National Aeronautics and
Space Administration

ORBITAL-2 MISSION
TO THE INTERNATIONAL SPACE STATION

Media Press Kit

July 2014

Version 1

OVERVIEW

Orbital Sciences Corporation's second contracted cargo resupply mission with NASA to the International Space Station will deliver approximately 3,300 pounds of science and research, crew supplies, vehicle hardware and spacewalk tools to the orbital complex and its crew. The scientific payloads on the Cygnus spacecraft include a group of small nanosatellites that will capture imagery of Earth, an investigation that will be used to help develop a devise that could enable small sample returns from the space station, and a suite of student-designed experiments that focus on studies ranging from food growth to the effects of microgravity on oxidation. Cygnus will spend approximately one month attached to the space station, at which point the crew will detach it from the Harmony module before its release. The spacecraft will dispose of approximately 3,000 pounds of trash during its fiery demise upon reentry into Earth's atmosphere.

CYGNUS CARGO

TOTAL CARGO	*3,293 pounds / 1,493.8 kg*
Crew Supplies	1,684 pounds / 764.2 kg
Crew care packages	
Crew provisions	
Food	
Vehicle Hardware	783 pounds / 355.1 kg
Crew Health Care System hardware	
Environment Control and Life Support equipment	
Electrical Power System hardware	
Extravehicular Robotics equipment	
Flight Crew Equipment	
PL Facility	
Struc & Mech equipment	
Internal Thermal Control System hardware	
Science Investigations	721 pounds / 327.0 kg
CubeSats and deployers	
Japan Aerospace Exploration Agency	
Dynamic Surf Hardware	
Human Research Program resupply	
Computer Resources	18 pounds / 8.1 kg
Command and Data Handling	
Photo and TV equipment	
EVA equipment	87 pounds / 39.4 kg

LAUNCH AND RENDEZVOUS

The launch sequence of the mission will take approximately 10 minutes from Antares liftoff through separation of Cygnus at its initial orbit. When it arrives to the orbiting laboratory four days later, Cygnus will be grappled by Expedition 40 Commander Steve Swanson of NASA. He will use the space station's robotic arm to take hold of the spacecraft. Ground commands will be sent from mission control in Houston for the station's arm to rotate Cygnus around and install it on the bottom side of the station's Harmony module, enabling it to be bolted in place for its stay at the International Space Station. Under Orbital's Commercial Resupply Services contract with NASA, the company will deliver approximately 44,000 pounds, or 20 metric tons, of cargo to the space station over the course of eight missions. Orbital-2 is the second of these missions. It will make the fourth Antares launch conducted by Orbital in 14 months from Pad 0A at the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility.

RESEARCH HIGHLIGHTS

Planet Labs' Flock 1b

On the Orbital-1 mission in January, Planet Labs of San Francisco launched an initial fleet of 28 CubeSats, individually known as Dove satellites, from the space station. This collective group of small, relatively inexpensive, nanosatellites, known as Flock 1, will be joined by 28 additional Dove satellites, Flock 1b, on the Orbital-2 mission. They will deploy using the NanoRacks Smallsat Deployment Program to launch from the space station's Japanese Experiment Module (JEM) airlock. Once deployed, these two flocks will work in unison and capture imagery of the entire planet on a more frequent basis. These images can be used to help identify and track natural disasters and responses to them, as well as improve environmental and agricultural monitoring and management.

Two of the 28 Planet Labs Dove satellites that make up the Flock 1 constellation are seen launching into orbit earlier this year from the space station.

TechEdSat-4

The satellite-related investigation TechEdSat-4 is part of a larger ongoing study, the Small Payload Quick Return system, which provides a means of returning small payloads in a temperature and pressure controlled environment from the space station. TechEdSat-4 will deploy using the JEM Small Satellite Orbital Deployer. Its primary objectives are to further develop a tension-based drag device, or "Exo-Brake," and demonstrate frequent uplink/downlink control capabilities. Engineers believe exo-brakes eventually will enable small samples return from the station or other orbital platforms to Earth.

