SPACE SHUTTLE MISSIONS SUMMARY

Robert D. Legler
Floyd V. Bennett

Mission Operations
Johnson Space Center

September 2011
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MOD EMBLEM DESCRIPTION

This emblem was developed during the Apollo program for the mission control team [JSC Mission Operations Directorate, MOD] to recognize their unique contribution to manned space flight since the Mercury program.

The sigma (Σ) represents the total mission team, including flight controllers, instructors, flight design and production specialists, and facility development and support teams including all engineering, scientific, operations disciplines, and supporting tasks.

The Shuttle launch represents the dynamic elements of space, the initial escape from our environment, and the thrust to explore the universe. The four stars on the Shuttle’s plume represent the basic principles of the Mission Operations team: discipline, morale, toughness, and competence. Their place along the Shuttle’s plume reminds us that they are the foundation upon which each mission is flown. Today’s core principles include confidence, responsibility, teamwork, and vigilance. Each of these words comes into the vocabulary of Mission Operations personnel at critical points in their development. These words can never be forgotten if we are to succeed in the future.

The orbiting International Space Station symbolizes a permanent human presence in space, conducting research and developing materials leading to the commercial utilization of the space environment.

The Earth is our home and will forever be serviced by both manned and unmanned spacecrafts in order to improve our quality of life. A single star is positioned over Houston, the home of U.S. human spaceflight operations.

The comet represents those individuals who have given their lives for space exploration. The seventeen stars represent our fallen astronauts, to whom in part we dedicate our commitment to excellence. These symbols serve as a reminder of the risks inherent to space flight and recognize that we of Mission Operations provide the margin that makes the risk acceptable.

The Mercury, Gemini, Apollo, Skylab, and Apollo-Soyuz Test are represented on the bottom border. At the top of the emblem, the Moon and Mars represent our future, signifying our intent to lead the way.

The wording “RES GESTA PER EXCELLENTIAM” - “Achieve through Excellence” - is the standard for our work. It represents an individual's commitment to a belief, to craftsmanship, and to perseverance, qualities required to continue the peaceful development of space and the quest for the stars.

The original emblem was designed (at the request of White Flight, Gene Kranz) by Robert T. McCall in April 1973 and bears the inscription “For the Personnel of Mission Control with Great Respect and Admiration. Robert T. McCall.” Mr. McCall died at age 90, May 5, 2010. In 1983, the original emblem was updated to support the Space Shuttle program. In 2004, with the artistic help of graphic designer Mike Okuda and participation of the Mission Operations team, the emblem was updated to recognize the achievements and contributions of the team supporting the International Space Station program as well as those that contributed to the success of the earlier Skylab and Apollo-Soyuz Test Project missions.
This document was originally produced as an informal Mission Operations book and has been updated since Space Shuttle Flight STS-1 and throughout the program. This version is a formally released NASA document. It is a handy reference guide for flight data for all Space Shuttle missions. “As-flown” data is provided as compiled from many flight support sources for ascent, on-orbit events, and descent mission phases. In addition, the specific shuttle vehicle configuration, payload, flight crew, and flight directors are identified for each flight. In the development of this book, the data for the early flights are contained on a single page per flight. For later flights, more pages per flight have been added, primarily for growth in mission complexity as noted in the “Mission Highlights” data column. This particularly applies to missions involved in the assembly of the International Space Station. Pertinent photos for each mission are also included on each mission summary page.
FOREWORD

THE REUSABLE SPACE SHUTTLE

The Space Shuttle Vehicle (SSV) was the world’s first reusable spacecraft. It consisted of a reusable Orbiter Vehicle with three Space Shuttle Main Engines (SSMEs), two Solid Rocket Boosters (SRBs), and an expendable External Tank (ET). The Space Shuttle System consisted of the SSV elements, Shuttle Carrier aircraft, payload accommodations, and ground support systems. The SSV was designed to perform a variety of missions to low Earth orbit with heavy payload lift capability.

SSV missions included: Manned payload bay laboratory science, deployment and servicing of payloads, and special support to space activities such as sortie missions (rescue, repair, maintenance servicing, assembly, and docking), and International Space Station (ISS) assembly, manning, and support including robotic and manned extra vehicular activities.

The SSV was flown for 30 years from 1981 to 2011. Brief mission summaries for each of these missions are provided in this document. The document contains “as flown” mission data and pertinent photographs for each flight. It was originally published as an informal document and routinely updated throughout the Shuttle era.

