INTERNATIONAL STANDARD

ISO 14620-3

First edition
2005-05-01

Space systems — Safety requirements —

Part 3: Flight safety systems

Systèmes spatiaux — Exigences de sécurité —

Partie 3: Systèmes de sauvegarde en vol

Reference number
ISO 14620-3:2005(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14620-3 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 14620 consists of the following parts, under the general title *Space systems — Safety requirements*:

— *Part 1: System safety*

— *Part 2: Launch site operations*

— *Part 3: Flight safety systems*

Introduction

Space launch activities can present hazards to people and damage to property and the environment. International space treaties adopted by the United Nations impose legal liabilities on countries involved in launching space vehicles to provide compensation for certain injuries and damages incurred as the result of such launches.

This part of ISO 14620 affects the safety of exposed people, property and environment, as well as those countries and organizations conducting commercial or civil launch activities.

Space systems — Safety requirements —

Part 3: Flight safety systems

1 Scope

This part of ISO 14620 sets out the minimum requirements for flight safety systems (FSSs), including flight termination systems (FTSs, externally controlled systems or on-board automatic systems), tracking systems, and telemetry data transmitting systems for commercial or non commercial launch activities of orbital or suborbital, unmanned space vehicles. The intent is to minimize the risk of injury or damage to persons, property or the environment resulting from the launching of space vehicles.

This part of ISO 14620 can be applied by any country, by any international organization, whether intergovernmental or not, and by any agency or operator undertaking the launching of space vehicles.

This part of ISO 14620 is intended to be applied by any person, organization, entity, operator or launch authority participating in commercial or non-commercial launch activities of orbital, or suborbital, unmanned space vehicles unless more restrictive requirements are imposed by the launch site country.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14620-1:2002, *Space systems — Safety requirements — System safety*

ISO 14620-2:2000, *Space systems — Safety requirements — Launch site operations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14620-2 and the following apply.

3.1
flight safety system
combination of flight-, ground- or space-based hardware and software designed, installed and/or operated specifically for providing flight safety

NOTE 1 This combination of equipment, facilities, procedures and personnel required to monitor operations provides protection to personnel and property both foreign and domestic from any damage that may be caused by a non-nominal flight.

NOTE 2 The flight safety system may include flight termination systems, telemetry data transmitting systems and range tracking systems.

3.2
flight termination system
explosive or other disabling or thrust-terminating equipment installed in a launch vehicle, plus any associated ground equipment, for terminating the flight of a malfunctioning vehicle or stage

3.3
launch
initial action to place, or attempt to place, a launch vehicle and payload, if any, in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space

3.4
range tracking system
combination of flight-, ground- or space-based hardware and software designed, installed and/or operated specifically for tracking a launch vehicle

3.5
safety envelope
area designated for launch and preorbital flight that is cleared of uninvolved persons or where the risk of injury, fatality or property damage to the public is below a designated threshold probability

3.6
telemetry data transmitting system
combination of flight- or space-based hardware and software, designed, installed or operated for down-linking vehicle and flight system performance and health data to flight safety operators

3.7
threshold probability
probability that loss or damage will exceed a specified level

NOTE Threshold probability is a quantitative measure that represents the probability of occurrence associated with unplanned events or levels of damage caused by launch-related activities.

4 Symbols (and abbreviated terms)

FSS flight safety system

FTS flight termination system

GPS global positioning system

GSE ground support equipment

RTS range tracking system

S&A safe and arm

SFP single failure point

TDTS telemetry data transmitting system

5 General requirements

5.1 All launch vehicles shall incorporate tracking devices or establish means of tracking that enable real-time monitoring of vehicle position and prediction of instantaneous impact points throughout the launch phase.

5.2 All spent stages shall incorporate tracking devices or establish means of tracking that enable real-time monitoring of vehicle position, except when pre-flight analysis establishes that the stage separation activity will not result in an unknown or hazardous impact area or dispersion.

