

INTERNATIONAL REFERENCE GUIDE TO SPACE LAUNCH SYSTEMS

Fourth Edition



 AIAA

Steven J. Isakowitz
Joshua B. Hopkins
Joseph P. Hopkins Jr.

Property of:
Marshall H. Kaplan
8029 Rising Ridge Road
Bethesda, MD 20817

**INTERNATIONAL
REFERENCE GUIDE TO
SPACE LAUNCH SYSTEMS
FOURTH EDITION**

STEVEN J. ISAKOWITZ • JOSHUA B. HOPKINS • JOSEPH P. HOPKINS JR.

Corporate Sponsors

SpaceWorks Engineering, Inc.
Lockheed Martin Corporation

Published and distributed by



American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Suite 500
Reston, Virginia 20191-4344

PHOTO CREDITS

Front cover, from left:

H-IIA, Dnepr, Athena, and Minotaur

Back cover, from left:

GSLV, Volna, Atlas V, and Delta IV

Background:

Athena launch from Kodiak Island, Alaska

Cover design by Sara Bluestone

Library of Congress Cataloging-in-Publication Data

Isakowitz, Steven J.

International reference guide to space launch systems / Steven J. Isakowitz, Joseph P. Hopkins Jr., Joshua B. Hopkins.-- 4th ed.

p. cm.

Includes bibliographical references.

ISBN 1-56347-591-X (pbk. : alk. paper)

1. Launch vehicles (Astronautics)--Encyclopedias. 2. Reusable space vehicles--Encyclopedias. 3. Space shuttles--Encyclopedias. I. Hopkins, Joseph P. II. Hopkins, Joshua B. III. Title.

TL785.8.L3I83 2004

629.47--dc22

2004014007

Copyright © 2004 by the American Institute of Aeronautics and Astronautics, Inc. All other rights reserved. Printed in the United States of America. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the Publisher.

Data and information appearing in this book are for informational purposes only and are not intended for use nor to be relied upon. AIAA, SpaceWorks Engineering, Inc., and Lockheed Martin Corporation are not responsible for injury or damage resulting from use or reliance, and do not warrant that use or reliance will be free from privately owned rights.

K-1



K-1

GENERAL DESCRIPTION

Summary

The K-1 is a new two-stage reusable launch vehicle being developed commercially by Kistler Aerospace Corporation. The K-1 can carry payloads up to 4600 kg. Both stages are recovered using parachutes and airbags. Launch operations will be conducted from new launch facilities in Australia and Nevada. Both stages burn LOX/kerosene propellants and are powered by Aerojet engines modified from the core Russian NK-33/43 engines. An optional expendable third stage, fueled by MMH/N₂O₄, can be used for high-orbit missions. An optional cargo module can be used for International Space Station (ISS) resupply missions.

Status

In development. First launch planned 13–18 months after completion of financing.

Origin

United States

Key Organizations

Marketing Organization	Kistler Aerospace Corporation
Launch Service Provider	Kistler Aerospace Corporation
Prime Contractor	Kistler Aerospace Corporation

Primary Missions

ISS servicing, LEO satellites, or small satellites to high-energy orbits with optional upper stage.

Estimated Launch Price

\$17 million for LEO missions (Kistler 2002)
\$25 million with upper stage (Kistler 2002)

Spaceports

Launch Site	Woomera, Australia
Location	31.1° S, 136.6° E
Available Inclinations	45–60 deg, 84–99 deg
Landing Site	Woomera, Australia
Launch Site	Nevada Test Site
Location	37.3° N, 116.5° W
Available Inclinations	45–60 deg, 84–99 deg
Landing Site	Nevada Test Site

Performance Summary

The following performance values are for a launch from the Woomera Spaceport using the standard payload module for LEO missions, the Active Dispenser Module for high orbits, and the ISS cargo module for ISS missions. Payload adapter mass must be subtracted to determine available spacecraft mass.

200 km (108 nmi), 45 deg	4600 kg (10,150 lbm)
200 km (108 nmi), 90 deg	3000 kg (6600 lbm)
Space Station Orbit: 407 km (220 nmi), 51.6 deg	3750 kg (8250 lbm) upmass 900 kg (2000 lbm) downmass
Sun-Synchronous Orbit: 800 km (432 nmi), 98.6 deg	1250 kg (2750 lbm)
GTO: 200x35,786 km (108x19,323 nmi), 45 deg	1570 kg (3460 lbm)
Geostationary Orbit	800 kg (1760 lbm)

Flight Record (through 31 December 2003)

Total Orbital Flights	0
-----------------------	---

Flight Rate

To be determined

NOMENCLATURE

The K-1 designation refers to the first launch vehicle developed by Kistler Aerospace Corporation. The first stage of the K-1 is referred to as the Launch Assist Platform (LAP). The name stems from an early design in which the first stage was to be a rocket-powered platform that carried the second stage. The second stage is called the Orbital Vehicle (OV). Spacecraft are carried in a reusable payload module (PM) rather than a conventional payload fairing. Three types are available – the Standard Payload Module (SPM), Extended Payload Module (EPM), and Active Dispenser Payload Module (ADPM). The phrase Active Dispenser refers to an optional expendable upper stage. A cargo module (CM) is also available to support ISS resupply missions.

COST

The K-1 development program has been financed commercially. More than \$600 million in financing was raised through the mid 1990s before investment began to decline. The funding was provided by investors in the United States, Saudi Arabia, Asia, and Europe, and from vendors and subcontractors. For example, Northrup Grumman had a contract for \$145 million to build structures for the vehicle, and advanced \$30 million to Kistler in 1998 to continue work when funding slowed. In 2001 Kistler received a contract worth up to \$135 million from NASA under the Space Launch Initiative. However, this consisted of a \$10 million firm contract and options for up to \$125 million for flight demonstrations of 13 technologies if the K-1 vehicle was developed. (These options had not been exercised at the time of publication.)

According to Kistler, LEO missions will be priced at \$17 million per flight. Missions requiring the expendable upper stage will be priced at \$25 million. These prices do not include mission integration.

AVAILABILITY

The first launch date is contingent on completion of fundraising. Once full financing is in place, first flight could occur within 18 months.

PERFORMANCE

The K-1 will be launched from Spaceport Woomera in Australia. A second launch site is also planned at the Nevada Test Site in the United States. Both sites are landlocked, so launch azimuths are limited to those that do not endanger populated areas. The K-1 can reach inclinations in two sectors between 45–60 deg and 84–99 deg from both sites. As operational experience is gathered, additional inclinations can be considered depending on customer needs. Performance shown includes a 3-sigma flight performance reserve (FPR). These performance values do not account for mission-specific spacecraft adapters or dispensers. Launches are assumed to be conducted from Spaceport Woomera, the location of initial flights. Performance is up to 400 kg (880 lbm) higher for launches from the Nevada Test Site as a result of the higher launch site elevation.

<u>Woomera Azimuths</u>	<u>Nevada Azimuths</u>	<u>Resulting Inclination</u>
55–33 deg	62–36 deg	45–60 deg
5–14 deg	5–14 deg	84–99 deg

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.