TechEdSat-3p deploys from the Japanese Small Satellite Orbital Deployer aboard the International Space Station.

Student Spaceflight Experiment Program

A close-up of the plant incubator in the NanoRacks Girl Scouts of Hawaii Microgreen Plant Growth investigation.

The National Center for Earth and Space Science-Charlie Brown, in association with the Student Spaceflight Experiment Program (SSEP), is an initiative of the National Center for Earth and Space Science Education, held in partnership with NanoRacks LLC. This STEM education initiative provides numerous students across the U.S. the ability to propose and design real experiments to fly on the space station. This investigation consists of 15 independent studies that were selected out of 1,344 student team proposals. These individual studies range from food growth and consumption, to determining the effect of microgravity on oxidation, to even the production of penicillin on the space station.

ORBITAL-2 MISSION TIMELINE

Flight Day 1 (Launch): Antares will launch Cygnus into orbit in a 10-minute flight sequence. After separation from Antares, Cygnus will deploy its solar arrays and prepare its propulsion system for maneuvers. As Cygnus orbits the Earth, it will increase its altitude, moving closer to the space station. The Cygnus team will conduct a series of tests to ensure the spacecraft's readiness for rendezvous and berthing with the space station.

Flight Day 2 & 3: Cygnus will continue its ascent toward the space station.

Flight Day 4: NASA will provide a "go" for Cygnus to berth with the station. Cygnus will approach to within 39.4 feet (12 m) and stop below the space station autonomously. Cygnus will be commanded by the astronauts aboard the station to "free drift," then will be captured by the robotic arm and subsequently attached to the station. This will require extreme precision as both Cygnus and station will be orbiting the Earth every 90 minutes, travelling in formation at approximately 17,500 mph (28,164 kph).

Flight Day 5 to Day 36: Astronauts will open Cygnus' hatch, unload the payloads and cargo and fill Cygnus with disposal cargo.

Flight Day 36: After it has completed its mission, Cygnus will be detached from the station August 15 and be guided to a safe distance away from the orbiting laboratory. The Cygnus spacecraft will fly up to an additional 15 days after departure to conduct spacecraft engineering tests to support future mission objectives. At the end of that free flight period, Cygnus will perform a series of engine burns so that it will re-enter Earth's atmosphere for a destructive reentry over the South Pacific Ocean.