5.3 All launch vehicles shall incorporate telemetry data transmitting systems for monitoring vehicle performance data and the flight termination system and tracking system status that are capable of functioning throughout the launch phase until the end of range safety responsibility.

5.4 Any launch vehicle having a stage, motor or component capable of violating the defined safety envelope shall be equipped with an FTS that interrupts the flight of the vehicle if it diverts from its predicted flight trajectory and has sufficient energy to become a threat to public safety.

5.5 All the FTS, telemetry and tracking systems of launch vehicles shall be compatible with applicable spaceport and/or range ground equipment.

5.6 The inability to accurately ascertain the vehicle's position shall be criteria for stopping the launch countdown.

5.7 If the ability to accurately determine the location of the vehicle is lost after launch, this will normally require initiation of FTS action, unless otherwise specified in the mission rules or range safety operational procedures.

5.8 For launch vehicles and payloads containing radioactive materials, proof of compliance with all appropriate regulations governing radioactive materials shall be provided.

6 Flight termination system requirements

6.1 General

6.1.1 Any launch vehicle where a malfunction of the vehicle or any stage, motor, payload or component may generate an unacceptable hazard to public safety shall contain flight termination systems.

6.1.2 All launch vehicle stages capable of violating the defined flight safety envelope shall contain flight termination systems.

6.1.3 The FTS flight equipment reliability shall be not less than 0,999 at the 95 % confidence level or shall be compliant with the quantitative flight safety requirements, as required in ISO 14620-2:2000 (see Clause 3), if the latter are more stringent. This reliability should be established by analysis of all components and supporting test data. The reliability of FTS ground equipment (including the radio-frequency propagation path as far as the launch vehicle) shall be compatible with the reliability requirements of the flight hardware.

6.1.4 The FTS, including monitoring and checkout circuits, shall be designed to eliminate the possibility of a single failure point (SFP) inhibiting the function of the system or causing an undesired output of the system. This requirement shall be verified by performing an SFP analysis.

6.1.5 The FTS shall make non-propulsive all powered stages and any other propulsive system of the vehicle.

6.1.6 Liquid propellant

a) The FTS of a liquid propellant launch vehicle shall provide both engine shutdown and stage destruct capability for each stage.

b) A rapid burning or explosion caused by destruct capability of toxic propellants shall be initiated to consume as much propellant as possible before impact.

6.1.7 Solid propellant

a) The FTS destruct charges of a solid propellant vehicle shall be designed to destroy the pressure integrity of the motor and ignite any non-burning propellant.

b) The destruct action shall cause a condition of zero thrust, zero lift and zero yaw; if not, any residual thrust shall cause a tumbling action such that no significant lateral or longitudinal deviation of the impact point could result.

6.1.8 The FTS shall be designed such that termination action of one stage will not sever or inhibit functioning of FTS circuitry or ordnance on other stages.

6.1.9 The FTS shall be designed to function properly in the environment (shockwave, heatwave, etc.) resulting from the vehicle break-up.

6.1.10 FTS components shall be independent of any other system on the vehicle or payload.

6.1.11 FTS components shall be isolated from other vehicle components to the extent that normal or abnormal functioning of the other vehicle components does not inhibit or activate the FTS components.

6.1.12 FTS active components, electrical cables, batteries, ordnance lines and destruct charges shall be redundant unless otherwise approved by the launch site country.

6.1.13 Redundant ordnance components, signal cables and electrical power cables shall be physically separated from each other by the maximum distance possible and mounted in different orientations, or on different axes where technically feasible.

6.1.14 FTS electrical and ordnance components shall have their operating and storage life specified.

6.1.15 The launch vehicle operator shall verify the FTS has sufficient service life for the specified mission prior to launch.

6.1.16 For externally controlled FTS, antenna, receivers and decoders shall be compatible with the used GSE (gain, coverage, operating frequencies, bandwidth and insertion loss).

