



FAA
Commercial Space
Transportation

Experimental Permit Program
Report to COMSTAC

May 2008



What Is An Experimental Permit?

An experimental permit is an authorization issued by the Federal Aviation Administration (FAA) to allow an experimental reusable suborbital rocket to launch or reenter. A permit is an alternative to licensing. A permit is valid for a one-year renewable term and allows a permittee to conduct an unlimited number of launches and reentries for a particular suborbital rocket design during that time.

Suborbital Rocket means a vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory, and the thrust of which is greater than its lift for the majority of the rocket-powered portion of ascent.

How Was The Experimental Permit Created?

On December 23, 2004, President Bush signed into law the Commercial Space Launch Amendments Act of 2004 (CSLAA). The CSLAA established an experimental permit regime for experimental reusable suborbital rockets. The FAA published experimental permit regulations, 14 CFR part 437, on April 6, 2007. The new regime makes it easier for the industry to test new types of reusable suborbital rockets. The FAA can grant experimental permits more quickly and with fewer requirements than licenses. The table below describes several differences that the CSLAA carved out between licenses and permits.

Did you know that the experimental permit regime was modeled on the special airworthiness certificates granted to experimental aircraft?

Statutory Differences Between A License And An Experimental Permit

	Experimental Permit	RLV Mission License
Review Period	FAA has a maximum of 120 days to review a permit application	FAA has a maximum of 180 days to review a license application
Compensation or Hire	Carrying any property or human being for compensation or hire is prohibited under a permit	Revenue generating launches are allowed under a license
Indemnification	Permitted launches are not eligible for indemnification	Licensed launches are eligible for government indemnification for 3rd party liability greater than required financial responsibility
Transferability	Permits are not transferable	Licenses are transferable

Who Is Eligible For An Experimental Permit?

The FAA will issue an experimental permit only for:

- ▶ Research and development to test new reusable suborbital rocket design concepts, new equipment, or new operating techniques,
- ▶ Showing compliance with requirements to obtain a license, or
- ▶ Crew training before obtaining a license.

How Long Does It Take To Get An Experimental Permit?

The FAA review period for an experimental permit is 120 days. Complying with the financial responsibility regulations takes an additional 30 days, so applicants should submit a complete enough application 150 days before their first launch. In addition, an applicant must allow time for pre-application consultation.

Experimental Permit Process Timeline

Pre-application consultation (submit draft application)	L-150+ days
Submit complete enough permit application	L-150 days
Start of 120-day review period	L-150 days
Permit issuance	L-30 days
Submit proof of financial responsibility	L-30 days
First launch	L-0 days

What Is The Experimental Permit Safety Strategy?

The safety strategy for experimental permits consists of three elements explained in the following sections:

1. A Hazard Analysis
2. Operating Area Containment
3. Abiding by Operating Requirements



What Is A Hazard Analysis?

A hazard analysis identifies and eliminates hazards and reduces the associated risk to the public. Typical elements of a hazard analysis include:

1. Identifying and describing hazards,
2. Assessing risk using qualitative severity and likelihood levels,
3. Identifying and describing risk elimination and mitigation measures to reduce the risk to acceptable levels, and
4. Demonstrating that the risk elimination and mitigation measures are correct, complete, and achieve an acceptable reduction in risk through validation and verification.

A hazard analysis is one of several components of the system safety process required for a license.

As part of the required hazard analysis, a permit applicant must use risk elimination and mitigation measures necessary to ensure that the likelihood and consequence of each hazard meets the following criteria:

1. The likelihood of any hazard that may cause death or serious injury to the public must be "extremely remote."
2. The likelihood of any hazard must be "remote" if it may cause
 - ▶ Major property damage to the public,
 - ▶ Major safety-critical system damage or reduced capability,
 - ▶ A significant reduction in safety margins, or
 - ▶ Significant increase in crew workload.

A hazard is an activity or condition that poses a threat to persons or property.

Risk means a measure that accounts for both the probability of occurrence of a hazardous event and the consequence of that event to persons or property.

Because the hazard analysis is an integral part of the permit process, the FAA developed an advisory circular to provide further guidance to applicants, AC 437.55-1, Hazard Analysis for the Launch or Reentry of a Reusable Suborbital Rocket Under an Experimental Permit.

What Is An Operating Area?