ABOVE: S81-30498 --- After six years of silence, the thunder of U.S. manned spaceflight is heard again, as the successful launch of the first Space Shuttle reusable vehicle, Columbia, ushers in a new concept in utilization of space - April 12, 1981.

RIGHT: Thirty years later on STS-135, the Atlantis vehicle executes the final Space Shuttle landing on July 21, 2011 at KSC. With the closure of the Space Shuttle Program, the thunder of U.S. manned spaceflight is not expected to be heard again for another several years.
The Space Shuttle--1981 to 2011

The Space Transportation System--STS--has had a spectacular career spanning three decades of intense and productive activities in space. The Shuttle was conceived as a reusable launch system to grossly reduce the cost of transporting humans and satellites into low earth orbit and to service the entire spectrum of government and commercial space operations requirements. To accomplish this challenging task required the development of a series of new technologies in rocket engines, space systems, unique materials, highly advanced manufacturing techniques, autonomous control concepts and never before attempted flight operations maneuvers. The fact that these devices were conceived and developed and in almost all cases could be reused is a testimony to the marvelous capability of the US and allied aerospace community.

Equally significant was the ability of the government industry team to bring about the successful development of this phenomenal machine under the stringent and ever changing and fickle government budgetary process. The management team was required to continuously adjust the expenditure of funds because of both postponement and reductions in national budget that resulted in a delay in manufacturing facilities, extended testing periods and technology development which presented extraordinary circumstances regarding the ability to arrive at the first flight of the Shuttle. And although the first and subsequent STS flights were delayed by several years, the cost to build the transportation system was reasonably close to the original cost estimates. Indeed, if the effects of inflation are included, the overall cost of the program was probably within the costs estimates made almost ten years previously.

There were two devastating fatal accidents during the course of the STS time period. It should be noted that both of these accidents took place because of mismanagement. The accidents literally destroyed the user confidence in the STS and resulted in the eventual termination of the Shuttle. The Space Shuttle without these two unnecessary failures is an extremely safe space faring vehicle and it will be a long time in the future before a reusable rocket caring humans will match this accomplishment.

An overall assessment of the STS must say that history will show the accomplishments were spectacular.

Christopher C. Kraft, Jr.
First Flight Director

I look at the three decades of Space Shuttle flights with a great deal of pride. John Young and I had the privilege of flying Columbia on the initial orbital test flight. While the Shuttle didn’t live up to some of the preflight hype regarding flight rate and cost, it still is the most fantastic spaceship ever built and likely will be for the foreseeable future. Yes, we had two terrible tragedies, but spaceflight is not without risk now and for the foreseeable future.

The Shuttle has accomplished many wondrous feats in its 30 years of flight. In the beginning it flew very important DOD missions that I believe played a major role in the winning of the Cold War. The payloads it has taken to orbit have revolutionized knowledge of our solar system and the universe. The Shuttle Program made possible the construction of the unbelievably complex International Space Station.

All in all, everyone associated with the Shuttle should be proud of what the program accomplished. It will be a very long time before we see a spaceship with anywhere near the Shuttle’s capability.

Bob (Crip) Crippen
PLT STS-1, and CDR STS-7, STS-41C & STS-41g
KSC Center Director 1992 - 1995

Continued…
Developed primarily in the 1970’s, the National Space Transportation System (Space Shuttle) was, and remains to this day, the most innovative and capable human rated space launch system created by man.

As much as Apollo, the Space Shuttle established the United States as the human space flight technology leader of the world, made human access to low-Earth orbit (LEO) relatively routine, and raised the expectations of the global population in regards to the value of space to mankind. It has enabled us to learn to live and work in space to create value on Earth.

The Shuttle designers both advanced the state of technology by levying seemingly unachievable technical challenges, such as the incredibly high power density Space Shuttle Main Engine (SSME), complex redundant data processing, and reusable thermal protection systems, as well as utilizing available technology like aluminum structure and hydraulic flight control and thrust vector control systems.

By advancing the state of the art in mission planning and execution, the Shuttle team took maximum advantage of the extensive capabilities available from both man and machine and the synergistic interplay between them. The results in mission accomplishments are undeniable and have forever transformed our understanding of the world in which we live.

