



FAA AST Workshop: AC 450.173-1

Part 450 Mishap Plan – Reporting, Response, and Investigation Requirements

**Jesse Hanson
Annette Parks
18 November 2021**



Background on Advisory Circulars

Advisory Circulars (ACs) are being used to supplement streamlined regulations by the Federal Aviation Administration (FAA), Commercial Space Transportation (AST).

Their goal is to assist license applicants in two ways:

1. Further explain the meaning of the regulatory text and its intent/goal
2. Provide a means of compliance

The ACs are guidance, not a regulation, and compliance is voluntary.

To demonstrate compliance using an AC, the entire AC must be implemented. This means all “should” statements must be accomplished if an AC is used.

DISCUSSION IS ENCOURAGED

We have up to two hours today, with incremental periods for Q&A as we step through the chapters of the AC.

NOTE:

Answers by presenters are preliminary; a future revision of the AC is the official response.



Regulation § 450.173 Mishap Plan (Summary)

Section 450.173 – An operator must:

- Document responsibilities for personnel assigned to report and investigate mishaps.
- Document the roles and responsibilities of the launch operator and any site operator for reporting, responding to, and investigating mishaps during ground activities at the site.
- Immediately notify the FAA Washington Operations Center of a mishap that involves a fatality or serious injury in accordance with § 450.173(c)(1).
- Notify the FAA Washington Operations Center of a mishap that does not involve a fatality or serious injury within 24 hours in accordance with § 450.173(c)(2).

Regulation § 450.173 Mishap Plan (Summary)

Section 450.173 cont.

- Submit a written preliminary report to the FAA Office of Commercial Space Transportation within five days of any mishap in accordance with § 450.173(c)(3).
- Activate emergency response services, maintain hazard areas to protect the public, and preserve data and physical evidence following a mishap in accordance with § 450.173(d).
- Investigate root causes and report investigation results of a mishap in accordance with § 450.173(e).
- Identify and implement preventative measures to avoid recurrence of a mishap in accordance with § 450.173(f).
- Maintain records associated with a mishap in accordance with § 450.219(b).

Regulation § 450.173 Mishap Plan (Summary)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



SECTION 1: PURPOSE.

- This Advisory Circular (AC) provides guidance and an acceptable method, but not the only method, for developing a mishap plan under title 14 CFR § 450.173.
- This AC includes recommendations based on lessons learned from past mishaps and insights gained from reviews of mishap plan submittals.
- Section 450.173 states that an operator must report, respond to, and investigate mishaps, as defined in § 401.7, using a written plan that meets the requirements of this section.



SECTION 2: APPLICABILITY.

- The guidance in this AC is for launch and reentry vehicle applicants and operators, experimental permittees, and site operators required to comply with 14 CFR part 450.
- The material in this AC is advisory in nature and does not constitute a regulation. This AC describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The FAA will consider other means of compliance that an applicant may elect to present.



SECTION 3: APPLICABLE REGULATIONS AND RELATED DOCUMENTS.

- Related statute,
- Regulations,
- FAA documents, and
- Other government documents.



SECTION 4: DEFINITION OF TERMS.

For this AC, the terms and definitions from § 401.7, and this list, apply.

- **Preventative Measure.** An action taken to prevent or eliminate the technical and organizational root causes of a mishap in order to avoid a recurrence of the event.
- **Root Cause.** An event or condition, primarily associated with organizational factors, that resulted in the occurrence of a mishap, which if eliminated or modified, would have prevented the mishap from occurring. Typically, multiple causes contribute to a mishap.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.1: Mishap Plan Submittal.

- To satisfy the regulatory requirements of § 450.173, an applicant must submit a written mishap plan, or other written means, containing processes and procedures for reporting, responding to, and investigating a mishap in accordance with § 450.173(b) through (g).
- The processes and procedures outlined in an applicant's mishap plan should contain sufficient detail to allow for FAA evaluation and approval, and for the applicant to implement the plan in the event of a mishap.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.1: Mishap Plan Submittal. cont.

5.1.1: Other Written Means.

In lieu of submitting a written mishap plan, an applicant may submit other written documentation to demonstrate compliance with § 450.173. Other written means may include, but are not limited to, the following:

- Checklists;
- Electronic procedures;
- Service contracts (i.e. range emergency service contracts); or
- Agreements (i.e. including Launch Site Operator agreements).

SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.2: Document Markings.

5.2.1: Proprietary Information.

If an applicant's mishap plan contains information considered proprietary, trade secrets, or competition sensitive, the FAA recommends marking the plan in accordance with 14 CFR § 413.9.

5.2.2: Export Controlled Information.

If an applicant's plan contains technical data subject to International Traffic in Arms Regulations (ITAR), 22 CFR parts 120-130, the FAA recommends marking the plan accordingly.

SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.3: Document Applicability.

- To facilitate review of a mishap plan, the FAA recommends that applicants identify whether the mishap plan is applicable to a single launch vehicle type, configuration, location, or applicable to multiple vehicles and locations.

Section 5.4: Document History and Version Control.

- An applicant should include information regarding document's history and a version control table to record the details of changes over time.