ANTARES LAUNCH SEQUENCE

Mission Parameters: Orbital Attitude: 197 km x 303 km; Inclination: 51.64°

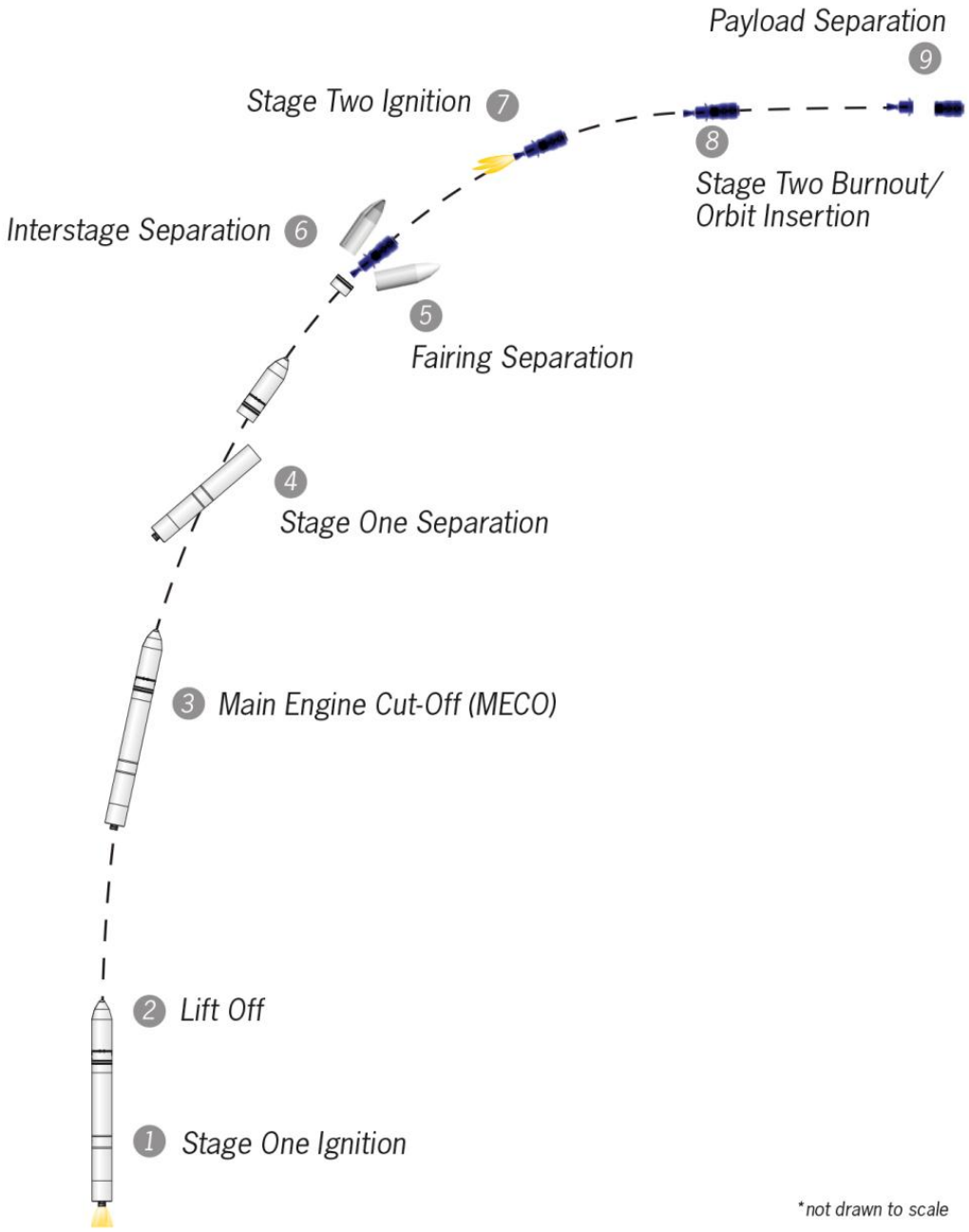
Countdown Highlights

*T Minus**	*Event*
T- 03:50:00	Launch Management Call to Stations
T- 03:05:00	Poll to Initiate Liquid Oxygen Loading System Chilldown
T- 01:30:00	Poll for Readiness to Initiate Propellant Loading
T- 00:15:00	Cygnus switched to Internal Power
T- 00:12:00	Poll for Final Countdown and MES Medium Flow Chilldown
T- 00:11:00	Transporter-Erector-Launcher (TEL) Armed for Rapid Retract
T- 00:05:00	Antares Avionics switched to Internal Power
T- 00:03:00	Auto-Sequence Start (Terminal Count)
T- 00:02:00	Pressurize Propellant Tanks
T- 00:00:00	Main Engine Ignition
T+ 00:00:02	Liftoff of Antares

* All times are approximate

Launch Highlights

	Time (Seconds)	*Event*	*Orbit (km)*
1	0	Stage One Ignition	0
2	2.1	Lift-off	0
3	235	Main engine Cut-Off (MECO)	102
4	241	Stage One Separation	108
5	331	Fairing Separation	168
6	336	Interstage Separation	170
7	340	Stage Two Ignition	171
8	477	Stage Two Burnout	202
9	597	Payload Separation	201


Payload Separation
9
Stage Two Ignition 7
8
Stage Two Burnout/
Orbit Insertion
Interstage Separation 6
5
Fairing Separation
4
Stage One Separation
3 Main Engine Cut-Off (MECO)
2 Lift Off
1 Stage One Ignition
*not drawn to scale

INTERNATIONAL SPACE STATION OVERVIEW

The International Space Station is an unprecedented achievement in global human endeavors to conceive, plan, build, operate and use a research platform in space.