6.1.17 For externally-controlled FTS, all equipment shall be designed or chosen to ensure a radio-frequency propagation path from the command transmitter/antenna system to the launch vehicle antenna.

6.1.18 For externally-controlled FTS, the response time of each equipment from the receipt of signal shall be between 4 milliseconds and 25 milliseconds.

6.1.19 For externally-controlled FTS, the FTS antenna system shall cover more than 95 % of the radiation sphere.

6.1.20 The FTS shall comply with the qualitative safety principles described in ISO 14620-2:2000 (see Clause 3) and be subjected to a safety analysis as described in ISO 14620-1:2002 (see Clause 3).

6.2 FTS safe and arm devices

6.2.1 For launch vehicles in which propulsive ignition occurs before first motion, the FTS S&A devices shall be armed prior to arming launch vehicle and payload ignition circuits.

6.2.2 For launch vehicles in which propulsive ignition occurs after first motion (e.g. submarine launched ballistic missile, dropped from carrier-aircraft launch vehicle), the FTS S&A devices shall contain an ignition interlock that shall be designed such that ignition cannot occur unless the FTS arming devices are in the armed position.

6.2.3 No FTS S&A device shall produce a terminate output as the result of a single component failure.

6.2.4 All the possibilities to perform each function of the FTS S&A devices (safing, arming) shall be tested after installation, but prior to launch.

6.2.5 FTS S&A devices shall be designed to interrupt the direct path of the initiating energy of the FTS.

6.2.6 FTS S&A devices shall incorporate a device providing a remotely controlled means of interrupting the direct path of the initiating energy of the FTS.

6.2.7 Redundant means shall be provided to remotely safe FTS S&A devices.

6.3 FTS ordnance

6.3.1 FTS ordnance shall be safed for any ground operation.

6.3.2 The FTS destruct ordnance train, including all ordnance components and appropriate interfaces or air gaps, shall be designed to initiate with the energy level provided from the arming or initiating device, to propagate through the ordnance train to the destruct charges and to render the propulsion system non-propulsive.

6.3.3 FTS ordnance items and other items that are conductive and interface with FTS ordnance shall be kept at the same voltage potential through grounding.

6.3.4 FTS ordnance components shall have a service life equal to or greater than that of the vehicle if the components are installed on the stage at the time of stage manufacture.

6.3.5 FTS ordnance component service life shall be dated from the time of component acceptance.

6.4 Ground support equipment

6.4.1 GSE shall provide verifiable safety inhibits.

6.4.2 GSE inhibits and inhibit controls shall be independent and shall not share the same failure modes.

6.4.3 All GSE and flight ordnance shall be safed for any ground operation.

6.4.4 System failures that could lead to catastrophic events shall be dual fault tolerant (three inhibits).

6.4.5 From prelaunch through lift-off, a means of continuously monitoring the status of the FTS shall be provided in order to verify the armed status of each FTS S&A device, the health and status of the FTS and other associated components (command receiver/decoders, firing units, batteries, etc.), proper functioning of the destruct simulator, power transfer switch status, hold fire control switch (stop launch sequencer), and status of the range command transmitter carrier (on/off).

6.4.6 GSE used for checkout of the airborne range safety equipment shall be calibrated on a periodic basis in accordance with the flight safety rules of the launch site.

6.4.7 For externally controlled FTS, the flight safety system shall be designed to interrupt the flight of a launch vehicle in the launch phase

a) if the vehicle deviates from its predicted flight trajectory and it can become a threat to public safety, or

b) if the ability to accurately determine the location of the vehicle is lost, unless otherwise specified in the mission rules or range safety operational procedures.

6.4.8 All GSE that is a part of the FSS shall be maintained in a configuration control system.

7 Range tracking system requirements

7.1 Description

The range tracking system is an integral part of the flight safety system which assists flight safety operators in analyzing flight data and protecting the public from errant vehicle flights.