An operating area is a three-dimensional region proposed by a permit applicant where permitted flights can take place. The FAA will approve an operating area based on the following criteria:

- ▶ Must be large enough to contain each planned trajectory and all expected vehicle dispersions,
- ▶ Must contain enough unpopulated or sparsely populated area to perform key flight-safety events,
- ▶ May not contain or be adjacent to a densely populated area or large concentrations of members of the public, and
- ▶ May not contain or be adjacent to significant automobile traffic, railway traffic, or waterborne vessel traffic.

Key flight-safety event means a permitted flight activity that has an increased likelihood of causing a launch accident compared with other portions of flight.

What Is Operating Area Containment?

The FAA requires an applicant to demonstrate, at a minimum, either that there are physical limits on the ability of the reusable suborbital rocket to leave the operating area, or that the operator will use abort procedures and other safety measures derived from a system safety engineering process to contain the instantaneous impact point (IIP). The FAA requires a permittee to operate its reusable suborbital rocket such that its IIP remains within an operating area and outside any FAA designated exclusion areas.

An instantaneous impact point means an impact point, following thrust termination, of a launch vehicle, calculated in the absence of atmospheric drag effects.



What Operating Requirements Must A Permittee Abide By?

The operating requirements with which a permittee must comply while conducting permitted activities are outlined below.

- ▶ Follow rest rules for vehicle safety operations personnel.
- ▶ Establish safety clear zones during pre-flight and post-flight hazardous operations.
- ▶ Implement safety requirements derived from the hazard analysis.
- ▶ Maintain validity of the hazard analysis based on experience.
- ▶ Contain vehicle IIP within an operating area and outside any exclusion area.
- ▶ Conduct all key flight-safety events over unpopulated or sparsely populated areas.
- ▶ Use appropriately sized landing locations that are cleared of the public.
- ▶ Comply with agreements with the launch site, Air Traffic, and any other party providing access to or use of property and services required to support the launch or reentry.
- ▶ Perform a collision avoidance analyses for launches with altitudes greater than 150 kilometers.
- ▶ Provide real time tracking of vehicle position and velocity.
- ▶ Maintain communications with Air Traffic Control during all phases of flight.
- ▶ Record any communications affecting the safety of the flight.
- ▶ Confirm the operation of all systems and operations necessary to ensure that safety measures are within acceptable limits before initiating launch.
- ▶ Abort the launch if it would endanger the public.
- ▶ Prevent careless or reckless operations.
- ▶ Record and report anomalies.
- ▶ Report, respond to, and investigate any mishaps.
- ▶ Abide by any additional requirement the FAA believes is necessary to protect public safety.

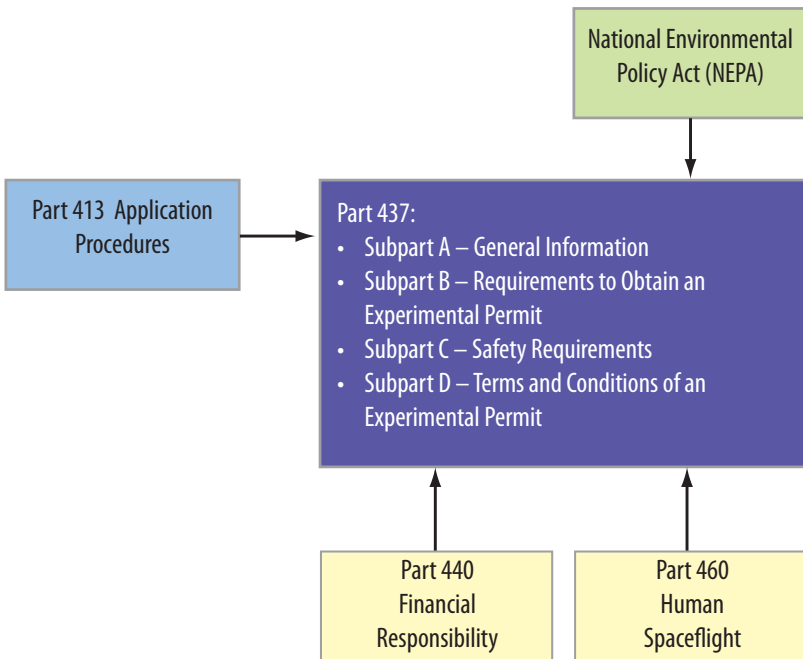
Anomaly means a problem that occurs during verification or operation of a system, subsystem, process, facility, or support equipment.



What Other Regulations Apply To A Permit Applicant?