Version	Description	Approval Authority	Approval Date
Revision history	Brief description of change	Printed name and title of individual approving change	Date revision is approved

SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.5: List of Abbreviations and Acronyms.

- To reduce confusion with like terms and terms unique to an organization, the mishap plan should include a list of abbreviations and acronyms used in the plan.



AC 450.173-1: Mishap Plan (Sections 1 – 5.5)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap?

- The FAA's mishap definition in § 401.7 describes nine (9) events that would constitute a mishap. The occurrence of any of these events during the scope of licensed or permitted activities constitutes a mishap and must be reported to the FAA in accordance with § 450.173(c).
- The following slides break down each of these criteria, providing examples and further clarification as required.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

1. A fatality or serious injury (as defined in 49 CFR 830.2);
 - Fatal Injury means any injury, which results in death within 30 days of the accident.
 - Serious Injury means any injury that:
 - Requires hospitalization for more than 48 hours, commencing within seven days from the date of the injury was received;
 - Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
 - Causes severe hemorrhages, nerve, muscle, or tendon damage;
 - Involves any internal organ; or
 - Involves second- or third-degree burns, or any burns affecting more than five percent of the body surface.

SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

2. A malfunction of a safety-critical system;
 - *Safety critical* means essential to safe performance or operation. A safety-critical system, subsystem, component, condition, event, operation, process, or item, is one whose proper recognition, control, performance, or tolerance, is essential to ensuring public safety and the safety of property.”
 - Section 450.107(d)(2), requires an applicant to identify all safety-critical systems. In addition, § 450.143(f)(1) requires an applicant to submit a list and description of each safety-critical system.
 - For example, the FAA would consider the failure of a flight safety system to activate when commanded, following a violation of flight safety rules to be a malfunction of a safety-critical system.

SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

3. A failure of the licensees or permittees safety organization, safety operation, or safety procedures.
 - “Failure of a safety organization” when an operator fails to complete an action expected or required by the safety organization, or when the organization stops functioning normally, such that it creates a public safety risk.
 - For example, the FAA would consider an operator’s failure to follow existing safety processes or procedures, thereby placing the public at risk, a failure of a safety organization, safety operation, or safety procedure. Additional examples include:
 - Failing to call a hold upon violation of launch commit criteria
 - A safety official failing to report potential safety matters to the mission director
 - The failure of an organization to recognize and mitigate a hazard, resulting in a public safety risk



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

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;
 - The FAA would consider any off-nominal event during pre-flight or flight operations that posed a high probability of fatality or serious injury to spaceflight participants, crew, government astronauts, or the public, to be “high risk.”
 - For example:
 - An event similar to a near miss in the aviation industry, or
 - Momentary loss of vehicle control in flight



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

5. Substantial damage, as determined by the FAA, to property not associated with licensed or permitted activity;
 - Eliminates previous \$25,000 threshold.
 - Determined on a case-by-case basis.
 - The FAA will base its determination on such factors as direct replacement cost, repair cost, and the property's intended use and functionality. Determination will include damage caused by debris impacts, toxic plumes, and fires ignited by the vehicle or its debris.
 - For example, The FAA would consider structural damage to public property exceeding 50 percent of its market value resulting from a failed launch attempt and subsequent post-impact fire to be substantial damage.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

6. Unplanned substantial damage, as determined by the FAA, to property associated with licensed or permitted activity;
 - FAA determination made on same basis as damage to property not associated with the activity.
 - Examples may include:
 - Major repair or replacement of launch facilities due to an unsuccessful launch attempt, including processing facilities, launch pads, or propellant tanks.
 - Damage adversely affecting the structural, performance, or flight characteristics of a launch or reentry vehicle which normally require major repair or replacement of the affected component.
 - In accordance with § 450.175(b), potential test-induced damages pre-coordinated with the FAA prior to licensed activities taking place are exempt from mishap classification. Applies only to licensed activities.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

7. Unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;
 - Under this criterion, the FAA intends to capture other events that may have future public safety implications.
 - For example, an authorized activity may result in the complete loss of a licensed or permitted vehicle in a remote and unpopulated area. Although the loss may not have resulted in fatalities, serious injuries, or public property damage on this occasion, it is important to find the root cause of the mishap. Failure to identify the cause of the mishap and implement corrective actions may endanger public safety during a future mission.
 - In accordance with § 450.175(b), potential test-induced damages pre-coordinated with the FAA prior to licensed activities taking place are exempt from mishap classification. Applies only to licensed activities.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

8. The impact of hazardous debris outside the planned landing site or designated hazard area; or
 - As defined in § 401.7, hazardous debris means any object or substance capable of causing a casualty or loss of functionality to a critical asset. Hazardous debris includes inert debris and explosive debris such as an intact vehicle, vehicle fragments, any detached vehicle component whether intact or in fragments, payload, and any planned jettison bodies.
 - This criterion applies to the impact of hazardous debris outside the planned landing site or hazard area. The occurrence of debris outside the hazard area that does not meet the definition of “hazardous debris” in § 401.7 is not a mishap, provided the anomalous event did not otherwise satisfy the remaining mishap definition criteria.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.6: What Constitutes a Mishap? cont.

