NASAfacts

NASA Launch Services Risk Classification Fact Sheet

NASA's Launch Services Program (LSP) aims to connect NASA and NASA-sponsored payloads with commercial rockets. LSP's principal objectives are to provide safe, reliable, cost-effective, and on-schedule launch services.

NASA's policy is to have a fleet of rockets that use both existing and emerging domestic launch capabilities to assure access to space for the agency's science and robotic missions. The program works with commercial providers to ensure science and robotic missions have integration services, payload processing facilities, and appropriate launch manifesting.

Rocket Technical Oversight

The NASA Flight Planning Board is responsible for ensuring the Launch Services Program procures launch services that align with the spacecraft's risk tolerance. LSP works to match missions with appropriate rockets.

Additionally, LSP performs technical oversight of launch services provided by commercial launch service providers, remaining accountable for the success of NASA missions. Some areas of oversight include:

- Rocket engineering and manufacturing
- Launch operations and countdown management
- Providing added quality and mission assurance

NASA's technical oversight approach identifies technical issues and assesses the competency and adequacy of the technical work performed by the commercial launch service providers. For more information, see NASA Policy Directive (NPD) 8610.23C.

Rocket Risk Classification

To classify rockets designed to launch robotics missions into Earth orbit and beyond, NASA uses three categories based on risk associated with the rocket. To certify a rocket into one of these three categories, NASA uses a set of requirements that examines various aspects of the rockets including management systems, flight experience, design and analysis, testing, and risk management strategies. The three categories are:

Category 1: High Risk – New, common rocket configuration with little or no prior demonstrated flight history.

Category 2: Medium Risk – Rockets that have a limited history of successful flights representing an 89% demonstrated reliability.

Category 3: Low Risk – Rockets that have a more robust flight history representing a 95% demonstrated reliability.

NPD 8610.7D addresses launch vehicle risk classification in addition to the assessment areas required for each level and provides more details about NASA's launch services risk mitigations.

(Left) A team prepares NASA's Psyche spacecraft for launch inside the Astrotech Space Operations Facility near the agency's Kennedy Space Center in Florida on Dec. 8, 2022. Photo credit: NASA/Ben Smegelsky

Payload Risk Classification

NASA's Office of Safety and Mission Assurance establishes criteria for risk classification for NASA payloads in NASA Procedural Requirements (NPR) 8705.4A. This publication defines "risk" as "the potential for shortfalls with respect to achieving explicitly established and stated objectives."

As applied to payloads, the stated objectives are translated into performance requirements, which may be related to safety, mission success, cost, schedule, or institutional support for mission execution. Mission directorates define risk tolerance classes for payloads within these criteria, considering the relative importance of the related objectives and aligning risk tolerance with risk appetite, or the amount and type of risk they are willing to pursue or retain.

NASA has four distinct risk tolerance levels, or classes, corresponding to the acceptable risk and degree of uncertainty assigned to a payload:

Class A: The lowest risk tolerance missions, normally representing a very high priority mission with very high complexity. Class A payloads will be launched on Risk Category 3 rockets with a more robust flight history, which matches the payloads with the lowest risk tolerance to the rockets with the lowest risk. Example missions for Class A payloads include the James Webb Space Telescope, Europa Clipper, and the Nancy Grace Roman Space Telescope.

Class B: Low risk tolerance missions, normally representing a high priority mission with high complexity, depending on the case. Class B payloads may be launched on Risk Category 3 rockets or Risk Category 2 rockets. Example missions for Class B payloads are the Mars Reconnaissance Orbiter, the Mars Science Laboratory, Psyche and Geostationary Operational Environmental Satellite-R (GOES-R).

Class C: Moderate risk tolerance missions, normally representing a medium priority mission with medium complexity. Class C payloads may be launched on Risk Category 3 rockets or Risk Category 2 rockets. Example missions for Class C payloads include TESS (Transiting Exoplanet Survey Satellite), and SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer).

Class D: High risk tolerance missions, normally representing a lower priority mission with a medium to low complexity. Class D payloads may be launched on Risk Category 1 rockets or rockets that NASA has not certified. Other high-risk payload launch service options may be pursued through the NASA Flight Planning Board. Example missions for Class D payloads include CYGNSS (Cyclone Global Navigation Satellite System), TROPICS (Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats), and ESCAPADE (Escape and Plasma Acceleration and Dynamics Explorers).