7.2 Requirements

7.2.1 All launch vehicles and sub-orbital vehicles shall have an approved means of tracking the vehicle's trajectory throughout the launch phase.

The RTS may use various ground-based or vehicle-incorporated tracking modes to provide accurate tracking information.

7.2.2 The RTS shall provide real-time data from which position and velocity can be determined.

7.2.3 The RTS shall be designed to operate under the worst predicted flight environment.

7.2.4 The RTS shall be protected from internal and external interference, such as electromagnetic energy, which could inhibit the operation of the system.

NOTE This protection can be achieved by physical or electrical protection systems or procedures.

7.2.5 The RTS shall provide real-time indications of position and velocity of the launch vehicle.

7.2.6 All RTS electrical flight components shall have their operating and storage life specified.

7.2.7 Electrical components used in any RTS mission shall not exceed their specified storage life.

7.2.8 Space-based translators or receivers, such as GPS, shall be independent of any on-board guidance system.

7.2.9 The RTS transponder system reliability shall be not less than 0,995 at the 95 % confidence level or shall be compliant with quantitative flight safety requirements as required in ISO 14620-2:2000 (see Clause 3) if the latter requirements are more stringent. This reliability should be established by analysis of all components and supporting test data.

7.2.10 The RTS space-based systems, such as GPS, reliability shall be not less than 0,999 at the 95 % confidence level, or shall be compliant with quantitative flight safety requirements as required in ISO 14620-2:2000 (see Clause 3) if the latter requirements are more stringent. This reliability should be established by analysis of all components and supporting test data.

7.2.11 The RTS ground equipment reliability shall be compatible with the reliability requirements of the flight hardware.

7.2.12 The RTS shall be tested, verified and certified by the director of range safety as capable of performing throughout the designated mission.

8 Telemetry data transmitting system requirements

8.1 Description

The telemetry data transmitting system is an integral part of the flight safety system which assists flight safety operators in analyzing flight data and protecting the public from errant vehicle flights.

8.2 Requirements

8.2.1 All launch vehicles shall have a TDTS to provide vehicle performance data to flight safety operators, except when pre-flight analysis establishes that the flight of the vehicle will not result in an unknown or hazardous impact area or dispersion.

8.2.2 The TDTS shall provide uninterrupted data from lift-off through orbital insertion, mission completion, or until range responsibility for safety has been fulfilled and terminated.

8.2.3 The TDTS shall acquire, store, process and provide data in real time throughout the launch phase.

8.2.4 Telemetry data shall include data relevant to position and tracking, FTS status, RTS status, vehicle performance, and engine and control information.

8.2.5 The TDTS shall provide real-time indications of malfunctions of the FSS.

8.2.6 Sufficient TDTS data shall be obtained to determine the adequacy of the flight safety system throughout flight and to support pre-flight and post-flight analyses.

8.2.7 The airborne telemetry system shall be compatible with the ground-based telemetry stations.

8.2.8 The TDTS shall be designed to operate under the worst predicted environments.

8.2.9 The TDTS shall be protected from internal and external interference, such as electromagnetic energy, which could inhibit the operation of the system.

8.2.10 All TDTS electrical flight components shall have their operating and storage life specified.

8.2.11 The use of TDTS electrical components in any mission shall not exceed the specified storage life.

8.2.12 The TDTS reliability shall be not less than 0,995 at the 95 % confidence level, or shall be compliant with quantitative flight safety requirements, as required in ISO 14620-2:2000 (see Clause 3), if the latter requirements are more stringent. This reliability should be established by analysis of all components and supporting test data. The TDTS ground equipment reliability shall be compatible with the reliability requirements of the flight hardware.

8.2.13 The TDTS shall be tested, verified, and certified by the director of range safety as capable of performing throughout the designated mission.

ICS 49.140

Price based on 7 pages