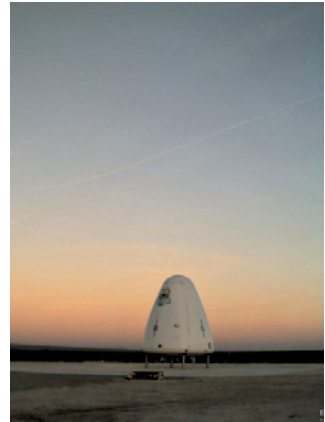
Other regulations may apply to permitted operations including:

- ▶ Application Procedures – An applicant must use the procedures in part 413 to apply for an experimental permit.
- ▶ Environmental – An applicant must provide enough information for the FAA to analyze the environmental impacts associated with proposed reusable suborbital rocket launches or reentries, in accordance with the National Environmental Policy Act (NEPA).
- ▶ Financial Responsibility – During the application process, an applicant must provide the information required by part 3 of appendix A of part 440 for the FAA to conduct a maximum probable loss (MPL) analysis. After permit issuance, a permittee must demonstrate compliance with part 440 by showing evidence of financial responsibility.
- ▶ Human Space Flight – An applicant proposing launch or reentry with flight crew or a space flight participant on board a reusable suborbital rocket must demonstrate compliance with part 460.



What is Maximum Probable Loss?

The FAA requires financial responsibility for losses to the US government and third parties resulting from a permitted activity based on a maximum probable loss (MPL) analysis. Maximum probable loss is the greatest dollar amount of loss for bodily injury or property damage that is reasonably expected to result from a permitted activity. The table below summarizes all of the MPL determinations we have issued for experimental permits.



Maximum Probable Loss Determinations For Permits

Company Vehicle	Operating Area	US Gov Property	Third Party
Blue Origin PM-1	West Texas	\$0	\$3M
Armadillo MOD	Oklahoma	\$0	\$3M
Armadillo MOD	Holloman AFB without concurrent operations	\$1.5M	\$3M
Armadillo MOD	Holloman AFB with concurrent operations	\$1.5M	\$6M
Armadillo QUAD	Las Cruces Int'l Airport	\$0.5M	\$9M
Armadillo QUAD	Oklahoma	\$0	\$3M
Armadillo QUAD	Holloman AFB without concurrent operations	\$1.5M	\$3M
Armadillo QUAD	Holloman AFB with concurrent operations	\$1.5M	\$6M

What Activities Are Authorized Under An Experimental Permit?

Launch and reentry activities are authorized under the experimental permit. Our regulations define launch to include the flight of a launch vehicle and pre- and post-flight ground operations as follows.

- ▶ Launch begins when any pre-flight ground operation at a U.S. launch site meets all of the following criteria:
 - ▶ Is closely proximate in time to flight,
 - ▶ Entails critical steps preparatory to initiating flight,
 - ▶ Is unique to space launch, and
 - ▶ Is inherently so hazardous as to warrant the FAA's regulatory oversight.
- ▶ Launch ends after reaching apogee if the flight includes a reentry, or otherwise after vehicle landing or impact on Earth, and after activities necessary to return the vehicle to a safe condition on the ground.

How Many Experimental Permits Have Been Issued?

We have issued four experimental permits as shown in the table below.

Experimental Permits Issued

Company Vehicle	Permit	Issued	Effective	Expiration
Blue Origin PM-1	EP06-001	9/15/06	10/2/06	10/2/07
Armadillo QUAD	EP06-002	10/17/06	10/18/06	10/21/06
Armadillo QUAD	EP07-003	2/27/07	3/1/07	3/1/08
Armadillo MOD	EP07-004	10/18/07	10/18/07	10/18/08

Visit our website for the most up to date information on what permits have been issued: <http://ast.faa.gov> >> Launch Data & Vehicles>> Active Permits



How Many Permitted Launches Have There Been?

As of May 2008, FAA has overseen fifteen permitted launches as shown in the table below.

Historical Permitted Launches

#	Date	Vehicle	Company	Site
1	10/19/06	Pixel	Armadillo Aerospace	Las Cruces Int'l Airport
2	10/20/06	Pixel	Armadillo Aerospace	Las Cruces Int'l Airport
3	10/21/06	Pixel	Armadillo Aerospace	Las Cruces Int'l Airport
4	10/21/06	Pixel	Armadillo Aerospace	Las Cruces Int'l Airport
5	10/21/06	Pixel	Armadillo Aerospace	Las Cruces Int'l Airport
6	11/13/06	PM-1	Blue Origin	West Texas Site
7	3/22/07	PM-1	Blue Origin	West Texas Site
8	4/19/07	PM-1	Blue Origin	West Texas Site
9	6/2/07	Pixel	Armadillo Aerospace	Oklahoma Spaceport
10	6/2/07	Pixel	Armadillo Aerospace	Oklahoma Spaceport
11	10/20/07	MOD-1	Armadillo Aerospace	Oklahoma Spaceport
12	10/27/07	MOD-1	Armadillo Aerospace	Holloman Air Force Base
13	10/27/07	MOD-1	Armadillo Aerospace	Holloman Air Force Base
14	10/28/07	MOD-1	Armadillo Aerospace	Holloman Air Force Base
15	10/28/07	MOD-1	Armadillo Aerospace	Holloman Air Force Base

