

SPACE SYSTEMS SYMPOSIUM (D1)  
Lessons Learned in Space Systems (5)

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NON-U.S. MEDIUM LAUNCH VEHICLE FAILURES

**Abstract**

**Purpose:** This is a follow-on paper to the following papers that the authors presented at ISTS in Japan and at IAC in Spain, Scotland, U.K., and Republic of Korea.

- ISTS 2006-a-22 "Survey of U.S. Small Launch Vehicle Failures"
- ISTS 2006-a-23 "Survey of Non-U.S. Small Launch Vehicle Failures"
- ISTS 2008-g-11 "U.S. Human Space Transportation Failures"
- ISTS 2008-g-12 "Non-U.S. Human Space Transportation Failures"
- IAC-06-D2.4.10 "Assessment of U.S. Human Space Launch and Flight Programs"
- IAC-08-D1.5.3 "Heavy Launch Vehicle Failure History"
- IAC-09-D1.5.1 "51 Years of Space Launches and Failures"

Successful launch to deliver satellites or humans to Earth orbit and beyond is the most important step in space exploration, and mitigating launch risks and improving launch reliability should be the top priority of any space endeavor. In this paper, the failure history of USSR/CIS, Europe, China, Japan, and India medium launch vehicles (MLVs) since the inception of space age is discussed. The purpose is to provide lessons learned on Non-U.S. MLV failures from the past to aid in implementing a strategy to mitigate launch risk in the future.

**Methodology:** A comprehensive database has been developed by The Aerospace Corporation that will eventually log the entire space launch and flight history. Space launch failure history data is a part of the comprehensive database highlighting launch failure description and corrective action explanation for all launch vehicles in the world. This paper complements the previously published papers on failure histories of Non-U.S. small and heavy launch vehicles and addresses the failure history of Non-U.S. MLVs.

**Results:** The paper starts with a description of Non-U.S. MLV background and reliability during last 53 years, followed by a discussion of Non-U.S. MLV failure causes during last 25 years. Analysis results of failures by root cause, element, function, domain, component, and part and of failure outcome, mode, and time are presented. Findings of failures and their mitigation strategy for Non-U.S. MLVs are summarized at end of the paper.

**Conclusions:** The compilation of data from different space programs and detailed analysis of launch failures and their mitigation strategy make the material in this IAC paper new and original. This paper is the result of research based on information available in public domain and has not been presented or submitted for publication elsewhere. Financing the attendance of at least one author at the 61st IAC to present the paper is assured.