Brewster H. Shaw, Jr.
PLT STS-9 and CDR STS-61B & STS-28
Space Shuttle Program Mgr 1993 -1995
VP & GM Space Exploration Boeing Houston
# Table of Contents

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
<th>Launch Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEMBLEM</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
<td></td>
</tr>
<tr>
<td>FOREWORD</td>
<td>iii</td>
<td></td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vi</td>
<td></td>
</tr>
<tr>
<td>ACRONYMS</td>
<td>vii</td>
<td></td>
</tr>
<tr>
<td>ABOUT THIS DOCUMENT</td>
<td>1-1</td>
<td></td>
</tr>
<tr>
<td>STS-1</td>
<td>2-1</td>
<td>04/12/81</td>
</tr>
<tr>
<td>STS-2</td>
<td>2-2</td>
<td>11/12/81</td>
</tr>
<tr>
<td>STS-3</td>
<td>2-3</td>
<td>03/22/82</td>
</tr>
<tr>
<td>STS-4</td>
<td>2-4</td>
<td>05/27/82</td>
</tr>
<tr>
<td>STS-5</td>
<td>2-5</td>
<td>11/11/82</td>
</tr>
<tr>
<td>STS-6</td>
<td>2-6</td>
<td>04/04/83</td>
</tr>
<tr>
<td>STS-7</td>
<td>2-7</td>
<td>06/18/83</td>
</tr>
<tr>
<td>STS-8</td>
<td>2-8</td>
<td>08/30/83</td>
</tr>
<tr>
<td>STS-9</td>
<td>2-9</td>
<td>11/28/83</td>
</tr>
<tr>
<td>STS-11 (41-B)</td>
<td>2-10</td>
<td>02/03/84</td>
</tr>
<tr>
<td>STS-41-C</td>
<td>2-11</td>
<td>04/06/84</td>
</tr>
<tr>
<td>STS-41-DR</td>
<td>2-12</td>
<td>09/30/84</td>
</tr>
<tr>
<td>STS-41-G</td>
<td>2-13</td>
<td>10/05/84</td>
</tr>
<tr>
<td>STS-51-A</td>
<td>2-14</td>
<td>11/08/84</td>
</tr>
<tr>
<td>STS-51-C</td>
<td>2-15</td>
<td>01/24/85</td>
</tr>
<tr>
<td>STS-51-E</td>
<td>2-16</td>
<td>N/A</td>
</tr>
<tr>
<td>STS-51-D</td>
<td>2-17</td>
<td>04/12/85</td>
</tr>
<tr>
<td>STS-51-B</td>
<td>2-18</td>
<td>04/29/85</td>
</tr>
<tr>
<td>STS-51-G</td>
<td>2-19</td>
<td>06/17/85</td>
</tr>
<tr>
<td>STS-51-F</td>
<td>2-20</td>
<td>07/29/85</td>
</tr>
<tr>
<td>STS-51-I</td>
<td>2-21</td>
<td>08/27/85</td>
</tr>
<tr>
<td>STS-51-J</td>
<td>2-22</td>
<td>10/03/85</td>
</tr>
<tr>
<td>STS-61-A</td>
<td>2-23</td>
<td>10/30/85</td>
</tr>
<tr>
<td>STS-61-B</td>
<td>2-24</td>
<td>11/26/85</td>
</tr>
<tr>
<td>STS-61-C</td>
<td>2-25</td>
<td>01/12/86</td>
</tr>
<tr>
<td>STS-51-L</td>
<td>2-27</td>
<td>01/28/86</td>
</tr>
<tr>
<td>STS-26</td>
<td>2-28</td>
<td>09/29/88</td>
</tr>
<tr>
<td>STS-27</td>
<td>2-29</td>
<td>12/02/88</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
<th>Launch Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-29</td>
<td>2-30</td>
<td>03/13/89</td>
</tr>
<tr>
<td>STS-59</td>
<td>2-74</td>
<td>04/09/94</td>
</tr>
<tr>
<td>STS-103</td>
<td>2-119</td>
<td>12/19/99</td>
</tr>
<tr>
<td>STS-130/20A</td>
<td>2-221</td>
<td>02/08/10</td>
</tr>
<tr>
<td>STS-30</td>
<td>2-32</td>
<td>05/04/89</td>
</tr>
<tr>
<td>STS-65</td>
<td>2-75</td>
<td>07/08/94</td>
</tr>
<tr>
<td>STS-99</td>
<td>2-121</td>
<td>02/11/00</td>
</tr>
<tr>
<td>STS-131/19A</td>
<td>2-225</td>
<td>04/05/10</td>
</tr>
<tr>
<td>STS-28</td>
<td>2-33</td>
<td>08/08/89</td>
</tr>
<tr>
<td>STS-64</td>
<td>2-76</td>
<td>09/09/94</td>
</tr>
<tr>
<td>STS-101/2A.2a</td>
<td>2-123</td>
<td>05/19/00</td>
</tr>
<tr>
<td>STS-132/ULF4</td>
<td>2-229</td>
<td>05/14/10</td>
</tr>
<tr>
<td>STS-34</td>
<td>2-34</td>
<td>10/18/89</td>
</tr>
<tr>
<td>STS-68</td>
<td>2-77</td>
<td>03/30/94</td>
</tr>
<tr>
<td>STS-106/2A.2b</td>
<td>2-125</td>
<td>09/08/00</td>
</tr>
<tr>
<td>STS-133/ULF5</td>
<td>2-234</td>
<td>02/24/11</td>
</tr>
<tr>
<td>STS-33</td>
<td>2-35</td>
<td>11/22/89</td>
</tr>
<tr>
<td>STS-66</td>
<td>2-78</td>
<td>11/03/94</td>
</tr>
<tr>
<td>STS-92/3A</td>
<td>2-127</td>
<td>10/11/00</td>
</tr>
<tr>
<td>STS-134/ULF6</td>
<td>2-240</td>
<td>05/16/11</td>
</tr>
<tr>
<td>STS-32</td>
<td>2-36</td>
<td>01/09/90</td>
</tr>
<tr>
<td>STS-63</td>
<td>2-79</td>
<td>02/03/95</td>
</tr>
<tr>
<td>STS-97/4A</td>
<td>2-130</td>
<td>11/30/00</td>
</tr>
<tr>
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<td>2-132</td>