Almost as soon as the space station was habitable, researchers began using it to study the impact of microgravity and other space effects on several aspects of our daily lives. With approximately 1,500 experiments completed on the station to date, the unique scientific platform continues to enable researchers from all over the world to put their talents to work on innovative experiments that could not be performed anywhere else.

The space station represents the culmination of more than two decades of dedicated effort by a multinational team of agencies spanning Canada, Europe, Japan, Russia and the United States. It provides the first laboratory complex where gravity, a fundamental force on Earth, is virtually eliminated for extended periods. This ability to control the variable of gravity in experiments opens up unimaginable research possibilities. As a research outpost, the station is a test bed for future technologies and a laboratory for new, advanced industrial materials, communications technology, medical research, and more.

In the areas of human health, telemedicine, education and observations from space, the station already has provided numerous benefits to human life on Earth. Vaccine development research, station-generated images that assist with disaster relief and farming, and education programs that inspire future scientists, engineers and space explorers are just some examples of research benefits, which are strengthening economies and enhancing the quality of life on Earth.

Clearly visible with the naked eye in the night sky, the expansive International Space Station is a working laboratory orbiting approximately 260 miles above the Earth traveling at 17,500 miles per hour and is home to an international crew. Assembly in space began in November 1998 with the launch of its first module, Zarya, and was completed with the departure of the Space Shuttle Atlantis on the program's final flight in June 2011. The station is as large as a five-bedroom home with two bathrooms, a gymnasium and a 360-degree bay window, and provides crew members with more than 33,000 cubic feet (935 cubic meters) of habitable volume. The station weighs nearly 1 million pounds (419,600 kilograms) and measures 361 feet (110.03 meters) end to end, which is equivalent to a U.S. football field including the end zones. The station's solar panels exceed the wingspan of a Boeing 777 jetliner and harness enough energy from the sun to provide electrical power to all station components and scientific experiments.

The station's first resident crew, Expedition 1, marked the beginning of a permanent international human presence in space, arriving at the station in a Russian Soyuz capsule in November 2000. For more than 13 years, station crews have provided a continuous human presence in space, with crews averaging six months at a time though the current 40th expedition.

Earlier this year, the Obama Administration approved an extension of the International Space Station until at least 2024. The decision will allow NASA to maximize its potential, deliver critical benefits to our nation and the world and maintain American leadership in space. This extension will give the agency and its private sector partners sufficient time to fully transition low-Earth orbit cargo transportation, research experiments and crew to the commercial space industry so that NASA can continue to focus on developing the next generation heavy-lift rocket and crew capsule necessary for deep space exploration.

Extending the life of the space station another decade will allow NASA to complete necessary technological and human research activities aboard the orbital laboratory that are associated with planned long-duration human missions beyond low-Earth orbit, including a planned human mission to an asteroid by 2025 and to Mars in the 2030s.

With the assembly of the space station at its completion and the support of a full-time crew of six, a new era of utilization for research is beginning. During the space station assembly phase, the potential benefits of space-based research and development were demonstrated, including the advancement of scientific knowledge based on experiments conducted in space, development and testing of new technologies, and derivation of Earth applications from new understanding.

The space station also is a vital precursor for future human exploration, where humans are learning how to combat the psychological and physiological effects of being in space for long periods, conducting both fundamental and applied research, testing technologies and decision-making processes.

