

# DARPA Launch Challenge: Qualification Guidelines

Revision 5 – November 5, 2018

Revision 5	November 5, 2018	DARPA Application due date
Revision 4	October 17, 2018	DARPA application updates
Revision 3	October 11, 2018	Application due dates Team eligibility updates
Revision 2	August 14, 2018	Prize funding clarification
Revision 1	May 21, 2018	Created

## 1 Introduction

This document describes the steps needed to complete the Qualification Phase for the DARPA Launch Challenge (DLC). This document is subject to change and revisions will be posted to [www.darpalaunchchallenge.org](http://www.darpalaunchchallenge.org).

The goal of the DLC is to demonstrate responsive and flexible space launch capabilities from the burgeoning industry of small launch (10kg-1000kg) providers. The DLC will meet the emerging needs of the Department of Defense (DoD) by delivering unique space capabilities on rapid timelines. The DLC will focus on driving the emerging small launch community to be able to launch from anywhere on extremely short notice without prior knowledge of their missions. There will be a close coordination with the Federal Aviation Administration (FAA), which grants licenses for commercial space launches and will be involved throughout the DLC. Competitors participating in the DLC will be required to obtain FAA licenses for all launch activity conducted under this program.

For the DLC, DARPA will not solicit formal proposals for contracted technology development through the traditional Broad Agency Announcement (BAA) method. Rather, participating teams are encouraged to leverage their ongoing work in the small launch arena to participate in the DLC.

## 2 Overview

The Launch Challenge will consist of two phases, a Qualification Phase (qualification competition) and a Launch Phase (with two launch competitions).

To successfully pass the Qualification Phase, potential competitors will need to complete a

three-step process. This process consists of prequalification, DARPA Challenge application, and FAA license application. Additional information for each step is provided in the Qualification Phase discussion (Section 4) below. If teams complete all three steps successfully, they will qualify for the Launch Phase and be awarded a cash prize.

The Launch Phase will consist of two launch competitions designed to occur in a serial manner, within weeks of one another in late 2019. The Launch Challenge will conduct two different launch competitions at two different locations – Launch #1 and Launch #2. A successful outcome in Launch #1 will be a prerequisite for participation in Launch #2.

Competitors will receive information about the launch sites with less than 30 days prior to each launch. Once launch sites are announced, competitors will transport their launch vehicles, equipment, and necessary infrastructure to the locations in an expedient and safe manner.

Teams will receive further requirements for each launch less than 14 days prior to the launch – including specific launch pad, payload and orbit details, as well as the physical payloads to be launched. This is intended to be reflective of future needs for tactical use of space, where the details of the launch requirements are not known until they are dictated by mission needs.

Launch #1 competitors that deliver their spacecraft to low Earth orbit (LEO) with acceptable orbit accuracy will receive cash prizes. Within weeks of successful completion of Launch #1, competitors will move to the Launch #2 location. Launch #2 competitors that deliver their spacecraft to LEO will be ranked by payload mass, time, and accuracy and the top three teams will receive cash prizes. Further details on the Launch Phase of the DLC, including the scoring criteria, will be available in the rules document, targeted for release early 2019 after the Qualification Phase is complete.

### 3 Prizes

The Launch Challenge winners will be determined by their scores in each competition and cash prizes will be awarded accordingly. The Government's obligation for prizes under the DARPA Launch Challenge is subject to the availability of appropriated funds from which payment for prize purposes can be made. No legal liability on the part of the Government for any payment of prizes may arise unless appropriated funds are available to DARPA for such purposes.

	Prize Criteria	Prize Amount per awardee
<b>Qualification Phase</b>	DARPA determination of “challenge ready” based on review of submittal and FAA acceptance of a license application	\$400K
<b>Launch Phase: Launch #1</b>	Successful LEO launch to correct orbit	\$2M
<b>Launch Phase: Launch #2</b>	Second successful LEO launch to correct orbit, competitors ranked by mass, time, and accuracy	\$10M – 1 <sup>st</sup> \$9M – 2 <sup>nd</sup> \$8M – 3 <sup>rd</sup>

## 4 Qualification Phase

To compete in the Launch Phase of the DARPA Launch Challenge, teams first must compete a three-step Qualification Phase process. Teams must complete all steps by February 1, 2019, and DARPA plans to announce successful teams no later than March 2, 2019.