<td>02/07/01</td>
</tr>
<tr>
<td>STS-102/5A.1</td>
<td>2-134</td>
<td>03/08/01</td>
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<td>STS-100/6A</td>
<td>2-136</td>
<td>04/19/01</td>
</tr>
<tr>
<td>STS-106/2A.2b</td>
<td>2-140</td>
<td>09/10/01</td>
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<td>2-142</td>
<td>12/05/01</td>
</tr>
<tr>
<td>STS-108/UF-1</td>
<td>2-144</td>
<td>03/01/02</td>
</tr>
<tr>
<td>STS-109</td>
<td>2-146</td>
<td>04/08/02</td>
</tr>
<tr>
<td>STS-110/8A</td>
<td>2-148</td>
<td>06/05/02</td>
</tr>
<tr>
<td>STS-111/UF-2</td>
<td>2-150</td>
<td>07/26/05</td>
</tr>
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<td>STS-112/9A</td>
<td>2-151</td>
<td>10/07/02</td>
</tr>
<tr>
<td>STS-113/11A</td>
<td>2-154</td>
<td>11/23/02</td>
</tr>
<tr>
<td>STS-107</td>
<td>2-157</td>
<td>01/16/03</td>
</tr>
<tr>
<td>STS-114/LF1</td>
<td>2-159</td>
<td>07/26/05</td>
</tr>
<tr>
<td>STS-121/ULF1.1</td>
<td>2-163</td>
<td>07/04/06</td>
</tr>
<tr>
<td>STS-115/12A</td>
<td>2-166</td>
<td>09/09/06</td>
</tr>
<tr>
<td>STS-116/12A.1</td>
<td>2-170</td>
<td>12/09/06</td>
</tr>
<tr>
<td>STS-117/13A</td>
<td>2-174</td>
<td>06/09/07</td>
</tr>
<tr>
<td>STS-118/13A.1</td>
<td>2-178</td>
<td>08/09/07</td>
</tr>
<tr>
<td>STS-120/10A</td>
<td>2-182</td>
<td>10/23/07</td>
</tr>
<tr>
<td>STS-122/1E</td>
<td>2-185</td>
<td>02/07/08</td>
</tr>
<tr>
<td>STS-123/1JA</td>
<td>2-189</td>
<td>03/11/08</td>
</tr>
<tr>
<td>STS-124/1J</td>
<td>2-193</td>
<td>05/31/08</td>
</tr>
<tr>
<td>STS-125-ULF2</td>
<td>2-198</td>
<td>11/14/08</td>
</tr>
<tr>
<td>STS-127/2A</td>
<td>2-201</td>
<td>03/15/09</td>
</tr>
<tr>
<td>STS-128/17A</td>
<td>2-213</td>
<td>08/29/09</td>
</tr>
<tr>
<td>STS-129/ULF3</td>
<td>2-217</td>
<td>11/16/09</td>
</tr>
<tr>
<td>Weight Summary</td>
<td>A-1</td>
<td></td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>B-1</td>
<td></td>
</tr>
<tr>
<td>Flight Director Log</td>
<td>C-1</td>
<td></td>
</tr>
<tr>
<td>Legler (in Memoriam)</td>
<td>IM-1</td>
<td></td>
</tr>
<tr>
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<td>SA-1</td>
<td></td>
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<tr>
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<td>ASCENDING RIGHT</td>
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<td>ASCENT</td>
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<tr>
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<td>ASCENT ENTRY</td>
<td></td>
</tr>
<tr>
<td>AVE</td>
<td>AVERAGE BRAKE DECELERATION</td>
<td></td>
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<td>BREAK UP ALTITUDE OF ET IN THOUSANDS OF FEET</td>
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<td>BANJUL</td>
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<tr>
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<td>CREW TIME ON BACK</td>
<td></td>
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<tr>
<td>DENS ALT</td>
<td>DENSITY ALTITUDE</td>
<td></td>
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<tr>
<td>DL</td>
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<td></td>
</tr>
<tr>
<td>DOLULU</td>
<td>DAY OF LAUNCH-LOAD UPDATE</td>
<td></td>
</tr>
<tr>
<td>DR</td>
<td>DESCENDING RIGHT</td>
<td></td>
</tr>
<tr>
<td>EDW</td>
<td>EDWARDS AFB</td>
<td></td>
</tr>
<tr>
<td>EMU</td>
<td>ENVIRONMENTAL MOBILITY UNIT</td>
<td></td>
</tr>
<tr>
<td>ET</td>
<td>EXTERNAL TANK</td>
<td></td>
</tr>
<tr>
<td>EVA</td>
<td>EXTRA VEHICULAR ACTIVITY</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>SS FEMALE NUMBER</td>
<td></td>
</tr>
<tr>
<td>FD</td>
<td>FLIGHT DIRECTOR</td>
<td></td>
</tr>
<tr>
<td>FDRD</td>
<td>FLIGHT DEFINITION &amp; REQUIREMENTS DOCUMENT</td>
<td></td>
</tr>
<tr>
<td>FRR</td>
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**CONVERSION FROM INFORMAL DOCUMENT**