Per § 401.7, a *Mishap* means any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

9. Failure to complete a launch or reentry as planned as reported in § 450.213(b).
 - The pre-flight reporting requirements of § 450.213(b)(2) requires a licensee to submit planned mission information, including the vehicle, launch site, planned flight path, staging and impact locations, each payload delivery point, intended reentry or landing sites including any contingency abort location, and the location of any disposed launch or reentry vehicle stage or component that is deorbited.
 - The failure to complete a launch or reentry as planned, as identified in the pre-flight report, constitutes a mishap. This criterion more accurately reflects the scope of activities that the FAA deems to be a mishap.



SECTION 5: OVERVIEW OF MISHAP PLAN.

Section 5.7: Incorporating Mishap Terms.

- To aid in determining if a mishap occurred and resulting reporting requirements, the mishap plan should incorporate the definition of a “mishap” under § 401.7, including the definitions of “fatal injury” and “serious injury” from 49 CFR 830.2.

Section 5.8: Reference Document Section.

- When applicable, the applicant should incorporate a reference document section in the mishap plan identifying all applicable reference documents or implemented plans in response to a commercial space transportation mishap.
- A copy of all referenced documents used to satisfy a mishap plan requirement should be included with the mishap plan submittal.
- As stated in AC 413.5-1, an applicant may provide the necessary evidence of compliance (such as data, plans, and other supporting documentation) by creating new documents that address the regulations specifically or by utilizing existing company documents with specific references to applicable sections.

AC 450.173-1: Mishap Plan (Section 5.6 – 5.8)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



SECTION 6: READINESS TO IMPLEMENT THE MISHAP PLAN.

- No specific mishap plan rehearsal requirements in Part 450.
- However, in accordance with § 450.155(a)(3), an operator must document and implement procedures to assess readiness to proceed with the flight of a launch or reentry vehicle, including readiness to implement the mishap plan required by § 450.173.



SECTION 6: READINESS TO IMPLEMENT THE MISHAP PLAN.

Section 6.1: Mishap Preparedness.

- An applicant should rehearse the procedures documented in the mishap plan to ensure safety-critical personnel, procedures, equipment, and services are prepared to implement the operator's plan.
- Rehearsal and review of those procedures will help operators assess the effectiveness of their mishap plan and identify deficiencies such as issues related to response, notification, public safety, or preservation of perishable mishap data.



SECTION 6: READINESS TO IMPLEMENT THE MISHAP PLAN.

Section 6.1: Mishap Preparedness. cont.

When assessing preparedness, operators should consider:

- Training for safety-critical personnel, including operator and emergency response personnel;
- Coordination of emergency response services with Federal Range or licensed launch or reentry site;
- Exercises (e.g. mishap simulations, table top exercises, full-scale exercises);
- Equipment availability (e.g. video/photographic equipment, including hand-held and overhead aerial-based), protective equipment, etc.);
- Supplies (e.g. go-kit items, evidence tags, notebooks, batteries, log books, etc.);
- Funding (e.g. travel, consultants, analyses, etc.);
- Debris storage locations; and
- Known requirements/special support equipment (e.g. cranes for large pieces of debris, transport equipment, etc.).

SECTION 7: RESPONSIBILITIES

In accordance with § 450.173(b), an operator's mishap plan must document responsibilities for personnel assigned to implement the requirements of § 450.173, including any personnel retained to conduct or participate in an investigation.

Section 7.1: Delegating and Sharing of Responsibilities.

- A mishap plan should identify each individual's roles and responsibilities within the applicant's organization, Federal Range, or a launch or reentry site operator.
- The mishap plan should document each individual's authority and define lines of communication.
- The delegation of roles and responsibilities may be shared between the applicant's organization and site operator, subject to mutual agreement.
- Applicants should describe roles and responsibilities using positions or titles, rather than information that are subject to change (e.g. names of staff).

SECTION 7: RESPONSIBILITIES

7.1.1: Roles and Responsibilities

- Consider who is responsible for:
 - Mishap reporting requirements of § 450.173(c);
 - Activating emergency response services;
 - Coordinating with external stakeholders;
 - Public Affairs coordination;
 - Evacuating and accounting for personnel;
 - Maintaining hazard area surveillance;
 - Securing the mishap site;
 - Securing data and physical evidence;
 - Documenting debris;
 - Implementing your mishap plan;
 - Conducting the investigation;
 - Reporting investigation results to the FAA; and
 - Identifying and implementing preventative measures.



SECTION 7: RESPONSIBILITIES

7.1.2: Using Checklists

- The FAA recommends incorporating the use of checklist for personnel responsible for implementing an operator's mishap plan.
- Checklists serve as a reminder of steps to complete when carrying out assigned tasks, ensure consistency, and reduce the likelihood of failure or omission of a critical step.
- Sample mishap notification checklist included in Appendix A.