The 2005 NASA Authorization Act designated the U.S. segment of the space station as a national laboratory. As the nation's only national laboratory on-orbit, the space station National Lab fosters relationships among NASA, other federal entities, and the private sector, and advances science, technology, engineering and mathematics education through utilization of the space station's unique capabilities as a permanent microgravity platform with exposure to the space environment. NASA's research goals for the space station are driven by the NASA Authorization Act of 2010 and are focused on the following four areas: human health and exploration, technology testing for enabling future exploration, research in basic life and physical sciences, and Earth and space science.

The International Space Station Program’s greatest accomplishment is as much a human achievement as it is a technological one—how best to plan, coordinate, and monitor the varied activities of the program’s many organizations. The program brings together international flight crews; multiple launch vehicles; globally distributed launch, operations, training, engineering, and development facilities; communications networks; and the international scientific research community.

Elements launched from different countries and continents are not mated together until they reach orbit, and some elements that have been launched later in the assembly

sequence were not yet built when the first elements were placed in orbit.

Construction, assembly and operation of the International Space Station requires the support of facilities on the Earth managed by all of the international partner agencies and countries involved in the program. These include construction facilities, launch support and processing facilities, mission operations support facilities, research and technology development facilities and communications facilities.

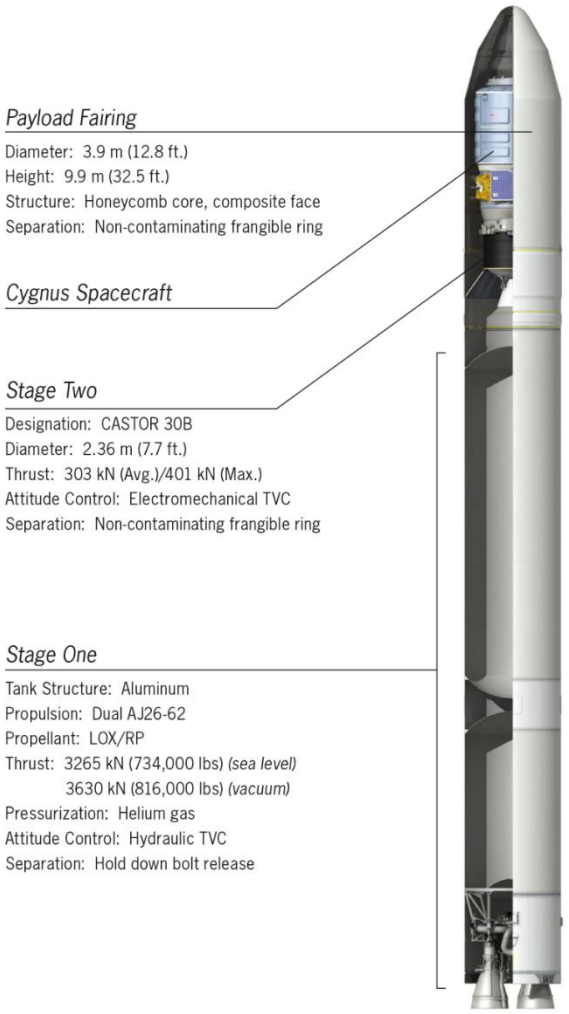
Operating the space station is even more complicated than other space flight endeavors because it is an international program. Each partner has the primary responsibility to manage and run the hardware it provides. The addition of commercial partners as providers of resupply and, in the future, crew transportation services, adds a new dimension to this complexity.

ANTARES

Antares is a two-stage launch vehicle consisting of a liquid-fueled liquid Oxygen/refined kerosene first stage powered by two Aerojet Rocketdyne AJ26 engines. The second stage is an ATK CASTOR 30B solid motor. Antares employs a 32.5 ft. (9.9 meter) fairing to protect Cygnus from atmospheric heating as it accelerates through Earth's atmosphere.

From its launch site at Wallops Island, Virginia, Antares is capable of supporting mid-inclination and polar orbiting spacecraft weighing up to approximately 13,500 lb. (6123 kg) and 5,500 lb. (2495 kg), respectively.