Robert D. “Bob” Legler/DA8/USA was the originator of this book as an informal Mission Operations Document to provide a “handy reference guide” for “as flown” mission data, often used by JSC Flight Controllers and Mission Planners.

Mr. Legler authored the informal book from flight STS-1 through flight STS-115. After Legler’s death in 2007, Floyd V. Bennett/DA8/USA/GHG took over the authorship for STS-116 and all missions to follow. In addition, a “Brief Mission Summary” statement for all ISS assembly missions and pertinent mission related photos to each summary file were incorporated.

This formal NASA document is a conversion of the informal version to provide an official historical record of pertinent Space Shuttle Missions Operational Data.

**DOCUMENT FORMAT**

The “as flown” operational mission data is presented in a summary table format of twelve columns. For early flights the book contains one page of data per flight. For later flights, as on-orbit activities became more and more complex, additional pages per flight were added, primarily for growth in the 12th column, “Mission Highlights”.

In addition a summary table of weight data for each shuttle element and payloads for each mission is provided in Appendix A.

In Appendix B the authors acknowledge individuals for contributions to the preparation of this document and provides the data sources and Points of Contact (POCs) used in compiling flight and weight data.

Appendix C provides an historical record of JSC Flight Controllers originally compiled by Bob Legler, “History Flight”. Since his death the listing has been maintained by the JSC Flight Directors Office.

And lastly, information about the authors is provided in the back of the book including an “In Memoriam” for Bob Legler.

**MISSION SUMMARIES DATA DEFINITIONS**

This section contains definitions of the data provided in the Mission Summaries by column number. Several entries have been assigned sequential numbers for reference purposes (e.g., # of rendezvous, # of night launches, # EVAs, etc.).

**Column 1:**

**FLIGHT NUMBERS** - The flight numbers include the official STS flight designator, followed by: the original flight designator (as applicable), the sequential flight number, the KSC launch sequential number, the OFT flight number (as applicable), the ISS flight number (as applicable), the launch pad sequential number, and MLP used.

