U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Definition of Launch and Scope of a Vehicle Operator License

Date: 09/29/2022 **AC No:** 450.3-1
Initiated By: AST-1

This Advisory Circular (AC) provides guidance on the Federal Aviation Administration's (FAA) definition of "launch" in Title 14 Code of Federal Regulations (14 CFR) § 401.7 and the determination of the scope of a license issued under § 450.3, particularly the beginning of a launch at a United States (U.S.) launch site. Specifically, this document clarifies and provides guidance on what constitutes an activity involved in the preparation of a launch vehicle or payload for launch (§ 401.7), and when hazardous pre-flight operations commence at a U.S. launch site that may pose a threat to the public (§ 450.3(b)(1)). This document also provides guidance on what application information regarding hazardous pre-flight operations at a U.S. launch site is sufficient for the FAA to determine the scope of activities authorized under the license.

The FAA considers this AC guidance on the regulatory requirements of § 450.3(b)(1) and (d). The guidance contained in this AC addresses the determination of the beginning of a launch. Updates of this AC, at a later date, will address the end of launch and the beginning and end of reentry of a commercial launch or reentry vehicle. This AC is intended to assist prospective applicants in obtaining commercial space authorizations and operating in compliance with commercial space regulations. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.

KELVIN B COLEMAN Digitally signed by KELVIN B COLEMAN
Date: 2022.10.03 11:59:29 -04'00'

Kelvin Coleman
Associate Administrator
FAA, Office of Commercial Space Transportation

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1 PURPOSE.

This Advisory Circular (AC) provides guidance on the Federal Aviation Administration's (FAA) definition of "launch" in § 401.7, and the determination of the beginning of a launch at a United States (U.S.) launch site, per § 450.3(b)(1) and (d). Specifically, this document clarifies and provides guidance on what constitutes an activity involved in the preparation of a launch vehicle or payload for launch (§ 401.7), and when hazardous pre-flight operations commence at a U.S. launch site that may pose a threat to the public (§ 450.3(b)(1)). The authority to issue this guidance is Title 51 United States Code (U.S.C.) § 50905. The intent of this AC is to provide clarity on which factors the FAA takes into consideration when making its determination regarding which activities constitute preparation of a launch vehicle or payload for launch, or which pre-flight operations constitute the beginning of launch in § 450.3(b)(1). An operator cannot independently determine which activities meet this standard. For this reason, it is important for an operator to provide as much information in its application as available on its operations so that the FAA can determine when launch begins for a given license.

2 APPLICABILITY.

2.1 The guidance in this AC is for operators who apply for a vehicle operator license under part 450. The guidance in this AC is for those seeking a license, or a licensed operator seeking to modify an existing vehicle operator license.

2.2 The material in this AC is advisory in nature and does not constitute a regulation. This guidance is not legally binding in its own right and the FAA will not rely upon this guidance as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with this guidance document (as distinct from existing statutes and regulations) is voluntary only, and nonconformity will not affect rights and obligations under existing statutes and regulations.

2.3 The material in this AC does not change or create any additional regulatory requirements, nor does it authorize changes to, or deviations from, existing regulatory requirements.

3 APPLICABLE REGULATIONS AND RELATED DOCUMENTS.

3.1 Related Statute.

- 51 United States Code (U.S.C.) Subtitle V, Chapter 509.

3.2 Related FAA Commercial Space Transportation Regulations.

The following 14 CFR regulations must be accounted for when showing compliance with § 450.3. The full text of these regulations can be downloaded from the U.S. Government Printing Office e-CFR. A paper copy can be ordered from the Government Printing Office, Superintendent of Documents, Attn: New Orders, P.O. Box 371954, Pittsburgh, PA, 15250-7954.

- Section 401.7, *Definitions*.
- Section 450.101, *Safety criteria.*
- Section 450.155, *Readiness.*
- Section 450.179, *Ground safety—general*.
- Section 450.181, *Coordination with a site operator*.
- Section 450.185, *Ground hazard analysis*.
- Section 450.209, *Compliance monitoring*.
- Section 450.219, *Records*.

3.3 Related FAA Advisory Circulars.

FAA Advisory Circulars (are available through the FAA website, http://www.faa.gov).

- AC 450.101-1A, *High Consequence Event Protection*, Safety Criteria, dated May 5, 2021.
- AC 450.179-1, *Ground Safety*, dated September 22, 2021.

Note: The documents referenced in this section refer to the current revisions or regulatory authorities' accepted revisions.

