



Designation: F3550 – 22

# Standard Guide for Classifying Safety-Related Events<sup>1</sup>

This standard is issued under the fixed designation F3550; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This standard provides guidance on how to classify safety-related events in space flight. In addition, this guide defines the terms needed for classification, such as their severity and impact.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *FAA Standard:*<sup>2</sup>

49 CFR 830.2 Notification and Reporting of Aircraft Accidents or Incidents and Overdue Aircraft, and Preservation of Aircraft Wreckage, Mail, Cargo, and Records

## 3. Safety-Related Events List

3.1 *Abort, Flight*—The process to limit or restrict the hazards to public safety, and the safety of property, presented by a launch vehicle or reentry vehicle, including any payload, while in flight by initiating and accomplishing a controlled ending to vehicle flight.

3.2 *Abort, Contingency*—Cessation of vehicle flight during ascent or descent in a manner that does not jeopardize public health and safety, and the safety of property, in accordance with mission rules and procedures. Contingency abort includes landing at an alternative location that has been designated as a contingency abort location in advance of vehicle flight.

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee F47 on Commercial Spaceflight and is the direct responsibility of Subcommittee F47.05 on Cross-Cutting.

Current edition approved Jan. 1, 2022. Published February 2022. DOI: 10.1520/F3550-22.

<sup>2</sup> Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, <http://www.faa.gov>.

3.3 *Abnormality*—An event or measurement that is not in the normal statistical population for a system performance parameter; a new extreme for a system performance parameter; a load or system performance measurement that is outside the expected design limits (excludes test flight program data).

3.4 *Accident*—An event resulting in serious injury (as defined in 49 CFR 830.2) to a space flight participant or crew member, or serious injury to ground flight preparation staff or members of the public, or any damage that is not associated with the flight, and that is not located at the launch site or designated recovery area, or an unplanned event occurring during licensed activities, or the flight of a launch vehicle resulting in the known impact of a launch vehicle, its payload, or any of its components outside the designated impact limits or landing site, as appropriate, for expendable or reusable vehicles.

3.5 *Accident, Launch:*

(1) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the flight;

(2) An event that causes damage estimated to exceed \$25 000 to property not associated with the flight that is not located at the launch site or designated recovery area;

(3) An unplanned event occurring during the flight of a launch vehicle resulting in the impact of a launch vehicle, its payload, or any component thereof;

(i) For an expendable launch vehicle, outside designated impact limit lines; and

(ii) For a reusable launch vehicle, outside a designated landing site;

(4) For a launch that takes place with a person on board, a fatality or serious injury (as defined in 49 CFR 830.2) to a space flight participant or crew member.

3.6 *Accident, Reentry:*

(1) Any unplanned event occurring during the reentry of a reentry vehicle resulting in the impact of the reentry vehicle, its payload, or any component thereof, outside a designated reentry site;

(2) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the reentry;

(3) An event that causes damage estimated to exceed \$25 000 to property not associated with the reentry and not located within a designated reentry site; and

(4) For a reentry that takes place with a person on board, a fatality or serious injury to a space flight participant or crew member.

3.7 *Anomaly*—Any condition during licensed or permitted activity that deviates from what is standard, normal, or expected, during the verification or operation of a safety-critical system, subsystem, process, facility, or support equipment.

3.8 *Casualty*—Serious injury (as defined in 49 CFR 830.2) or death.

3.9 *Close Call/Near Miss*—An event in which there is no injury or only minor injury requiring first aid and no significant equipment/property damage/mission failure, but which possesses a potential to cause a mishap.

3.10 *Damage, Major*—Damage or failure that adversely affects the structural strength, performance, or flight characteristics of the vehicle, and that would normally require major repair or replacement of the affected component.

3.11 *Damage, Minor*—Damage other than major damage.

3.12 *Deviation*—A planned departure from the manufacturing requirements, a clearance, or operation of a component or system that is a documented acceptable best practice.

3.13 *Emergency*—A serious, unexpected, and often dangerous situation requiring immediate action by personnel or automated systems that can mitigate the consequences of the failure or limit the magnitude of the event.

3.14 *Escape*—Removal of occupants from an imminent catastrophic hazard.

3.15 *Failure*—An event, during operation or test, where a safety critical system or component becomes nonfunctional in an environment covered by its design performance envelope.

3.16 *Failure Condition*—A condition, or set of conditions, that affect the operation of a component, part, or element such that it can no longer function as intended.

3.17 *Hazard*—Equipment, system, operation, or condition with an existing or potential condition that may result in loss or harm, illness, or death of people, or damage to or loss of equipment or property.

3.18 *Hazardous Occurrence*—An event with an existing or potential risk that can lead to injury, illness, or fatality; damage to or loss of a system, equipment, or property; or damage to the environment.

3.19 *Hazard, Operational*—A hazard created by an operating environment or by an unsafe act.

3.20 *Hazard, System*—A hazard associated with a system and generally exists even when no operation is occurring.

3.21 *Incident*—An unplanned event, other than an accident, involving a malfunction of a safety-critical system (including those caused by human error), or a failure of the licensee's or permittee's safety organization, design, or operations.

3.22 *Incident, Launch*—An unplanned event during the flight of a launch vehicle, other than a launch accident, involving a malfunction of a flight safety system or safety-critical system, or a failure of the licensee's or permittee's safety organization, design, or operations.