**Column 2:**

**ORBITER** - Provides Orbiter designation, number of flights flown, & OMS PODs #’s.

**Column 3:**

**FLIGHT CREW** - Flight Crew members & titles are listed for each flight. Space shuttle flight (SS) number designators are listed for each crew member as follows:
P = sequential number of person flown on SS; R = SS rookie number; V = SS veteran number (second flight on SS); M = SS male number; F = SS female number. No attempt is made to determine which seat arrives first in orbit on the same flight. Example: P17/R2/V1/M2 - person 17, rookie 2, veteran 1, male 2. Once assigned a number, the crew member retains those R, V, & M or F numbers. Only the P number would change on subsequent flights.

**EVAs** - Relates to SS EVAs. Includes type of EVA, dates/times of EVAs, EVA crew member names, and sequential number of SS EVAs and EVA times.

**FLIGHT DIRECTORS** - The Flight Directors and Mission Operations Director are listed for each flight.

**CAPCOMS** - CAPCOMS are listed for missions STS-116 and all to follow.
Column 4:
LAUNCH/LIFTOFF/ASCENT DATA - Includes Pad Number, Liftoff Times [planned (P) and actual (A) in Eastern Time Zone and Greenwich Mean Time (GMT) liftoff time], Date of Launch followed by a number indicating how many SS flights have been launched on that month to date, Day-of-Week Launch followed by a number indicating how many SS flights were launched on the day of the week, Window Duration and Closure Rationale, Planned Landing Sites including those selected on Day of Launch, Ascent Events, and Abort Calls. In the later flights, there are two sets of data in the Ascent Events Column. The left set is planned METs and Velocities, and the right set is the actual METs and Velocities for the specified events.

Column 5:
LANDING DATA - Includes Landing Site/Runway followed by a Sequential Number indicating the Number of Concrete/Lakebed landings at EDW or a Sequential Number for Landings at NOR and KSC. Landing time is in local time for the landing site. The Landing Day of Week is followed by a Number indicating how many landings have been made on that day of the week. The Number after the Landing Date is the Sequential Number of Landings during that month, i.e., 4/2/92 (7), STS-45 is the seventh landing in April. Each Orbit Direction for Landing is followed by a Sequential Number. The Winds are designated in knots of head, tail and left and right crosswinds. The first listing was obtained from the MOD Descent Postflight Summary and is basically the Winds observed on a display at the touchdown time. The second listing is the “Official” Winds, which are the Two Minute Average Winds spanning the MLG Touchdown Time. The Flight Durations are determined from the time of liftoff to MLG Touchdown, specified in days, hours, minutes, and seconds.

Column 6:
SSME DATA - Includes Nominal, Abort, and Emergency Throttles, Predicted and Actual Throttle Profile, and Engine Serial Numbers followed by the Number of Flights on that engine. For a lack of space elsewhere, the Mach 3 End-of-Mission Weights and X CG and Landing Weight and X CG have been added in this column.

Column 7:
SRB/SRM/RSRM - Includes the “Build Item” Number followed by SRM/RSRM Type or Number.
ET DATA - Includes ET Numbers, ET Rupture and Breakup Altitudes and Times in MET, and Tumble Valve Use. These times and altitudes were not available for flights after STS-46. However, the time, latitude, and longitude of ET Impact are included for all missions.

Column 8:
ORBIT INCLINATION - This is the Inclination after OMS-2 and is followed by a Sequential Number indicating how many flights were flown at that inclination. Inclinations between 28.45 and 28.55 have been considered the same for the purposes of assigning Sequential Numbers.

Column 9:
ORBIT HA/HP - Insertions were Standard Insertions unless specifically stating “Direct Insertion”. Generally, Altitudes for Post OMS-2 are given, as well as Payload Deploy Altitudes and De-orbit Altitude.

