

Unpressurized Cargo ORION a Launch Opportunities for Lunar Missions. M. B. Milam¹ and R. Lewis²,
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Introduction: Access to space cost and availability is and has been the primary problem for lunar missions. The Orion/Aires I launch vehicle can be used as a launch platform for lunar missions while the Orion is enrooted to the ISS. Studies at the GSFC indicate that a 50 kg payload can be placed in lunar orbit using this launch method. This capability is part of a new program similar to the Hitch Hiker program where excess space on the Space Shuttle was filled with scientific instruments, small free flying satellites and technology experiments. The approach is to launch the Orion with the Aires I and use one of three modes to accommodate science payloads, fixed pallet payloads, extractable or ejectable payloads. The fixed pallet mode is where the payload is permanently integrated with the Orion service module and stay in space for 6 months while the Orion is attached to the ISS. The extractable payload mode is one that is removed from the Orion with one of the ISS robotic arms and placed on the ISS for long durations. The third mode is to eject a free flying satellite out of the Orion Service Module that can stay in an ISS like orbit, boosted to a longer duration orbit or sent to lunar orbit. Possible payloads for the lunar case are scientific instruments, communication relays or lunar technology demonstrations.

Resources: The resources available to the payload change based of mission timeline. For example while attached to the Orion. The resources available are as follows:

Fixed Pallet Table I

Parameter	Capability
Orbit	LEO, 52°; ~350 km
Duration of Flight	180 days
Volume	≤2.92(m ³ (103 ft ³))
Mass	25-250 kg
Power	≤1.0 kW
Data Rate	≤ 30 Mbps
Thermal	Passive/Active
Field of View	Zenith or Nadir
Payload sites	One-Four

For the free flyer the post ejection the parameters are mission specific based on specific spacecraft design. The next table shows what is possible with known technology at this time.

Free Flyer Table II

Parameter	Capability
Orbit	LEO to Lunar
Duration of Flight	Varies
Volume	≤2.92(m ³ (103 ft ³))
Mass	50-200 kg
Power	1.5 kW
Data Rate	≤2.25 Mbps
Pointing Accuracy	TBD

Extractable Payload Table III* (ISS Attached Payload)

Parameter	Capability
Orbit	LEO, 52°; ~350 km
Duration of Flight	Varies
Volume	≤2.92(m ³ (103 ft ³))
Mass	450 kg
Power	1.25-3.0 kW
Data Rate	1.55 – 100 Mbps
Thermal	Passive
Field of View	Zenith or Nadir

*NASA/TP-2007-214768 "Overview of Attached Payload Accommodations and Environments on the International Space Station"

Payload Volume: The payload volume for the fixed pallet case is shown in the table above. A more restricted case is the free flyer that, due to clearance issues is restricted to a cylinder 127 cm Dia. by 152.4 cm H or 114.3 cm Dia. by 203.2 cm H. The volumes are very generous. The parameters in the tables are based on studies of various missions to explore the use of excess performance on Orion. Free flying spacecraft when detached will have performance per the satellite design that may be different than the study values above.

Conclusion: The Orion has excess performance on at least 14 flights that can be used for lunar and other missions early in the Orion program. It is in the best interest of the Lunar Science community to take full advantage of this capability the new launch vehicle infrastructure brings to NASA. The point of contact for UPC-Orion is Bruce.Milam@nasa.gov.