<i>[Insert position responsible for completing tasks]</i> Mishap Notification Checklist		
In the event of a mishap...	Notify the FAA Washington Operation Center	
1. Involving a fatality or serious injury	Immediately	Phone: (202) 267-3333 Toll-free: (800) 322-3804 Email: 9-awa-ash-woc@faa.gov Fax: (202) 267-5289
2. Not involving a fatality or serious injury	Within 24-hours	
Submit a preliminary written report including the following information, as applicable, to...		FAA Office of Commercial Space Transportation
(i) Date and time of the mishap; (ii) Description of the mishap and sequence of events leading to the mishap, to the extent known; (iii) Intended and actual location of the launch or reentry or other landing on Earth; (iv) Hazardous debris impact points, including those outside a planned landing site or designated hazard area; (v) Identification of the vehicle; (vi) Identification of any payload; (vii) Number and general description of any fatalities or injuries; (viii) Description and estimated costs of any property damage; (ix) Identification of hazardous materials, as defined in § 401.7 of this chapter, involved in the event, whether on the vehicle, any payload, or on the ground; (x) Action taken by any person to contain the consequences of the event; (xi) Weather conditions at the time of the event; and (xii) Potential consequences for other similar vehicles, systems, or operations.		Within five days of the mishap to the assigned FAA Mishap Response Coordinator. 800 Independence Avenue SW Washington, DC 20591 202-267-7793 202-267-5450 (fax)
Note: The lack of information known should not delay the immediate notification.		

SECTION 8: MISHAP REPORTING REQUIREMENTS

Under § 450.173(c), an operator is required to notify the FAA Washington Operations Center (WOC) in the event of a mishap.

Section 8.1: Immediate Notifications (§ 450.173(c)(1))

- In the event of a mishap involving a **fatality or serious injury**, operators must immediately notify the FAA's WOC of the event per § 450.173(c)(1).
- The immediate notification should not hamper the activation of emergency response activities and a lack of information should not delay the notification.
- When notifying the WOC, the operator should provide their name and telephone number in the event additional information is needed.
- AC includes FAA WOC contact information and sample mishap plan text.

Note: Providing mishap notifications to FAA personnel on-site (e.g. FAA Safety Inspector) following a mishap does not satisfy the notification requirements of § 450.173(c) and does not remove the need to comply with all Part 450 reporting requirements.

SECTION 8: MISHAP REPORTING REQUIREMENTS

Section 8.2: 24-Hour Notifications. (§ 450.173(c)(2))

- In the event of a mishap **not involving a fatality or serious injury**, the operator must provide notification to the FAA WOC within 24-hours of the event .
- However, the FAA recommends notifying the FAA WOC as soon as possible following the mishap.
- When making the initial notification, the FAA recommends including the information from the five-day reporting requirements (§ 450.173(c)(3)) to the extent known at the time of notification. The lack of information should not delay the required 24-hour notification. If information is unknown, the operator may report it as such.

SECTION 8: MISHAP REPORTING REQUIREMENTS

Section 8.3: Five-Day Written Preliminary Report. (§ 450.173(c)(3))

- Within five days of a mishap, the operator must submit a written preliminary report to FAA AST in accordance with § 450.173(c)(3).
- The five-day report is a follow-up requirement designed to supplement the initial mishap notification once more detailed information is known.
- Following a mishap, the assigned FAA Mishap Response Coordinator (MRC) will contact the designated operator point of contact (POC). The FAA MRC will be the primary POC for all mishap-related information submittals, including the five-day report.



SECTION 8: MISHAP REPORTING REQUIREMENTS

Section 8.3: Five-Day Written Preliminary Report. (§ 450.173(c)(3))

Information requirements (AC Sections 8.3.1 – 8.3.12)

- Date and Time
- Description/Sequence of Events
- Intended and Actual Locations
- Hazardous Debris Impact Points
- Identification of the Vehicle & Payload
- Number and General Description of any Fatalities or Injuries
- Description/Estimated Cost of Property Damage
- Identification of Hazardous Materials
- Actions Taken to Contain the Consequences of the Event
- Weather Conditions
- Potential Consequences for other Similar Vehicles, Systems, or Operations

AC 450.173-1: Mishap Plan (Sections 6 – 8)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



SECTION 9: EMERGENCY RESPONSE

- In accordance with § 450.173(d)(1), an operator must activate emergency response services as necessary to protect property and public safety.
- An operator must also maintain hazard area surveillance and clearance as necessary to protect public safety, pursuant to § 450.173(d)(2).
- Lastly, an operator must contain and minimize the consequences of a mishap, preserve data and physical evidence, and implement agreements with government authorities and emergency response services as necessary under § 450.173(d)(3)–(5).

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services

- In accordance with § 450.173(d)(1), the mishap plan must contain procedures to ensure activation of emergency response services necessary to protect the public and property following a mishap.
- These procedures must address the evacuation and rescue of members of the public, taking into consideration debris dispersions, toxic plumes, and extinguishing fires in accordance.

Note: An operator launching from a Federal launch site need not execute and implement agreements to provide emergency response services if the Federal site already has the necessary coordination in place to satisfy the requirements of § 450.173.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.1: Identify Stakeholders.

- In accordance with § 450.173(b)(3), an operator must identify all stakeholders who may play a role, or have a stake in responding to an emergency.
- All parties involved in emergency response procedures should receive appropriate training relevant to their roles and any vehicle/site specific hazards they may encounter, including environmental hazards.

For example, employees are likely to be the first people aware of an emergency. They should know who to notify in the event of an emergency, how to secure a scene safely, when and where to evacuate, and be able to render basic first aid to coworkers, if needed.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services

Section 9.1.2: Coordinating with Local Emergency First Responders.

