000)^{1.46} = 200 \qquad \text{Equation (3)}$$

W_p: the weight of the propellant (kg)

T_e for solid propellant = 0.05

T_e for pyrotechnics = 1

(2) For the case of liquid (LOX/LH_2 or hydrazine/NTO) propellants

Where I_L stands for irradiance (W/m^2) from the fireball, t_L stands for the duration (s) of the fireball, and *F* stands for the quantity distance (m):

$$I_L = 8.58 \times 10^6 \times w_p^{2/3} / F^2 \qquad \text{Equation (4)}$$

Note: If the propellant is composed of LOX/LH_2 only (no other kinds of propellant, including solid propellant, are present), I_L is considered to be $8.58 \times 10^6 \times 0.85$

$$t_L = 1.82 \times w_p^{1/6} \qquad \text{Equation (5)}$$

$$t_L \times (I_L /1{,}000)^{1.46} = 200 \qquad \text{Equation (6)}$$

W_p: the weight of the propellant (kg)

(3) For the case where both hydrazine, NTO and solid propellants exist

i) If $t_L \geqq t_S$:

Equation (1), (2), (4), (5) and

$$t_S \times ((I_L + I_S) /1{,}000)^{1.46} + (t_L - t_S) \times (I_L /1{,}000)^{1.46} = 200$$

ii) If $t_L < t_S$:

Equation (1), (2), (4), (5) and

$$t_L \times ((I_S + I_L) /1{,}000)^{1.46} + (t_S - t_L) \times (I_S /1{,}000)^{1.46} = 200$$

[Note]

For those who seeks to obtain quantity distance from heat radiation from the fireball, the standard from the following document shall be used for permissible irradiance.

“NASA-STD-8719.12 Safety Standard for Explosives, Propellants and Pyrotechnics”

Table 1. Quantity distance during Maintainance

The mass of the propellant		NTO (Note1)		Hydrazine (Note2)		A case where both hydrazine and NTO exist; or where these and solid propellants exist			
						A(Note4)		B(Note3)	
kg	(lbs)	m	(ft)	m	(ft)	m	(ft)	m	(ft)
0.1	(0.2)	15.2	(50)	243.8	(800)	43.2	(142)	71.9	(236)
0.2	(0.5)	15.2	(50)	243.8	(800)	43.2	(142)	72.1	(236)
0.3	(0.7)	15.2	(50)	243.8	(800)	48.1	(158)	80.2	(263)
0.5	(1)	15.2	(50)	243.8	(800)	53.3	(175)	88.8	(291)
4.5	(10)	15.2	(50)	243.8	(800)	86.6	(284)	144.4	(474)
9.1	(20)	15.2	(50)	243.8	(800)	96.7	(317)	161.1	(529)
13.6	(30)	15.2	(50)	243.8	(800)	102.5	(336)	170.9	(561)
22.7	(50)	15.2	(50)	243.8	(800)	109.9	(361)	183.2	(601)
45.4	(100)	15.2	(50)	243.8	(800)	120.2	(395)	200.4	(658)
65.4	(144)	15.2	(50)	243.8	(800)	146.3	(480)	243.8	(800)
90.7	(200)	15.2	(50)	243.8	(800)	169.5	(556)	282.6	(927)
136.1	(300)	15.2	(50)	243.8	(800)	198.4	(651)	330.6	(1085)
181.4	(400)	15.2	(50)	243.8	(800)	218.8	(718)	364.7	(1197)
204.1	(450)	15.2	(50)	243.8	(800)	227.2	(746)	378.7	(1243)
226.8	(500)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
453.6	(1,000)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
2,268	(5,000)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
4,536	(10,000)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
6,804	(15,000)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
9,072	(20,000)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
10,567	(23,297)	15.2	(50)	243.8	(800)	228.6	(750)	381.0	(1250)
11,340	(25,000)	15.2	(50)	249.6	(819)	228.6	(750)	381.0	(1250)
13,608	(30,000)	15.2	(50)	265.2	(870)	228.6	(750)	381.0	(1250)
16,785	(37,004)	15.2	(50)	284.5	(933)	243.8	(800)	406.3	(1333)
20,412	(45,000)	15.2	(50)	303.6	(996)	260.2	(854)	433.7	(1423)
22,680	(50,000)	15.2	(50)	314.5	(1,032)	269.5	(884)	449.2	(1474)
31,751	(70,000)	15.2	(50)	351.8	(1,154)	301.5	(989)	502.5	(1649)
45,359	(100,000)	15.2	(50)	396.2	(1,300)	339.6	(1114)	566.0	(1857)
68,039	(150,000)	15.2	(50)	453.6	(1,488)	429.1	(1408)	715.2	(2346)
90,718	(200,000)	15.2	(50)	499.2	(1,637)	506.6	(1662)	844.4	(2770)
113,398	(250,000)	15.2	(50)	537.8	(1,764)	576.2	(1891)	960.4	(3151)
120,201	(265,000)	15.2	(50)	548.3	(1,798)	587.5	(1927)	979.1	(3212)
136,077	(300,000)	15.2	(50)	548.6	(1,800)	612.3	(2008)	1020.5	(3347)
226,795	(500,000)	15.2	(50)	548.6	(1,800)	725.9	(2381)	1209.9	(3969)

(Note) Values taken from AFMAN91-201

Note1: Quantity distance of NTO/MON

15.2m (Constant)

Note2: Quantity distance of hydrazine (Tank burst pressure > 690 kPa)

The minimum quantity distance shall be 243.8m.

11.11 x The weight of the propellant ^ (1/3) m

If the weight > 120,201kg, 548.6m

Note3: Quantity distance where both hydrazine and NTO exist; or where these and solid propellants exist (column B)

The minimum quantity distance shall be 71.9m.

TNT equivalent weight < 45.4kg: 107.87 +[24.14 x ln (TNT equivalent weight)] m

45.4kg ≦ TNT equivalent weight ≦ 204.1kg: -251.87 + [118.56 x ln (TNT equivalent weight)] m

204.1kg < TNT equivalent mass ≦ 13,608kg: 381.0m

13,608kg < TNT equivalent mass ≦ 45,359kg: 15.87 x TNT equivalent mass^1/3 m

45,359kg < TNT equivalent mass ≦ 113,398kg: 1.1640 x TNT equivalent mass^0.577 m

113,398kg < TNT equivalent mass: 19.84 x TNT equivalent mass ^1/3 m

If hydrazine is present, the minimum quantity distance shall be 243.8m.

Note4: Quantity distance where both hydrazine and NTO exist; or where these and solid propellants exist (column A)

The value should be 60% of column B.

If hydrazine is present, the minimum quantity distance shall be 243.8m.