Column 10:
FLIGHT SOFTWARE DESIGNATORS - OI (Operational Increment) numbers are followed by a Sequential Flight Number for that OI.
Column 11:
PAYLOAD DATA - Includes Cargo, Chargeable, Deployed, Non-Deployed, and Middeck Weights as documented in the SODB for flights STS-1 through STS-57. Effective with STS-51, the SODB data is no longer updated as flown. Therefore, the data has been obtained from the Day-of-Launch (DOL) Trajectory Design Data Package (TDDP). The following Shuttle Accumulated Weights are provided: (1) Total Payload Deployed Weights left in orbit, (2) Total Non-Deployed Payload Weights (does not include Ancillary Equipment such as ASE, cabling, etc.), and (3) Total Cargo Weights which include all Ancillary Equipment. Weights for seven DOD flights are not included. Performance Margins: Four numbers are provided - (1) Flight Planning Reserve (FPR); (2) Fuel Bias; (3) Final TDDP is margin above FPR, and Fuel Bias using mean wind and atmosphere for launch month, no unplanned drainback and final selected I-load; and (4) Recon is margin above MET wind and atmosphere, any unplanned drainback, final estimated MPS loads (a.k.a., “Reconstructed” Systems Performance). It should be noted that STS-27 Delta Margin was -295 lbs for drainback, -365 lbs for wind/atmosphere. STS-31 Delta Margin was -753 lbs for drainback, +461 lbs for wind/atmosphere. STS-41 was -358 lbs for drainback, -488 lbs for wind/atmosphere. Payloads are identified as being Primary, Payload Bay (PLB), and/or Middeck Payloads. Payload Column also contains the number of cryo Tank sets and whether a RMS was flown followed by a Sequential Number and serial number of the RMS.

Column 12:
MISSION HIGHLIGHTS/MISCELLANEOUS DATA COLUMN - Includes the Number of KSC Workdays in OPF, at VAB, at Pad, and Total Workdays. Launch Postponements may not contain early postponements. Postponements are defined as launch delays which occurred prior to call-to-stations for OMI S0007 Shuttle Countdown. Scrubs are launch date changes after the start of Shuttle countdown (countdown was terminated or recycled to a later launch date). Launch Delays are delays which occur only on the day-of-launch. Other data included are TAL Weather Data, Night Launch and Night Landing Sequential Numbers, Flight Duration Changes, Landing Site Changes, Firsts, Events, and Significant Anomalies as judged by the compiler (not all Anomalies are included). Use of Alternate and DOLILU I-loads are included with a Sequential Number for Uplinks. STS-27 was the first flight with the capability to uplink Alternate I-loads for use and STS-48 was the first flight with DOLILU capability. Rendezvous operations are identified including the Target and Sequential Number of each Space Shuttle Rendezvous. Also, a Brief Mission Summary has been added for the first ISS Assembly Mission, STS-88/2A, and all missions to follow.
**SPACE SHUTTLE MISSIONS SUMMARY**

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<th>NO.</th>
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<th>CREW (2)</th>
<th>LAUNCH SITE, LIFTOFF TIME, ABORT TIMES</th>
<th>LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRBLS/DAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<td>OV-102</td>
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<td>KSC 39A 102:12:00:03.6Z 70:00:04 AM EST (P) Sunday 1 4/12/81</td>
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STS-1: First orbital flight of reusable Space Shuttle vehicle. First manned vehicle space flight w/o unmanned test flight.

SIGNSIFICANT ANOMALIES:
- SRB ignition overpressure (higher than expected)
- deformed FRCS oxidizer tank aft Z strut
- OMS POD tile LRSI tiles lost
- WMS problems (degraded air suction)
- ET tumble system did not work
- PLBD closure overlap more than expected
- Cabin temperature controller did not maintain selected temperature
- OMS quantity gaging system was sticking during flight
- Both Radar Altimeters lost lock at 75 feet (no valid data after 75 feet)
- Difficulty locking doors on two storage lockers due to misalignment

CONTINGENCY LANDING SITE: ROTA was a contingency landing site but not required for one SSME out.

S-BAND TRACKING SITES:
- MIL, PDL, BDA, MAD, ICS, CRR, BUC, GDS, HAV, ACN, GMW, QM, AGO, TUL (NOR), PTT, VDT

---

On-Orbit:
- First orbital flight of reusable Space Shuttle vehicle
- First manned vehicle space flight w/o unmanned test flight

CONTINGENCY LANDING SITE: No TAL site for STS-1.