4 DEFINITION OF TERMS.

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

4.1 Component

A piece of equipment, a piece part, or a group of piece parts that are viewed as an entity for purposes of an analysis or test.

4.2 Stage

A portion of a vehicle that contains propulsive systems used to propel the vehicle until thrust is exhausted or shut down in order to achieve a planned state vector.

5 ACRONYMS.

AC – Advisory Circular

CFR – Code of Federal Regulations

FAA – Federal Aviation Administration

FSS – Flight Safety System

OMB – Office of Management and Budget

U.S.C. – United States Code

U.S. – United States

6 SCOPE OF LICENSE.

The FAA is responsible for licensing commercial space launches and reentries, as well as licensing launch and reentry sites under 51 U.S.C. Subtitle V, Chapter 509. The following sections focus on the definition of "launch," per § 401.7, and the scope of a launch license, per § 450.3(b)(1). The FAA must determine when a launch license begins. An applicant must identify pre- and post-flight ground operations at a U.S. launch site sufficient for the Administrator to determine the scope of activities authorized under the license per § 450.3(d). This should include any operations that are potentially hazardous to the public. Once the FAA has a clear understanding of the applicant's concept of operations, the FAA will determine the starting point for the beginning of launch. In order to make a determination on when a license begins, the FAA uses the information provided by the vehicle operator. This AC provides clarity on how this determination is made and what information vehicle operators should provide to comply with § 450.3(d).

7 BEGINNING OF A LAUNCH.

The FAA makes a determination regarding the beginning of licensed launch activities by applying a two-step inquiry:

1. The FAA identifies activities that meet the definition of "launch" in § 401.7. Specifically, the FAA identifies activities involved in the preparation of a launch vehicle or payload for launch, when those activities take place at a launch site in the United States.
2. Once the FAA has identified the activities involved in preparation of a launch vehicle or payload for launch, the analysis moves to the standard articulated in § 450.3(b)(1). According to this section, licensed activities begin when hazardous pre-flight operations commence at a U.S. launch site that may pose a threat to the public. Hazardous pre-flight operations that may pose a threat to the public include, but are not limited to, pressurizing or loading of propellants into the vehicle or launch system, operations involving a fueled launch vehicle, the transfer of energy necessary to initiate flight, or any hazardous activity preparing the vehicle for flight. 14 CFR § 450.3(b)(1). Hazardous pre-flight operations do not include the period between the end of the previous launch and launch vehicle reuse, when the vehicle is in a safe and dormant state. 14 CFR § 450.3(b)(1).

7.1 Launches agreed to by the Administrator.

Licensed launch activities will begin with the first activity that both qualifies as "launch" under § 401.7 and meets the standard in § 450.3(b)(1), unless otherwise agreed to by the Administrator in accordance with § 450.3(a).

7.2 **Launches at non-U.S. Sites**.

At a non-U.S. launch site, launch begins at ignition or at the first movement that initiates flight, whichever occurs earlier, consistent with § 450.3(b)(2).

7.3 **Preparation of a Launch Vehicle or Payload for Launch**.

As mentioned previously, the FAA's threshold inquiry is which activities meet the definition of "launch" in § 401.7. Specifically, the FAA identifies activities involved in the preparation of a launch vehicle or payload for launch, when those activities take place at a launch site in the U.S., per § 401.7. The FAA considers an activity to be in preparation of a launch vehicle for launch if it involves the assembly, integration, or processing of a launch vehicle for the purpose of preparing it for flight. Additionally, the integration of a payload may constitute preparation of a payload for launch.

7.4 **Activities That Are Not Preparation of a Launch Vehicle or Payload for Launch**.

The FAA generally does not license developmental testing or manufacturing performed by operators, because these operations do not constitute activities involved in the preparation of a launch vehicle or payload for launch, consistent with the definition of "launch" in § 401.7.[1]

7.4.1 Developmental Operations.

Developmental operations are conducted to validate system and component designs against expected operating environments and performance requirements, and to ensure quality in manufacturing. Vehicle development testing operations may include, but are not limited to: stress testing of structural assemblies; pressure and temperature testing of tanks and other vessels; shock and vibrational testing of electronics; and static firings of engines and stages.

7.4.2 Manufacturing Operations.

Manufacturing operations turn processed materials into vehicle components using industrial activities. These activities may include the welding or riveting of parts together, the assembly of structures, the soldering of electronics, and the layering of composites, among others. Production of fuel tanks, engines, stage structures, and fairings are examples of manufacturing operations.