The first step is for teams to prequalify via the registration tab on [www.darpalaunchchallenge.org](http://www.darpalaunchchallenge.org). Teams are encouraged to prequalify as soon as possible beginning May 24, 2018. DARPA plans to use the prequalification information to communicate directly with the teams and assist them through the next steps of the process. Teams' prequalification must be submitted by October 15, 2018. Teams will be notified within 30 days of their submission if they are approved. To successfully prequalify, teams need to answer each question with clearly defined responses. DARPA may choose to set up follow-up discussions for any submission that is unclear. Only teams that propose complete systems for space launch capability will prequalify. **Note:** If a group only offers a supporting service or partial capability, they should directly contact a potential team to work with, as DARPA will not coordinate teaming.

The second step is for teams to submit a Launch Challenge Application (see Exhibits A and B) to [Launchchallenge@darpa.mil](mailto:Launchchallenge@darpa.mil). This application requires teams to provide a detailed explanation of their approach, full technical details of their system and thorough launch operations and safety plans. DARPA will evaluate each application to ensure each team has demonstrated that it has the capabilities that would be flexible and responsive enough to successfully meet the goals and timelines of the DARPA Launch Challenge. The application has a 10 (ten) page limit though teams may provide links to relevant videos. Team applications will be evaluated individually and not compared to other submissions. There is not a current set limit on the number of applications DARPA plans to accept.

Teams are encouraged to submit this application as soon as possible, but no later than November 30, 2018, to be considered for entry into the Launch Challenge. Application information is confidential and will not be shared without the participant's permission. If DARPA requires further clarification, it may contact the team within 30 days of submission. DARPA may schedule site visits or teleconferences to discuss the details of the application. DARPA will inform teams of their selection on or before December 30, 2018, so they may focus on their FAA License.

The third step in qualifying for the Launch Challenge is FAA-AST acceptance of a license application. Note as part of the FAA inter-agency review process, teams must also satisfy FCC spectrum authorization requirements, and if applicable, a NOAA remote sensing license. Prior to submitting an application for an authorization issued by FAA-AST, prospective applicants must comply with the pre-application consultation requirement stated in 14 CFR §413.5. When the

applicant submits an application, FAA-AST conducts a “complete enough” review to determine whether the application contains substantive responses to all of the relevant regulations. If so, the application is accepted. The launch challenge application and the FAA license application should be pursued in parallel. Further details on the process can be found at:

[https://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/licenses\\_permits/launch\\_reentry/#expendable](https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/launch_reentry/#expendable)

The FAA-AST pre-application process is extremely thorough and can be lengthy for teams that have not begun the process. Potential Launch Challenge participants are encouraged to contact the FAA-AST immediately to begin DLC pre-application consultation, either by contacting their established points of contact or by contacting Pam Underwood ([pam.underwood@faa.gov](mailto:pam.underwood@faa.gov) or 321-474-9570) to establish a point of contact. **Teams need to have a license application accepted by the FAA by February 1, 2019 to qualify for the Launch Phase.**

Pre-application consultation typically consists of a series of focused discussions between representatives of AST and a prospective applicant. Pre-application consultation minimizes programmatic risk for the prospective applicant by establishing a plan for compliance. The compliance plan:

1. Prepares a prospective applicant to submit an application that demonstrates the applicant has met the applicable requirements;
2. Identifies regulatory requirements that could constrain or affect an applicant’s proposed application;
3. Assists a prospective applicant in determining potential approaches to meeting the regulatory requirements for an applicant’s proposed application, especially if the application contains unique or novel elements; and
4. Facilitates coordination with the other lines of business (LOB) within the FAA (such as the Air Traffic Organization, Office of Aviation Safety, and Office of Airports), and identifies pertinent regulations outside of 14 CFR chapter III that might be relevant to the proposed application.

The complexity of the commercial space transportation regulations can present challenges for both new and experienced applicants. The pre-application consultation process minimizes the burden on a prospective applicant by clarifying the requirements for an acceptable application and reducing the likelihood that AST will require revisions or reject the application outright. Pre-application consultation also is intended to reduce a prospective applicant’s programmatic risk by enabling the applicant to identify and address possible regulatory questions or issues relevant to AST’s licensing or permitting decision and other FAA LOB regulatory requirements, such as in the areas of airspace integration, aircraft/airman certification and operation or airport compliance. Specifically, pre-application consultation enables the FAA and the prospective applicant to anticipate FAA regulatory requirements early in the program development and operations planning processes. Finally, pre-application consultation aids in reducing the potential for noncompliance and FAA enforcement action once operations begin.

In evaluating an application for an authorization, AST's objective is to determine whether the proposed activity or site jeopardizes public health and safety, the safety of property, U.S. national security or foreign policy interests, or the international obligations of the United States. A successful application addresses these criteria through compliance with the regulations. An application is accepted when it addresses the regulatory criteria. The end of pre-application consultation is marked by AST's acceptance of an application, and the start of the FAA's evaluation of the proposed authorization.