- Prior to the start of launch operations, an operator should coordinate with federal, state, and local authorities, and emergency first responders to familiarize them with their operations and any launch vehicle or site-specific hazards.
- Pre-coordination and cooperation with these entities is critical to the general safety of all parties involved.
 - Ensures the availability of appropriate emergency and personal protective equipment based on the operation's vehicle(s) or site hazards.
 - Ensures that responding fire departments are familiar with and equipped to respond to the specific hazards of their vehicle(s) or launch or reentry site.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.3: Coordination in Rural Areas.

- Many launch operations take place in remote areas far from large population centers.
- A large scale event could easily overwhelm a local volunteer fire department.
- In addition, local fire departments may not have the specialized equipment necessary to deal with unique hazards associated with such an event, such as hypergolic propellants.
- In such cases, it may be necessary to pre-position specialized assets nearby, or coordinate with a larger fire department further away that is equipped to handle hazardous materials.
- Opportunity to determine the level of support operator personnel will provide to first responders.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.4: Examples of Vehicle and Operational Hazards.

- Vehicle composites,
- Propellants,
- Oxidizers,
- Pressure vessels,
- Unexploded ordnance,
- Oxygen systems, and
- Batteries.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.5: First Responders Guide.

- In support of emergency response activities and recovery operations, an operator should develop a quick reference guide for rapid dissemination to first responders, including those outside the local area who may not be aware of the hazards associated with the launch vehicle.
- Such a guide may include:
 - Vehicle hazards, as previously noted,
 - The quantity and location of specific hazards (i.e. parachute mortars, hypergolic propellants, destruct charges, etc.),
 - Recommended standoff distances,
 - Appropriate personal protective equipment (PPE), and
 - Launch operator point of contact information.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.6: Emergency Response Guidebook (ERG).

- The ERG, as revised, is intended for use by first responders during the initial phase of a transportation incident involving dangerous goods or hazardous materials.
- Basic safety recommendations include approaching and securing the scene, identifying hazards, assessing the situation, obtaining help, and response.
- A digital copy of the ERG is available for download from the U.S. Department of Transportation, Pipeline, and Hazardous Materials Safety Administration's website at:
<https://www.phmsa.dot.gov/hazmat/erg/emergency-response-guidebook-erg>

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.7: Evacuating and Rescuing the Public.

- In accordance with § 450.173(d)(1)(i), the mishap plan must contain procedures for evacuating and rescuing members of the public, taking into account debris dispersions, toxic plumes, and far-field blast overpressure or distance focusing overpressure (DFO).
- An operator should determine the needed actions in coordination with local emergency responders, based on the information available.
- In some cases, the best option may be evacuation. In others, sheltering-in-place may be best.

Note: In preparing for potential evacuation or other emergency measures to prevent harm to the public, operators can also look to their toxic hazard release analyses prepared in accordance with §§ 450.139 and 450.187. These sections require operators to account for operational constraints and emergency procedures, such as evacuation plans or other constraints needed to protect the public from the effects of a toxic release from a vehicle or any of its components or payloads.

SECTION 9: EMERGENCY RESPONSE

Section 9.1: Activation of Emergency Response Services.

Section 9.1.8: Extinguishing Fires.

- In accordance with § 450.173(d)(1)(ii), the mishap plan must contain procedures for controlling and extinguishing fires caused by licensed activities.
- The allocation of roles and responsibilities shared between a launch operator and a site operator or federal range, including emergency response services, must be documented in the mishap plan or by other written means in accordance with § 450.173(b)(3).
- Under § 450.173(d)(5), operators may implement agreements with government authorities and emergency response services, as necessary, to satisfy the requirements of this section.

SECTION 9: EMERGENCY RESPONSE

Section 9.2: Hazard Area Surveillance and Clearance.

- In the event of mishap, in accordance with § 450.173(d)(2), the operator must maintain existing hazard area surveillance and clearance as necessary to protect public safety.
 - For example: through use of Notices to Mariners (NOTMAR) and Notices to Airmen (NOTAM), roadblocks, or facility access.
- These procedures can include:
 - Holding current clearance areas up until hazards are contained;
 - Adding surveillance or reducing hazard area surveillance based on the location and impact of the mishap; and
 - Expanding or reducing personnel as needed for different mishap scenarios.



SECTION 9: EMERGENCY RESPONSE

Section 9.3: Restricting Hazard Area until Debris Collection is Complete.

- In the event of a mishap that results in debris impacts on land, be prepared to maintain, expand, or establish a new ground hazard area(s) until all fires are extinguished, and the extent of any remaining hazards can be verified.
- Be aware that access to the launch pad and immediate surrounding area could remain restricted for several days while debris documentation and collection occurs, or while any relevant ground system evidence is collected, such as commodity samples.



SECTION 9: EMERGENCY RESPONSE

Section 9.4: Containing and Minimizing the Consequences of an Event.

Per § 450.173(d)(3), an operator is responsible for containing and minimizing the consequences of a mishap caused by its activities, to include securing impact areas to ensure no members of the public enter, safely disposing of hazardous materials, and controlling hazards at the site or impact area.