[1] It should be noted that certain activities may fall under the jurisdiction of other regulatory agencies that are responsible for safety, such as the Occupational Safety and Health Administration (OSHA). Section 450.13 states that the issuance of a vehicle operator license does not relieve a licensee of its obligation to comply with all applicable requirements of law or regulation that may apply to its activities. State and local laws governing industrial and construction work may apply to a licensee's activities, including zoning laws, fire protection laws, and laws governing the use and handling of hazardous materials.

7.4.4 Developmental and Manufacturing Operations at a U.S. Launch Site.

7.4.4.1 Co-located Processes.

Traditionally, vehicle operators create a single vehicle using a single set of parts, or they may develop vehicles in a serial manner using a stable and proven design in a manner that is similar to an automobile assembly line. Vehicles are built in this manner at a company facility or at multiple company sites. The commercial space vehicle's components may arrive at a launch site as fully assembled stages. At the launch site, they are integrated (stacked vertically or mated horizontally) either on the pad itself or in an adjacent facility and then moved to the launch pad.

7.4.4.2 Installation of Payloads and Flight Safety System (FSS) Components.

Integrated payloads and FSS components can be installed either before or after the stages are integrated, depending on the design of the vehicle. While stages may arrive at the site weeks or months in advance, final pre-flight testing – in the form of rehearsals and sometimes static fires – may happen just days before flight.

7.4.4.3 Testing and Installation of Components and Subsystems.

More recently, some vehicle operators are implementing a different approach, where collections of components and systems may be manufactured and assembled into a vehicle at the launch site, and pre-flown components or stages may be refurbished. This approach is sometimes used when the vehicle or its primary components are too large to readily transport. These operators collect a large number of smaller components and systems (e.g., engines, avionics boxes, thermal tiles) developed elsewhere or at the launch site, and attach them to multiple sets of larger components manufactured at the launch site, like tanks, thrust assemblies, and body panels. Testing on these components and subsystems and the vehicle, as a whole, is performed at the launch site. The launch site is where manufacturing, assembling, refurbishing, and testing processes turn collections of components and systems into a vehicle.

7.4.4.4 Concurrent Process Flows.

Companies using concurrent manufacturing and test process flows at a launch site can iteratively vet aspects of their designs because all of the materials, tools, and technicians are present at the same location where these activities are conducted. As sets of larger components and systems are assembled from smaller ones, they undergo developmental testing to validate their structural integrity and successful integration.

7.4.4.5 Design Changes resulting from Test Results

At significant milestones, the results of testing are reported and result in design improvement and manufacturing improvements for the next set of components and systems. Thus, the static firing of one thrust assembly can inform or confirm the configuration of the next assembly, the proofing of one set of tanks can inform the manufacturing of the next set, and so on. Successful tests confirm aspects of the design while test failures drive design changes.

7.4.4.6 Developmental Test Configurations.

For a company using the approach described in paragraph 7.3.4.5, the relative timing of iterative activities can create collections of components and systems with different pedigrees. Some components and systems represent the current design and some represent past or future designs. These components and systems are collected at various times in different combinations to support different test objectives. For example, an ignition sequence test could include some components intended to fly and others that are not intended to fly, but happen to be available to support the test at the time it is scheduled. In this manner, a given assembly of components and systems represents a developmental test configuration, not a launch vehicle.

7.4.4.7 Clear and Tangible Transition to Licensed Activities.

During the transition from vehicle development to preparation of a launch vehicle or payload for launch, milestones signify a transition from activities that do not require a license to activities that do require a license. The FAA expects clear and tangible indicators marking these milestones. Since tests like proofing and static fires can be used for both development and launch preparation, and because they can be conducted on collections of components of varying pedigrees, this type of test is not always a clear indicator. Again, when determining whether an activity is an activity involved in the preparation of a launch vehicle or payload for launch, per § 401.7, the FAA will look to whether the activity involves the assembly, integration, or processing of a launch vehicle for the purpose of preparing it for flight. One indicator of the completion of developmental testing is the installation of flight essential components necessary to achieve a successful mission and protect the public from the associated flight hazards. Flight essential components can include the installation of key components such as functional avionics components, the integration of vehicle stages, or the installation of components of an FSS.