## **5 Payloads**

To best exercise the performance capabilities of all teams, initial details (including interfaces) of the payload will be released in the launch rules in early 2019. Basic payload mechanical, electrical, and data interfaces and constraints will be provided long enough in advance to allow hardware fabrication. Exact details (configuration, mass properties, etc.) on the payload will be provided in the weeks before each of the two Launch events.

In order to be considered for the DARPA Launch Challenge, teams must show that their system can deliver a minimum of 10kg to circular sun synchronous orbit (SSO) at 400km.

For initial planning purposes, teams should plan to show calculations at their maximum launch capability for a maximum extent of inclinations from each prospective launch site.

DARPA will work with the FAA to issue further guidance regarding inputs for license applications for the planned orbit and launch trajectories. The intention is to allow maximum flexibility for launch parameters, while maintaining public safety.

## **6 Orbits**

Exact details on orbits will be given when the launch sites and payload information is provided in the weeks before each launch event. For initial planning purposes, DARPA will provide example orbits before January 2019 to include in their FAA License Application.

## **7 Launch Sites**

Teams will receive exact details on the launch sites with the payload information in the weeks before each launch event. For initial planning purposes, competitors should assume any current or future FAA-licensed spaceport may be used. Launch site services are planned to be austere – primarily a concrete pad with bolt-down fixtures and generator or shore power. DARPA may consider providing additional commonly used resources, dependent upon needs common among competitors.

DARPA will provide a list of potential launch sites before January 2019 to be included in the FAA License Application.

## **8 Eligibility**

All United States-based teams with approaches to launch payloads into LEO are encouraged to qualify.

The following individuals and organizations are not eligible to participate in the DLC:

- Organizations that are not based in the United States.
- Individual, organization or sponsor that is named in the Specially Designated Nationals list of the U.S. Department of Treasury.
- Residents of Iran, North Korea, Sudan, Syria, or other countries prohibited on the U.S. State Department State Sponsors of Terrorism list (due to OFAC restrictions), and where prohibited by law.
- Federal employees, including DARPA employees and DARPA support contractors and their spouses, dependents, and household members are not eligible to participate in the DLC. Federal employees and contractors acting outside the scope of their employment should consult their ethics official and appropriate management before participating in the DLC.

## **9 Notification**

Teams will be notified of their pre-qualification status within 30 days of submission. Prequalified teams that submit both a Launch Challenge Application and Launch License Application will be notified of their status as soon as possible after the Qualification Phase closes on February 1, 2019, but no later than March 2, 2019.

## **10 Financial Responsibility Requirements**

FAA licensees are required to demonstrate compliance with the financial responsibility regulations in 14 CFR Part 440. This includes the licensee must obtain liability insurance or demonstrate financial responsibility to compensate for the maximum probable loss (MPL) from claims by a third party for death, bodily injury, or property damage or loss; and the U.S. Government for damage or loss to government property resulting from activities carried out under and FAA license. The amount of this liability insurance or financial responsibility is prescribed by the FAA upon issuance of a license and is commensurate with the maximum probable loss analysis conducted by the FAA during its evaluation of a license application.

Licensees are also required to make a reciprocal waiver of claims with applicable parties involved in launch services under which each party agrees to be responsible for personal injury to, death of, or property damage or loss sustained by it or its own employees resulting from activities carried out under an FAA license. Applicable parties include contractors, subcontractors, and customers of the licensee; and contractors and subcontractors of the customers. This reciprocal waiver of claims also includes the government, executive agencies of the government involved in launch services, and contractors and subcontractors involved in launch services.

Additional information about these financial responsibility requirements should be directed to the FAA during pre-application consultation for the proposed licensed activity.

## **11 Communication**

The DARPA Launch Challenge will communicate all official information and updates via [www.darpalaunchchallenge.org](http://www.darpalaunchchallenge.org). DARPA will notify pre-qualified teams of updates via email, but teams should check for updates to the guidelines periodically. The DLC government personnel also may engage participant teams directly via points-of-contact identified in prequalifying. However, these interactions will be for status updates and gathering feedback, but nothing transmitted should be taken as official guidance or rule changes.

# Exhibit A

DARPA Launch Application (template)  
Guidelines: 10 page limit, no classified material

Team Name:  
Team Address:  
Team Point of Contact:  
POC Email:  
POC Phone:

**Technical Approach:** Describe the overall design, operations approach, and current development status for your launch system. This should include major system elements (structures, propellants, engines, avionics), key technical details, and unique technical approaches.