3.23 *Incident, Reentry*—Any unplanned event occurring during the reentry of a reentry vehicle, other than a reentry accident, involving a malfunction of a reentry safety-critical system or failure of the licensee's or permittee's safety organization, procedures, or operations.

3.24 *Incorrect Function*—An event or occurrence with functional outputs outside of acceptable and expected ranges, incorrect functional output(s), when required, or functional outputs produced at the wrong time (inadvertent function).

3.25 *Injury or Illness, Severe*—Any injury or illness that: (1) requires hospitalization for more than 48 h, commencing within 7 days from the date an injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, or nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 % of the body surface.

3.26 *Injury or Illness, Minor*—An injury or illness that requires less than 48 h of hospitalization up to 7 days after the accident.

3.27 *Loss of Function*—The absence of functional output(s), when required.

3.28 *Medical/Clinical Event (Adverse)*—Any unexpected medical occurrence and/or injury, illness, disease, or death, incurred by the subject that has a causal relationship with the flight operation, activities, or environment.

3.29 *Mishap*—Any event, or series of events, associated with a licensed or permitted activity resulting in any of the following:

3.29.1 A fatality or serious injury;

3.29.2 A malfunction of a safety-critical system;

3.29.3 A failure of the licensee's or permittee's safety organization, safety operations, and safety procedures;

3.29.4 High risk, as determined by the FAA, of causing a serious or fatal injury to any space flight participant, crew, government astronaut, or member of the public;

3.29.5 Substantial damage, as determined by the FAA, to property not associated with licensed or permitted activity;

3.29.6 Unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity;

3.29.7 Unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;

3.29.8 The impact of hazardous debris outside the planned landing site or designated hazard area; or

3.29.9 Failure to complete a launch or reentry as planned.

3.30 *Near Midair*—An incident associated with the flight operation of a vehicle in which a possibility of collision occurs as a result of proximity, or a report is received from a vehicle or aircraft crew member stating that a collision hazard existed between two or more vehicles and aircraft, or an incident

associated with the operation of a vehicle in which the possibility of collision has been reported by one of the involved crew.

3.31 *Nominal*—In reference to launch vehicle performance, trajectory, or stage impact point, a launch vehicle flight where all vehicle aerodynamic parameters are as expected, all vehicle internal and external systems perform exactly as planned, and there are no external perturbing influences other than atmospheric drag and gravity.

3.32 *Off-Nominal*—An event or occurrence outside of nominal parameters.

3.33 *Preventive Action*—An action taken to prevent an anomaly from occurring.

3.34 *Proximate Cause*—The immediate event that sets off a series of events to cause an anomaly; also known as the direct cause.

3.35 *Risk*—The future impact of a hazard that is not controlled or eliminated, or a measure that accounts for both the probability of occurrence of a hazardous event, and the consequence of that event to persons or property.

3.36 *Safety-Critical System*—One whose functions are essential to safe performance or operation. A safety-critical system subsystem, condition, event, operation, process, or item is one whose proper recognition, control, performance, or tolerance is essential to system operation such that it does not jeopardize crew, occupant, or public safety.

3.37 *Safety Event*—Any occurrence that negatively impacts the safety of operations.

3.38 *Unsafe Activity or Condition*—An unsafe condition or act that is a safety or health hazard and/or hazardous act that could cause a close call or a mishap, although neither has occurred.

#### 4. Summary of Guide

4.1 This is a guide to classify safety-related events, their severity, and their impact.

4.2 This guide will be updated from time-to-time as industry requires and will inform future voluntary safety programs (VSP) and other safety enhancing tools to enhance commercial spaceflight industry safety.

#### 5. Significance and Use

5.1 This guide can be used to standardize how space flight operators classify safety-related events, including the severity and impact of those events. The framework made by this guide would benefit the creation of any future voluntary safety programs.

#### 6. Basis

6.1 Safety events' severity and impact definitions are informed by the following attributes:

6.1.1 The actual or potential severity of consequences of the event on life or property.

6.1.2 Departure from intended safety standards or margins of the event.

6.1.3 Departure from regulatory compliance.

6.1.4 The assumed probability of reoccurrence of the event, and a determination of whether:

6.1.4.1 Event is limited to a single occurrence by unique circumstances; or

6.1.4.2 An event represents a flaw in the system where it occurred; or

6.1.4.3 An event represents a new design or operational constraint to similar types of systems operated by other organizations.

#### 7. Classification of Event Severity

7.1 This section outlines and defines the different types of events based on their severity and impact.

7.1.1 *Catastrophic (Category I)*—An event causing death to crew and/or public, or complete safety-critical system loss.

7.1.2 *Critical (Category II)*—An event causing serious injury (as defined in 49 CFR 830.2) or illness to the crew or public, or major safety-critical system damage.

7.1.3 *Marginal (Category III)*—An event causing minor injuries or illness to the crew or public, or safety-critical system damage.

7.1.4 *Negligible (Category IV)*—An event causing less than minor injury or illness to the crew or public, or identifies less than minor safety-critical system damage.

#### 8. Keywords

8.1 abnormality; accident; contingency abort; damage; emergency; failure; flight abort; hazard; incident; injury; mishap; near miss; off-nominal; safety; voluntary safety program