SECTION 9: EMERGENCY RESPONSE

Section 9.4: Containing and Minimizing the Consequences of an Event.

Section 9.4.1: Site Security.

- Use of roadblocks, checkpoints, fenced or roped off areas, and utilization of and cooperation with local authorities to protect the public from entering potentially hazardous areas.

Section 9.4.2: Disposal of Hazardous Materials.

- Per § 450.173(d)(3)(ii), the mishap plan must include procedures for proper disposal of hazardous materials, including contaminated water and soil, as applicable.
- Operators may not dispose of debris associated with a mishap until the FAA notifies the operator that the debris no longer needs to be retained in accordance with § 450.219(b).

SECTION 9: EMERGENCY RESPONSE

Section 9.4: Containing and Minimizing the Consequences of an Event.

Section 9.4.3: Controlling Access to a Mishap Site.

- Ensure that only authorized personnel can access a mishap site.



SECTION 9: EMERGENCY RESPONSE

Section 9.4: Containing and Minimizing the Consequences of an Event.

Section 9.4.4: Safing and Securing the Mishap Site.

- To contain and minimize the consequences of the mishap and maintain site integrity for investigation, the operator should safe and secure the mishap site as soon as possible.
 - Safing refers to the steps necessary to identify and remove hazards from the mishap site following documentation.
- The mishap plan should prioritize the removal of debris presenting a public safety hazard (e.g. unexploded ordnance).
- As necessary, establish a local hotline to allow members of the public to report debris locations for further collection.
- Mishap plan should identify who is responsible for securing site, identifying hazards, etc.

SECTION 9: EMERGENCY RESPONSE

Section 9.5: Preserving Data and Physical Evidence.

- Per § 450.173(d)(4), the mishap plan must contain procedures for collecting and preserving data and physical evidence.
- Identify the individual(s) responsible for collecting and preserving data and physical evidence.
 - These individuals should have sufficient technical knowledge and familiarity with the vehicle to identify and locate major vehicle systems, components, and hazards.
- Establish secured storage area.
- Store hazardous debris separately, with restricted access.
- Data examples include:
 - Debris, vehicle drawings, inspection and maintenance records, as-run procedures, vehicle close-out photos, telemetry data, voice and video recordings, witness statements, etc.

SECTION 9: EMERGENCY RESPONSE

Section 9.5: Preserving Data and Physical Evidence.

Section 9.5.1: Treatment of Debris.

- In general, an operator should not move or disturb debris without prior approval from the investigative authority, except to remove injured or trapped persons, to protect the wreckage from further damage, or to protect the public from injury.
- Prior to moving debris, the debris should be fully documented (measured, photographed, etc.), and location recorded for investigative purposes to the extent possible.

Note: As noted in the Streamlined Launch and Reentry Licensing Requirements Notice of Proposed Rulemaking, the FAA considers debris to be a physical record of the mishap's occurrence. Section 450.219(b) requires operators to maintain records, including debris, associated with a mishap until the FAA advises the licensee that the records need not be retained.

SECTION 9: EMERGENCY RESPONSE

Section 9.5: Preserving Data and Physical Evidence.

Section 9.5.2: Documenting Physical Evidence.

- When possible, systematically document, collect, protect, and preserve physical evidence.
- Collect evidence in a manner that permits future evaluation of how and why the mishap occurred.
- Consider the following:
 - Site documentation,
 - Cataloging debris,
 - Photographing debris,
 - Handling debris,
 - Tagging debris, and
 - Additional documentation, such as witness contact information, photos and videos taken by others, etc.

Note: See FAA Order 8020.11, as revised for additional considerations.

SECTION 9: EMERGENCY RESPONSE

Section 9.6: Implementing Agreements.

- Per § 450.147(a)(4) – *Mishap response*, an operator is responsible for entering into agreements with government authorities and emergency response providers, as necessary, to satisfy the requirements of § 450.173.
- Section 450.173(d)(5) requires operators to implement agreements with governments and emergency responders as necessary to satisfy § 450.173.

“As necessary”

An operator that launches from a Federal launch or reentry site, or licensed launch or reentry site is not required to execute agreements with local authorities if their launch or reentry site use agreement, as required by § 450.147(a)(1), has the necessary coordination in place to satisfy the requirements of § 450.173.



AC 450.173-1: Mishap Plan (Section 9)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



SECTION 10: MISHAP INVESTIGATION

Per § 450.173(e), the operator must investigate the root cause of the mishap and report the investigation results to the FAA.

Section 10.1: Investigation Procedures.

- The mishap plan should clearly document procedures for investigating the root cause of a mishap and for reporting results to the FAA.
- Per § 450.173(b), the mishap plan must clearly delineate responsibilities of personnel assigned to conduct an investigation and anyone retained to conduct, or participate in, any mishap investigation.
- The mishap plan procedures should address the following:
 - Composition of the investigation team,
 - Coordination with industry and government stakeholders,
 - Documented method for determining root cause,
 - Documented description of the investigative review process, and
 - Provide for periodic updates to the FAA during the course of an investigation, on a schedule as mutually agreed upon.



SECTION 10: MISHAP INVESTIGATION

Section 10.2: Root Cause Analysis.