The Antares program successfully conducted its inaugural test launch on April 21, 2013 and the Orb-D1 demonstration mission on Sept. 18, 2013, both of which were conducted under the Commercial Orbital Transportation System (COTS) agreement with NASA. The first Commercial Resupply Services (CRS) program launch was conducted Jan. 9, 2014. For the CRS program, there are currently six more launches on the Antares manifest after the Orb-2 mission.



CYGNUS SPACECRAFT

Cygnus is a free-flying spacecraft developed under NASA's Commercial Orbital Transportation program. The spacecraft consists of a Pressurized Cargo Module (PCM) and a Service Module (SM). The PCM carries pressurized cargo and experiments to the space station and pressurized disposal cargo away from the station for destructive reentry at the end of the mission. The SM provides power, propulsion, guidance, computation, and communications for Cygnus.

Pressurized Cargo Module

Developed by Thales Alenia of Turin, Italy, the PCM shares its heritage with numerous space station modules, including the Multipurpose Logistics Module, the Autonomous Transfer Vehicle, and Nodes 2 and 3. The Cargo Module is designed with two configurations. The standard configuration carries up to 4,409 lbs. (2,000 kg) of cargo while the enhanced variant will carry up to 5,952 lbs. (2,700 kg). The Orb-2 mission will use the standard configuration.

Service Module

Propulsion
Dual-mode N2H4/MON-3 or N2H4, IHI Delta V engine generating 100 lbf. thrust, and 32 Rocket Engine Assemblies (REAs) which provide 6 lbf. of thrust, each.

Power
Two solar array wings on the service module, six panels total, generating 3.5 kW of power

Communications
Communication between Cygnus and the ISS is provided by JAXA's PROX system. The space station crew commands Cygnus using the Hardware Control Panel. Cygnus can also communicate on S-band via either the Tracking and Data Relay Satellite System or ground stations.

Environmental Control System
Astronauts will enter Cygnus to remove cargo. Cygnus provides a habitable cabin with air circulation, fire detection, lighting, pressure and temperature monitoring.

Safety
Cygnus meets NASA's high standards for human-rating to permit rendezvous and berthing to the space station. Cygnus successfully completed NASA's 3 Phase safety

certification program, proving that Orbital-engineered designs will ensure safe and successful missions for NASA and its crews. In addition, Cygnus met all 425 requirements necessary to approach and berth with the space station, imposed by the station to Visiting Vehicle Office specifications.

Power Video Grapple Fixture
The Cygnus Service Module includes a Power Video Grapple Fixture (PVGF) developed by MacDonald, Dettwiler and Associates, providing a mechanical and electrical interface between Cygnus and the Space Station Robotic Arm (SSRMS). The PVGF allows Cygnus to obtain 120V power from the SSRMS once captured, reducing the time sensitivity of berthing Cygnus after it is grappled by the robotic arm.

Avionics System
The Avionics System provides a two fault tolerance for all critical computational and commanding systems, ensuring that Cygnus will safely and successfully complete its resupply mission to the space station. Cygnus includes a four computer real time voting architecture that is designed to continually monitor the health of the spacecraft and react to anomalies while still maintaining the stringent safety requirements imposed on Cygnus by NASA.

Guidance and Navigation
Guidance and Navigation systems include specialized sensors and software to provide guidance from Antares separation to the capture location 12 meters below the ISS. The Navigation sensors include redundant Space Integrated Global Positioning System/Inertial Navigation System (SIGI) and redundant LIDARs to provide far and near field rendezvous guidance, respectively. SIGI and LIDAR have extensive flight heritage, increasing the chances for mission success. Navigation software includes Orbital proprietary software and software provided from Draper Laboratory, the company responsible for successfully guiding the Apollo capsule to the Moon and return, and providing rendezvous software for the Space Shuttle.