Details should include a description of launch integration timeline – including givers and receivers for information and hardware (eg: orbit requirements, spacecraft mechanical, electrical and data interfaces, spacecraft models, etc). A timeline summarizing a baseline launch operations flow should be included, highlighting key events and when they occur in relation to launch date.

Submissions should give specific emphasis to showing how the technical approach and timelines can accommodate the goals of the Launch Challenge – specifically, how the launch system can launch a payload to LEO twice from different sites, each within days of notification of requirements and receipt of payload hardware.

**System Capabilities:** Provide an overview of the capabilities of your launch system. This should include performance calculations to low Earth orbit (LEO), payload mass and volume envelopes, predicted payload environments (loads, acoustic, RF, thermal, shock, vibration, humidity, cleanliness), planned LV-to-payload electrical and mechanical interfaces and expected injection accuracy.

Submissions should give special emphasis to showing how the system capabilities can meet the goal of the Launch Challenge to accommodate a range of payloads with accelerated analysis prior to launch. Constraints for payload characteristics should be clearly identified. Teams should list any limitations on achievable orbits.

Special emphasis should include a description of launch operations and range dependencies



**Launch Requirements:** Provide a description of all equipment, information, and services required to conduct launch operations. This should include commodities (fuels, oxidizers, pressurants, etc.), launch site infrastructure (communications, power, water, mechanical fixtures, lifting equipment, payload processing facilities). Include descriptions of equipment and services which are desired to be provided by the range and its facilities – and which your organization will provide itself (or via subcontractors and vendors).

Submissions should provide detail on how typical fixed-range functions will be accommodated in a flexible manner – namely, flight termination and telemetry receipt. Approaches using autonomous flight termination should address the intended hardware and software approach and its state of flight qualification.

Note as part of the FAA inter-agency review process, teams must also satisfy FCC spectrum authorization requirements, and if applicable, a NOAA remote sensing license.

# Exhibit B

## DARPA Application Checklist For Teams to ensure all areas are addressed

	<b><u>Technical Approach:</u></b>								
<input type="checkbox"/>	Describe the overall design, operations approach, and current development status for your launch system.								
<input type="checkbox"/>	Major system elements (structures, propellants, engines, avionics), key technical details, and unique technical approaches								
<input type="checkbox"/>	Description of launch integration timeline								
<input type="checkbox"/>	A timeline summarizing a baseline launch operations flow								
<input type="checkbox"/>	How the technical approach and timelines can accommodate the goals of the Launch Challenge								
<input type="checkbox"/>	How the launch system can launch a payload to LEO twice from different sites, each within days of notification								
	<b><u>System Capabilities:</u></b>								
<input type="checkbox"/>	Provide an overview of the capabilities of your launch system.								
<input type="checkbox"/>	Performance calculations to low earth orbit (LEO), payload mass and volume envelopes, and predicted payload environments								
<input type="checkbox"/>	How system capabilities can accommodate a range of payloads with accelerated analysis prior to launch.								
<input type="checkbox"/>	Constraints for payload characteristics should be clearly identified								
<input type="checkbox"/>	Teams should list any limitations on achievable orbits.								
<input type="checkbox"/>	Special emphasis should include a description of launch operations and range dependencies								
	<b><u>Launch Requirements</u></b>								
<input type="checkbox"/>	Description of all equipment, information, and services required to conduct launch operations.								
<input type="checkbox"/>	Description of equipment and services which are desired to be provided by the range and its facilities								
<input type="checkbox"/>	Descriptions of equipment and services which your organization will provide itself (or via subcontractors and vendors)								
<input type="checkbox"/>	List of required commodities (fuels, oxidizers, pressurants, etc.)								
<input type="checkbox"/>	Desired launch site infrastructure								
<input type="checkbox"/>	Details on how typical fixed-range functions will be accommodated in a flexible manner								
<input type="checkbox"/>	Autonomous flight termination intended hardware and software approach and its state of flight qualification.								