- The root cause is the fundamental reason or underlying cause that, if eliminated, would mean the mishap would not have occurred.
- A mishap may have multiple root causes. To identify a root cause, it is necessary to look beyond the direct cause, to perform a root cause analysis and understand potential organizational deficiencies as well the technical issue.

SECTION 10: MISHAP INVESTIGATION

Section 10.2: Root Cause Analysis. cont.

- A root cause analysis should include the following steps, at a min:
 - Scope of the investigation – timeframe of the occurrence, systems involved, accepted risk items, etc.
 - Event timeline – timeline of the operations, up to and during event.
 - Root cause analysis process – investigation methodology (e.g., fault tree, fishbone, video analysis, etc.).
 - Causal Factor Process – iterative process to continue investigating areas of concerns until finding a true root cause (e.g., the “5-whys”).
 - Identify and implement preventive measures.
 - Preventative measures follow-up – an operator’s plan should include a process for following up to verify the implementation and effectiveness of preventative measures.



SECTION 10: MISHAP INVESTIGATION

Section 10.3: Reporting Investigation Results to the FAA.

- A mishap investigation report is meant to clearly and concisely document and convey the results of the investigation.
- The final, signed mishap investigation report must be submitted for FAA review, in accordance with § 450.173(e)(2).
- The FAA recommends use of the NASA mishap report format, as documented in NASA Procedural Requirements (NPR) 8621.1 – Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping, as revised, which includes the following sections:
 - Section 1: Signature pages, list of consultants, and executive summary.
 - Section 2: Narrative description and facts (what, when, where, how).
 - Section 3: Type of data gathered and data analysis.
 - Section 4: Findings.
 - Section 5: Recommendations.
 - Section 6: Minority Report.



SECTION 10: MISHAP INVESTIGATION

Section 10.4: FAA and National Transportation Safety Board (NTSB) Investigations.

- Based on the severity and consequences of the event, the FAA or NTSB may initiate an investigation to determine root or probable cause and make recommendations for avoiding a recurrence of the event.
- In the event of a Federal investigation, the operator will be a participant/party to the investigation.
- However, the operator may conduct a concurrent investigation in accordance with their approved mishap plan provided it does not interfere with the Federal investigation.

Note: In accordance with § 450.209(a), a licensee must allow access by, and cooperate with, Federal officers or employees or other individuals authorized by the FAA to observe any of its activities, or any of its contractors' or subcontractors' activities, associated with the conduct of a licensed launch or reentry.

SECTION 10: MISHAP INVESTIGATION

Section 10.5: Press Conferences and Press Releases.

- All operator press conferences and press releases related to a commercial space transportation mishap should be coordinated with the FAA's Office of Communication prior to release.
- Press conference coordination should take place with enough advanced notification to allow for FAA participation as required.

Note: Per existing procedure, prior to each FAA-authorized launch or reentry, the FAA pre-coordinates media point of contact information between the operator, FAA Office of Communication, and FAA Office of Commercial Space Transportation in the event a media response is required.

SECTION 10: MISHAP INVESTIGATION

Section 10.6: Release of Investigative Information.

- In the event of a Federal investigation, the release of investigative information should be coordinated with the lead investigative agency.

Section 10.6.1: FAA Investigations.

- In the event of an FAA investigation, the FAA's Office of Communications is responsible for the release of information to the public. All operator press releases should be coordinated with the FAA's Office of Communication in coordination with the Office of Commercial Space Transportation prior to release.

Section 10.6.2: NTSB Investigations.

- In the event of an NTSB investigation, the release of information to the public must be coordinated with the NTSB Investigator in Charge in accordance with 49 CFR § 831.13(c). Refer to 49 CFR § 831.13, Provision and dissemination of investigative information, for more details.

SECTION 11: PREVENTATIVE MEASURES

- Per § 450.173(f), an operator must identify and implement preventative measures for avoiding the recurrence of a mishap.
- These measures actions should not only address technical root causes, but also any organizational root causes.
- Unless otherwise approved by the FAA, an operator must implement preventative measures prior to the next flight.

Mishap plans should take into consideration how an operator will:

- Identify and approve preventative measures and corrective actions,
- Validate that proposed preventative measures and corrective actions are correct, complete, and feasible,
- Timeline for implementing preventative measures and corrective actions, and
- Implement and verify that preventative measures and corrective actions are effective.



SECTION 12: MISHAP RECORDS

12.1: Records Retention.

- Under 14 CFR § 450.173(g), operators are required to maintain all records associated with a mishap in accordance with § 450.219(b).
- An operator must retain and make available to Federal officials for inspection or copying all records covered by § 450.219(b) until completion of any Federal investigation and notification from the FAA that the records need not be retained.

12.2: Debris Disposal.

- The FAA considers debris to be a physical record of a mishap occurrence, coordinate with FAA prior to disposal.

12.3: Incorporating Recordkeeping into the Mishap Plan.

- The FAA recommends incorporating § 450.219 into the mishap plan to ensure all required records and physical evidence are properly maintained.

SECTION 13: APPLICATION REQUIREMENTS

- Per § 450.173(h), an applicant must submit a plan or other written means satisfying these requirements of this section.
- A plan developed in accordance with this AC satisfies the requirements of 14 CFR § 450.173.