7.5 **Hazardous Pre-flight Operations that may Pose a Threat to the Public.**

To constitute beginning of launch, hazardous pre-flight activities must be preparing the vehicle for flight and therefore meet both prongs of the two-prong test in 7.0 of this AC. In order to meet § 450.3(b)(1), an operation must be: (1) hazardous; (2) a pre-flight operation; (3) at a U.S. launch site; and (4) an activity that may pose a threat to the public. Each of these elements is explained below:

1. Hazardous. Any real or potential condition that could cause death or serious injury.
2. Pre-flight operation. Pre-flight operations may occur at any point before flight. There is no time limit on when a licensed activity may occur prior to the flight of the vehicle.
3. At a U.S. launch site. A U.S. launch site is a spaceport or complex where launches and/or reentries are capable of taking place located in the U.S. mainland or in U.S. territories.
4. An activity that may pose a threat to the public. An activity can be considered to be a "threat to the public" if the hazardous operation can reasonably be expected to pose a threat to the public.[2]

7.5.1 Pressurizing or Loading Propellants into the Vehicle.

Section 450.3(b)(1) also contains a list of hazardous pre-flight operations that may pose a threat to the public. Hazardous pre-flight operations that may pose a threat to the public include, but are not limited to, pressurizing or loading of propellants into the vehicle, operations involving a fueled launch vehicle, the transfer of energy necessary to initiate flight, or any hazardous activity preparing the vehicle for flight.

7.5.2 Examples of Pressurizing Propellants and Cryogenic Loading.

Loading propellants is a hazardous operation because there are processes in the act of fueling a tank that can result in spills and mixing of fuels and oxidizers resulting in fire or explosion. Fuels and oxidizers kept static in containers far apart pose little hazard; however, during fuel loading, the liquids are moving through pipes and into tanks on the vehicle. There is a chance that fuel may ignite during loading resulting in a fire or explosion. Pressurizing propellants may include activities such as loading of cryogenic fuels into vehicle components such as engines, fuel tanks, oxidizer tanks, and related vehicle structures used to hold these parts and connect them to the launch pad. Cryogenic loading involves fueling a tank with liquefied gas, such as liquid oxygen, at very low temperatures. Hazards associated with cryogenic fuels include exposure to extreme cold, asphyxiation, fire, and explosion. Cold exposure can have adverse health effects such as skin burns and frostbite. Asphyxiation can cause death. Flammable gases

[2] Public means, for a particular licensed or permitted launch or reentry, people that are not involved in supporting the launch or reentry and includes those people who may be located within the launch or reentry site, such as visitors, individuals providing goods or services not related to launch or reentry processing or flight, and any other operator and its personnel. 14 CFR 401.7

such as hydrogen and methane can burn or explode when mixed with air even at very low concentrations. Fire can threaten the safety of people and property. Explosions can occur during cryogenic loading when there is inadequate venting, or pressure relief, and the pressure increases to the point where a boiling liquid expanding vapor explosion[3] takes place. An explosion can cause hazards from debris and overpressure. There is also a risk of explosion by mixing fuels and oxidizers due to tank failure.

7.5.3 Operations Involving a Fueled Launch Vehicle**.**

Operations involving a fueled launch vehicle may constitute hazardous pre-flight activity. This is because operations involving a fueled launch vehicle could result in an inadvertent launch or explosion. An inadvertent launch could result in the flight of an uncontrolled vehicle not having a flight safety system. This could impact the safety of the public. An explosion creates debris and overpressure hazards. Examples of operations involving a fueled launch vehicle may include static fires and wet dress rehearsals.

7.5.3.1 Static Fire.

Static fires are used to ensure the structural integrity of the full vehicle, particularly its critical joints and interfaces between final assemblies. They also ensure the successful integration of all the vehicle's critical systems, demonstrated by the time-sequenced commanding of various actions; the measured flow of propellants and other consumables through the various tanks, channels, and connectors up to and at full capacity; and the full range of movement of mechanical components like valves, thrust vector control systems, and fins. Because a static fire is "an operation involving a fueled launch vehicle," and therefore meets the standard in § 450.3(b)(1), if the static fire is also in preparation of a launch vehicle for launch, per § 401.7, that activity is considered a licensed activity. A static fire may not constitute the beginning of licensed activities if it is part of a developmental test because it is not in preparation of a launch vehicle for launch, consistent with § 401.7. For example, a static fire used to test an engine configuration may not be a licensed activity because it is not preparing the launch vehicle for launch. The tested engine configuration may not be the one flown. On the other hand, a static fire used to finalize parameters used for flight may be a licensed activity because the static fire is being used to prepare the launch vehicle for launch.

[3] A boiling liquid expanding vapor explosion is an explosion caused by the rupture of a vessel containing a pressurized liquid that has reached temperature above its boiling point. Because the boiling point of a liquid rises with pressure, the contents of the pressurized vessel can remain liquid as long as the vessel is intact. If the vessel's integrity is compromised, the loss of pressure and dropping boiling point can cause the liquid to rapidly convert to a gas and expand rapidly, resulting in the explosion of the vessel.