# Exhibit C

Launch Architecture Questionnaire  
 Complete and include with DARPA Application  
 (does not count against page limit)

<b>Instructions: Please enter "X" in the appropriate check box fields for each section.</b>							
<b>Systems Engineering</b>							
<b>Architecture</b>	<b>Indicate phase completion of the overall launch architecture</b>						
	SRR	PDR	CDR	Fabrication	Assembly	Integration	Flight Test
<b>Systems</b>	<b>Indicate phase completion for each system below</b>						
	Conceptual	Preliminary	Detailed	Flight H/W	Assembly	Integration	Test
Propulsion							
Structures							
Trajectory/Flight Dynamics							
Guidance & Navigation							
Avionics							
Thermal Control and/or Protection							
Flight Termination System							
Payload Accommodation (fairing, interfaces, etc.)							
Facilities & Ground Support Equipment							

<b>System Design and Analyses Status</b>							
<b>Indicate status for each of the design activities or analyses. E.g. engine nozzle conceptual and preliminary designs complete, detailed design in work. "X,X" entered in "Complete" column, one "X" entered for "In Work" column indicating detailed design in progress.</b>							
<b>Propulsion</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
main engine or motor design							
primary propulsion propellant selection							
main engine nozzle geometry & sizing							
main propulsion propellant feed subsystem							
main engine ignition subsystem							
main engine or motor fluid, thermal and pressure models							
RCS engine or motor design							
ullage motor design							
RCS subsystem design							

<b>System Design and Analyses Status</b>							
Indicate status for each of the design activities or analyses. E.g. engine nozzle conceptual and preliminary designs complete, detailed design in work. "X,X" entered in "Complete" column, one "X" entered for "In Work" column indicating detailed design in progress.							
ullage subsystem design							
materials selection							
Combustion effects characterization (pogo, etc.)							
TVC design							
system schematics							
system specifications							
<b>Structural</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
aeroshell							
propellant tanks							
propellant tanks baffle and slosh analysis							
thrust frames							
interstages							
stage separation components							
propellant feed lines							
control surfaces							
payload faring							
vibroacoustic analysis							
loads analysis							
dynamic analysis							
stress analysis							
shock analysis							
structural life (i.e. fatigue, fracture, life cycles, failure times, etc.)							
materials selection							
composites-aluminum galvanic isolation							
system schematics							
system specifications							
<b>Aerodynamics</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
aerodynamic force and moment coefficients							
CP determination							
MaxQ							
steady state aerodynamic environments (localized loads & venting)							
aeroelastic stability							
acoustics overpressure							
ground winds and winds aloft							

<b>System Design and Analyses Status</b>							
Indicate status for each of the design activities or analyses. E.g. engine nozzle conceptual and preliminary designs complete, detailed design in work. "X,X" entered in "Complete" column, one "X" entered for "In Work" column indicating detailed design in progress.							
buffet design parameters							
aerodynamic heating: engine plume radiation flux							
aerodynamic heating: airstream convective heat transfer							
engine exhaust plume electron profiles							
<b>Trajectory/Flight Dynamics</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
Reference orbits							
Reference launch site(s)							
Launch vehicle nominal and reference trajectories							
Trajectory time histories							
Staging requirements							
stage separation characteristics							
# engines required							
Propellant requirements							
CG and CP analysis							
Throttling profile							
performance margins							
dispersion characteristics							
abort targets							
If autonomous FTS, thrust termination analysis							
reentry/recovery targets							
<b>GN&amp;C</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
Launch vehicle and environmental disturbances							
RCS requirements							
Control algorithms							
Sensor requirements							
Software requirements							
Software documentation							
Component requirements							
accuracy requirements							
Error budgets							
OBC guidance parameters and presets							
<b>Avionics &amp; Communications</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
LV data management subsystem							
EGSE data management subsystem							

<b>System Design and Analyses Status</b>							
<b>Indicate status for each of the design activities or analyses. E.g. engine nozzle conceptual and preliminary designs complete, detailed design in work. "X,X" entered in "Complete" column, one "X" entered for "In Work" column indicating detailed design in progress.</b>							
communications subsystem							
electrical subsystem							
main propulsion, RCS, ullage and separation controllers							
Software requirements							
RF link budgets							
EMI and EMC analysis							
Component requirements (e.g. flight computer, telemetry, multiplexers, data storage, radios, antennas, batteries, power converters, etc.)							
system schematics							
system specifications							
<b>Thermal Control and Protection</b>	<b>Complete</b>	<b>In Work</b>	<b>Not Started</b>	<b>Conceptual</b>	<b>Preliminary</b>	<b>Detailed</b>	<b>n/a</b>
thermal control system requirements							
structural gradients							
propellant gradients							
thermal protection system requirements							
main propulsion and RCS insulation requirements							
cyrogenic insulation requirements							
materials selection							
external thermal environments (ground, ascent and on-orbit phases)							
induced thermal loads (e.g. aerothermal, main propulsion, RCS and ullage motor plume effects, other subsystems)							
compartment thermal environments							
motor and/or engine soakback transfer models							
interstage thermal transfer models							
time histories							
thermal sensor requirements							
system schematics							
system specifications							