Note: In addition to a mishap plan, per § 450.189(e) – *Emergency procedures*, an operator must have general emergency procedures that apply to any emergencies not covered by the mishap plan of § 450.173 that may create a hazard to the public.



Appendix A

Appendix A: Sample Mishap Notification Checklist Template.

<i>[Insert position responsible for completing tasks]</i> Mishap Notification Checklist		
In the event of a mishap...	Notify the FAA Washington Operation Center	
1. Involving a fatality or serious injury	Immediately	Phone: (202) 267-3333 Toll-free: (800) 322-3804 Email: 9-awa-ash-woc@faa.gov
2. Not involving a fatality or serious injury	Within 24-hours	Fax: (202) 267-5289
Submit a preliminary written report including the following information, as applicable, to...		FAA Office of Commercial Space Transportation
<ul style="list-style-type: none"> (i) Date and time of the mishap; (ii) Description of the mishap and sequence of events leading to the mishap, to the extent known; (iii) Intended and actual location of the launch or reentry or other landing on Earth; (iv) Hazardous debris impact points, including those outside a planned landing site or designated hazard area; (v) Identification of the vehicle; (vi) Identification of any payload; (vii) Number and general description of any fatalities or injuries; (viii) Description and estimated costs of any property damage; (ix) Identification of hazardous materials, as defined in § 401.7 of this chapter, involved in the event, whether on the vehicle, any payload, or on the ground; (x) Action taken by any person to contain the consequences of the event; (xi) Weather conditions at the time of the event; and (xii) Potential consequences for other similar vehicles, systems, or operations. 		Within five days of the mishap to the assigned FAA Mishap Response Coordinator. 800 Independence Avenue SW Washington, DC 20591 202-267-7793 202-267-5450 (fax)
Note: The lack of information known should not delay the immediate notification.		



AC 450.173-1: Mishap Plan (Sections 10 – App A)

Discussion



**Floor open for questions/comments
Either verbally or via comments**



Where to Find Part 450 ACs

Links to ACs:

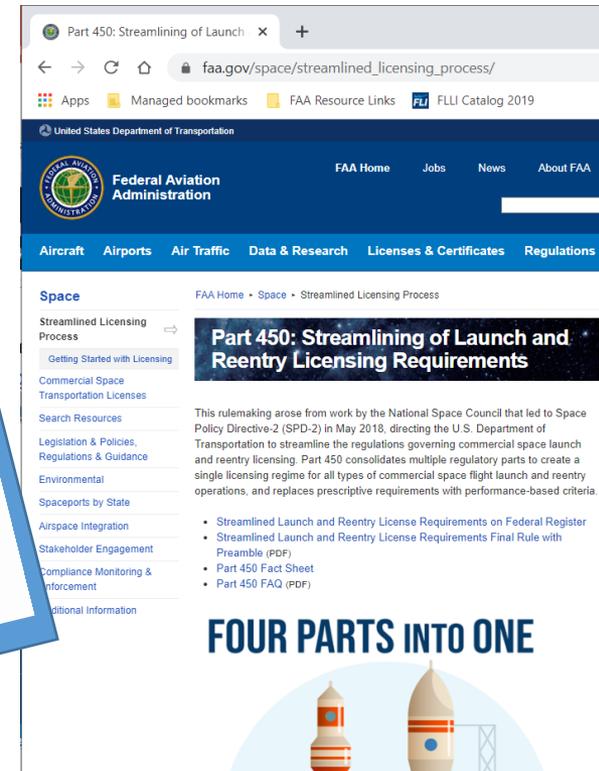
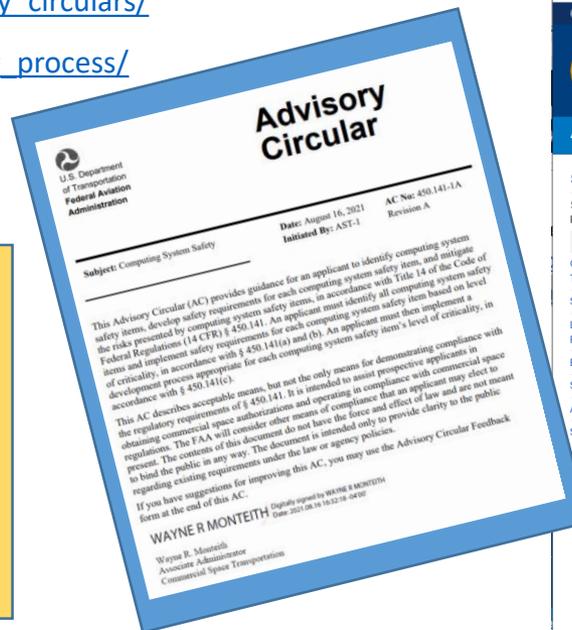
https://www.faa.gov/regulations_policies/advisory_circulars/

https://www.faa.gov/space/streamlined_licensing_process/

To ensure your comments and questions are considered in a future revision of the AC, please submit via the Feedback Form:

<https://www.faa.gov/documentLibrary/media/Form/FAA1320-73.pdf>

Attachments to this form are welcome.



Upcoming Workshops

- TBD