New Systems on Orb-2 Mission
The Orb-2 Cygnus spacecraft includes two major updates for this mission. One of the LIDARs will be replaced with Triangulation LIDAR (TriDAR), a model-based laser navigation sensor. While LIDAR relies on retro-reflectors located on the space station for navigation, TriDAR compares its readings with a CAD model of the station to determine Cygnus' relative position and attitude. TriDAR has a proven heritage having flown on three Space Shuttle missions. Cygnus will employ one TriDAR unit for the Orb-2 mission. Future missions will incorporate two TriDARs and one LIDAR.

For the Orb-2 mission Cygnus will also employ a new Quasonix S-band radio for telemetry and commanding of the Spacecraft. The Quasonix radio is lightweight and provides higher power capability than the S-band radio used in previous Cygnus missions.

LAUNCH FACILITIES

Virginia Commercial Space Flight Authority/Mid-Atlantic Regional Spaceport

The Virginia General Assembly created the Virginia Commercial Space Flight Authority (VCSFA) in 1995 to promote the development of the commercial space flight industry, economic development, aerospace research, and science, technology, engineering and math (STEM) education throughout the commonwealth.

In 1997, VCSFA entered into a Reimbursable Space Act Agreement with NASA, which provided for the lease of land at NASA Wallops Island, and applied for and was granted an FAA license to launch to orbit. This led to establishment of the VCSFA Mid-Atlantic Regional Spaceport (MARS), located on the southern portion of Wallops Island. MARS is approved for launch azimuths from 38 to 60 degrees, making it an ideal location from which to launch to the International Space Station. Pad-0B for small-class solid fueled rockets became operational in 1999 and was upgraded with a movable gantry in 2004.

Following the 2008 NASA selection of Orbital to participate in the COTS program and the follow-on CRS contract and subsequent selection of MARS as the launch site, MARS began construction on the all new state-of-the-art Pad 0A.

Since its establishment, nine successful space launch missions have launched from MARS.

- TacSat-2 (Minotaur I) 2006
- NFIRE (Minotaur I) 2007
- TacSat-3 (Minotaur I) 2009
- ORS-1 (Minotaur I) 2011
- A-ONE (Antares) 2013
- LADEE (Minotaur V) 2013
- Orb-D1 COTS Demonstration (Antares) 2013
- ORS-3 (Minotaur I) 2013
- Orb-1 (Antares) 2014

MARS Pad 0A

MARS Pad 0A is a medium-class launch facility used for Antares missions. The pad consists of:

- Piling-reinforced launch pad
- Ramp
- Liquid fueling facility
- Deluge system for cooling and acoustic suppression
- Launch mount/flame trench
- Hydraulic system for erecting the Antares Transporter/Erector/Launcher
- Environmental control system for payload/launch vehicle
- LO2 subcooler

Gross Lift-off Weight: More than one million pounds (453.6 metric tons); licensed for payloads up to low-Earth orbit: 11,100 lb. (5035 kg).

Pad 0A Specifications

Longitude:	75.49º E
Latitude:	37.83º N
Altitude:	0.03 km
Azimuth:	128.65º

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High Resolution Photos and Video

NASA and Orbital will post pre- and post-launch photos at http://www.nasa.gov/orbital and at http://www.orbital.com and on social media sites. Video highlights of the mission will be posted on NASA's and Orbital's YouTube channel after the launch.
More Resources on the Web

NASA Websites
http://www.nasa.gov
http://www.nasa.gov/orbital
http://www.nasa.gov/station
http://www.nasa.gov/nasatv
http://www.nasa.gov/connect

Orbital Websites
http://www.orbital.com
http://twitter.com/OrbitalSciences
http://facebook.com/orbitalSciencesCorp
http://youtube.com/OrbitalSci
http://flickr.com/photos/orbitalsciences

Broadcast/Webcast Information

The launch will be broadcast live on NASA Television and webcast at
http://www.nasa.gov/nasatv

Prelaunch coverage will begin approximately one hour prior to launch.