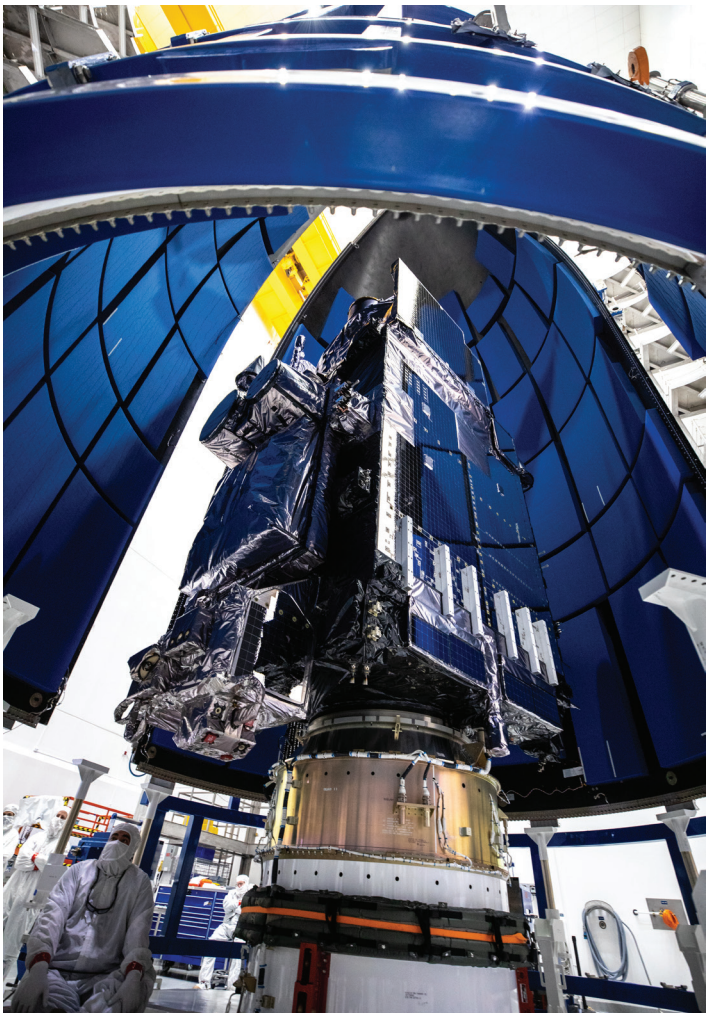
Differences Between Launch Contracts

To provide unique launch capabilities and opportunities for different payloads, LSP offers contracts that also carry different risk assessment requirements.

NASA Launch Services II contracts are for high priority, low and medium risk tolerant missions, with full NASA technical oversight and mission assurance, resulting in the highest practical probability of launch success. It is the primary method to acquire Category 2 and Category 3 commercial launch services. However, LSP can place a Class D 'high risk tolerant' payload on a low or medium risk launch vehicle, and many rideshares are higher risk missions. In those cases, they're configured to do no harm, so they don't interfere in any way with the primary payload.

VADR (Venture-Class Acquisition of Dedicated and Rideshare) launch service contracts implement a modified technical oversight approach using a lower level of mission assurance and

The United Launch Alliance Atlas V 541 rocket, carrying NASA's Mars Perseverance rover and Ingenuity helicopter, begins rollout from the Vertical Integration Facility to the launch pad at Space Launch Complex 41 at Cape Canaveral Air Force Station on July 28, 2020. Photo credit: NASA/Ben Smegelsky



In this view looking up, the United Launch Alliance Atlas V payload fairings are being secured around NOAA's Geostationary Operational Environmental Satellite-T (GOES-T) inside the Astrotech Space Operations facility in Titusville, Florida, on Feb. 7, 2022. Photo credit: NASA/Ben Smegelsky

more commercial practices to achieve lower launch costs. Use of VADR is only available to higher risk tolerant missions, which includes Class D mission or missions that do not receive a formal spacecraft risk designation but have been approved for use of VADR.

Through Federal Aviation Administration (FAA) licensed launches, VADR helps foster a growing U.S. commercial launch market. Through Venture-Class missions, NASA's CubeSat Launch Initiative provides launch opportunities to CubeSats with a higher risk tolerance, helping demonstrate and mitigate risks associated with the use of new rockets and providing access to space for future small spacecraft and missions.

VCLS (Venture-Class Launch Services) demonstration contracts, a precursor to VADR, were fixed price contracts for demonstration launches. These contracts were created to understand new emerging rockets prior to having a first flight. The 2015 Venture-Class Launch Services (VCLS) demonstra-

A wet dress rehearsal is underway for Rocket Lab's Electron rocket at Launch Complex 1 in Mahia, New Zealand on April 28, 2023. NASA's Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) CubeSats are secured in the payload fairing atop the rocket. Photo credit: Rocket Labs

Technicians prepare NASA's Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) CubeSats for encapsulation in Rocket Lab's Electron payload fairing in a processing facility near Launch Complex 1 in Mahia, New Zealand. Photo credit: Rocket Labs

A SpaceX Falcon Heavy rocket begins its demonstration flight with liftoff February 6, 2018 from Launch Complex 39A at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Kim Shiflett

tion contracts studied the risks of selecting new rockets before they had flown and determined that these new rockets could deliver NASA payloads at a fixed price. The 2021 VCLS Demo 2 contracts continued this journey to better understand the new U.S. launch suppliers.

NASA's Launch Services Program is based at the agency's Kennedy Space Center in Florida. Through careful analysis and evaluation – along with prudent risk – NASA can make sure that science payloads find the appropriate rockets to meet all the mission requirements, reduce costs while supporting new launch providers, and send a wide variety of payloads to space that benefit people on Earth.

The standard CubeSat size uses a "one unit" or "1U" measuring 10x10x10 centimeters and is extendable to larger sizes; 1.5, 2, 3, 6, and even 12U. A CubeSat typically weighs less than 2 kilograms (4.4 pounds) per unit.

A SpaceX Falcon 9 rocket with the Surface Water and Ocean Topography (SWOT) spacecraft onboard is seen as preparations for launch continue, Wednesday, Dec. 14, 2022, at Space Launch Complex 4E at Vandenberg Space Force Base in California. Photo credit: NASA/Keegan Barber

National Aeronautics and Space Administration

John F. Kennedy Space Center
Kennedy Space Center, FL 32899

www.nasa.gov

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