7.5.3.2 Wet Dress Rehearsals.

Similarly, a wet dress rehearsal, which involves filling a vehicle with propellants, may be considered a licensed operation if it is involved in the preparation of a launch vehicle for launch, per § 401.7, and it meets the standard in § 450.3(b)(1). Wet dress rehearsals that are used to train personnel or check vehicle operation that are not preparing the vehicle for launch may not be considered licensed operations.

7.5.4 Transfer of Energy Necessary to Initiate Flight**.**

The transfer of energy necessary to initiate flight is a hazardous pre-flight operation that may pose a threat to the public because it usually results in the flight of the vehicle. Traditionally, this transfer of energy involves chemicals that burn and produce thrust through gas expansion. As technology advances, other systems that transfer energy to initiate flight have been developed that do not involve chemicals. Railguns using electromagnetic energy and launchers using centrifugal force are examples of such systems.

7.5.5 Any Hazardous Activity Preparing the Vehicle for Flight.

While § 450.3(b)(1) lists the most common hazardous pre-flight operations that may pose a threat to the public, there may be other hazardous pre-flight operations that fall under the scope of § 450.3(b)(1). These hazardous pre-flight operations are conducted in preparation for flight and may occur well before flight and up until the initiation of flight. For these operations, every component of the vehicle is a component intended for flight because it represents the current flight design and has successfully passed prior developmental tests.

Note: Examples of hazardous activities preparing the vehicle for flight may include: payload integration to the launch vehicle; pneumatic and cryogenic load testing; installation of ordnance; installation of flight termination system components into the vehicle; lifting of an integrated vehicle or of vehicle components; pin pulls; and stacking the vehicle's stages. Because there are a number of different hazardous activities that may constitute the beginning of launch, it is not possible to list all hazardous pre-flight operations that meet § 450.3(b)(1).

7.6 **Vehicles in a Safe and Dormant State**.

The FAA will not consider activities occurring between launches of reusable vehicles as hazardous pre-flight activities if the vehicle is in a safe and dormant state, per § 450.3(b)(1). Generally, a launch system is in a safe and dormant state when it is not undergoing the pressurization or loading of propellants, a transfer of energy necessary to initiate flight, operations involving a fueled launch vehicle, or any hazardous activity preparing the vehicle for flight.

8 FACTORS USED TO DETERMINE SCOPE OF LICENSE AS AGREED TO BY THE ADMINISTRATOR.

Section 450.3(a) states that a vehicle operator license identifies the scope of authorization defined in paragraphs (b) and (c) of that section or as agreed to by the Administrator. This means that even if an activity meets the standard in § 450.3(b)(1), an applicant may request and the FAA may agree that a different activity, either before or after, constitutes the beginning of launch. The FAA retains the ability to determine that licensed oversight is unnecessary for certain activities if the Administrator determines that they do not jeopardize public health and safety, safety of property, and the national security and foreign policy interests of the United States.

8.1 Requests by an Operator.

An operator may request to begin the license at a particular activity. An applicant wishing to deviate from the scope of license parameters laid out in § 450.3(b) or (c) would typically discuss the deviation during pre-application consultation. The FAA would only allow a deviation for unique operations where the scope of license continued to cover those hazardous launch activities identified by statute. The request should be supported by rationale and information that allows the FAA to make a determination to accept or deny the request.

9 APPLICATION REQUIREMENTS.

In accordance with § 450.3(d), an applicant must identify pre- and post-flight ground operations at a U.S. launch site sufficient for the Administrator to determine the scope of activities authorized under the license. In order for the FAA to determine which launch operations are licensed and which are not, the FAA needs information from the applicant. An applicant should provide a comprehensive list of activities leading to liftoff and provide updates to the FAA whenever changes are made to the list. An applicant may indicate which activities it believes are licensable but should not withhold activities that it thinks are not licensable.

9.1 The FAA will make a determination on the requirement for a license during the pre-application process and expects to discuss its determination with the applicant. The FAA realizes that an applicant may not have its launch process fully defined, but the operator should provide as much information as is available.

9.2 After determining the scope of license under § 450.3, a transmittal letter with accompanying approval documentation will be forwarded to the applicant. The FAA will also inform the applicant in writing of a rejection or delayed launch determination. Incomplete information or lack of information could result in a conservative determination of when the license begins, such as when a vehicle arrives at the launch location.

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