Visit our website for the most recent data on number of permitted launches:

<http://ast.faa.gov> >> Launch Data & Vehicles >> Recently Completed & Historical Launch Data

How Do You Apply for An Experimental Permit?

Before applying for a permit, a prospective applicant must consult with the FAA. This process allows a prospective applicant to familiarize the FAA with the proposed vehicle and operations and the prospective applicant to become familiar with the FAA's application process and information requirements. Early consultation helps an applicant identify possible regulatory issues at the planning stage when changes to an application or to proposed activity are less likely to result in significant delay or costs to the applicant. To begin pre-application consultation, contact the AST-100, Space Systems Development Division Manager (<http://ast.faa.gov> >>Contact Us).

The FAA has developed a number of tools to help you prepare your application including:

Sample Format	Helps you organize your application, ensures all application requirements are addressed, and facilitates a faster FAA review
Sample Application	Provides an example of a permit application
Hazard Analysis Advisory Circular	Provides guidance for applying a systematic and logical hazard analysis to the identification, analysis, and control of public safety hazards and risks associated with the launch and reentry of a reusable suborbital rocket under an experimental permit
Anomaly Reporting Advisory Circular	Provides guidance for reporting anomalies under an experimental permit
Workshop Materials	Materials from an FAA workshop on the Experimental Permit
Experimental Permit Checklist	Ensures that you have addressed all of the applicable regulations

What Are The Challenges The FAA Faces With Experimental Permits?

There are a number of challenges facing the FAA with respect to issuing experimental permits. The table below summarizes the most pressing issues we are currently working to resolve.

Allowable Changes vs. Application Modifications	The FAA identifies in an experimental permit the type of changes a permittee may make to a reusable suborbital rocket design without invalidating the permit. This is intended to reduce the burden of applying for and evaluating requests for permit modifications. The proper scope of allowable design changes is, however, difficult to establish.
Methodology for Determining MPL	Before establishing the experimental permit, the FAA's MPL methodology was based on probabilistic risk assessments. The reduced application requirements of a permit combined with the developmental nature of experimental vehicles is forcing the FAA to explore alternative methods.
Safety Clear Zones	The FAA requires a permittee to establish a safety clear zone and verify that the public is outside that zone before and during any hazardous operation. Determining the appropriate size of a safety clear zone, as well as when a safety clear zone is necessary is sometimes difficult to determine.
Operating Areas	Although not required, many permit applicants propose a minimum-size operating area. Determining whether such an operating area is large enough to contain a vehicle's instantaneous impact point can be challenging, particularly when the uncertainty of input parameters is considered.
Buffer Zones	An operating area may not be adjacent to a densely populated area or large concentrations of members of the public. An operating area may also not be adjacent to significant automobile traffic, railway traffic, or waterborne vessel traffic. Accordingly, the FAA may establish a buffer zone around an operating area to protect densely populated areas and significant automobile, railway, or waterborne vessel traffic. The FAA is currently developing procedures for determining appropriate buffer zones.
Regression and Software Testing	In its hazard analysis, a permit applicant must identify and describe hazards, including those that result from software errors. Software is often used to mitigate risks to acceptable levels. The FAA is currently developing guidance on the scope and depth of what an applicant must do to demonstrate the adequacy of software in its permit application.
1st party vs. 3rd party	FAA licensing and permitting is designed to protect public safety, not launch participants. Historically, discriminating members of the public from personnel involved with a launch was relatively straightforward. However, the entrepreneurial nature of many permit applicants, as well as the advent of the "rocket show," complicates this determination.

Photographic Credits



Virgin Galactic



Armadillo Aerospace



XCOR Aerospace



Blue Origin



Armadillo
Aerospace

For more information,

See the FAA Experimental Permit Webpage:

<http://ast.faa.gov> >> Licenses & Permits >> Experimental Permits

Michelle Murray
Experimental Permit Program Lead
Michelle.Murray@faa.gov
(202)267-7892