---

We Have Liftoff! -- April 12, 1981 -- (S81-30500)

---

...On-Orbit...
- CDR Young in the cockpit
- PLT Crippen prepares dinner on middeck

---

In the MCC:
- Gene Kranz/FOD, Chris Kraft/JSC Ctr Dir, & Max Faget/E&D (Father of U.S. Manned Spacecraft Design)

---

...and Touchdown at EAFB! -- April 14, 1981 -- "That’s the world’s greatest flying machine" - CDR John Young! (S81-30746)
<table>
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<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (2)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERGINGS</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>
| STS-2  | OV-102  | CDR: Joe H. Engle  
P3/R3/M3  
PLT: Richard H. Truly  
PA/R4/M4  
MCC FCR-1 (2) | KSC 39A  
316:15:09:59.8Z 7:20:00 AM EST (P) 10:10:00 AM EST (A) Thursday 11/12/81 | EDW/23, LAKESIDE (EDW/2, LAKESIDE 2)  
1:23:12 PM PST  
11/12/81 | 100/100  
107  
1 = 2007 (2)  
2 = 2005 (2)  
A9/10  
MTR STD  
66%  
CASE  
START  
-53.5°  
ALTITUDE  
137 NM  
END  
-56.2°  | STD  
CASE  
START  
-53.5°  
ALTITUDE  
137 NM  
END  
-56.2°  | | R18/T11  
18778 lbs  |
|       |         |          |                           |                          |                                  |                               |               |        |     |                | STS-2 WD: OFF 99, VAB 18, PAD 70 = 187 |
|       |         |          |                           |                          |                                  |                               |               |        |     |                | LAUNCH POSTPONEMENT: 45-day postponement caused by FRCS N204 spill on tiles resulting in debonding of tiles. |
|       |         |          |                           |                          |                                  |                               |               |        |     |                | LAUNCH SCRUB: Scrubbed 11/4/81 launch at T-31 seconds because APUs 1 & 3 lube oil pressure high at 100 to 112 PSA. Rescheduled launch 11/12/81. L53 days total slip. |
|       |         |          |                           |                          |                                  |                               |               |        |     |                | LAUNCH DELAYS: 2H40M delay MDM OF3 failure. Flew in replacement MDM which also failed. Rescheduled launch. |
| S61-3949 | | | | | | | | | | | |

**Aerial view of STS-2 launch from KSC Pad 39A (S81-39840)**

**S81-3949:** President Ronald Reagan is briefed by Dr. Christopher C. Kraft, Jr., JSC Director, pointing to MOCR screen. The President said, “Dr. Kraft, I was in the cavalry, I don’t understand all this.” Then he talked to crew on orbit.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (2)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ABORT TIME</th>
<th>LANDING TIMES/FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE ENGS. SUN</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD/WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-3</td>
<td>OV-102</td>
<td>CDR: Jack R. Lousma, PLT: C. Gordon Fullerton</td>
<td>KSC 39A 11:00:00 AM EST Monday 1</td>
<td>100,100 (107) 86% 1 = 2007 (3) 2 = 2006 (3) 3 = 2005 (3) KSC WI 1055, VAB 12, Pad 30-97</td>
<td>100,100 (107) 86% 1 = 2007 (3) 2 = 2006 (3) 3 = 2005 (3)</td>
<td>100,100 (107) 86% 1 = 2007 (3) 2 = 2006 (3) 3 = 2005 (3)</td>
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<td>100,100 (107) 86% 1 = 2007 (3) 2 = 2006 (3) 3 = 2005 (3)</td>
<td></td>
</tr>
</tbody>
</table>

**CREW AT WORK ON ORBIT**

**ABOVE:** s03-22-123 --- CDR Lousma

**BELOW:** s03-23-178 --- PLT Fulerton

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**S82-28746:** First flight with ET white paint deleted for 800 lb weight savings.
### Space Shuttle Missions Summary

<table>
<thead>
<tr>
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<th>ORBITER</th>
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<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LAUNCH TIMES, PLT DURATION, WINDS</th>
<th>THROTTLE PROFILE ENG. SUN</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
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<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-4</td>
<td>OV-102</td>
<td>CDR</td>
<td>OV-102</td>
<td>Columbia</td>
<td>KSC 39A</td>
<td>EDW22, CONC (EDW3, CONC1)</td>
<td>100/100 (107)</td>
<td>MTR STD</td>
<td>CASE 86-80E</td>
<td>A13/14</td>
<td>R18/10T1</td>
<td>CARGO</td>
<td>244/492 lbs</td>
</tr>
<tr>
<td>SEQ</td>
<td>KSC-4</td>
<td>PLT</td>
<td>KSC-4</td>
<td>Columbia</td>
<td>KSC 39A</td>
<td>100/100/100</td>
<td>204/204/204</td>
<td>SWT ET-4</td>
<td>END: +20.5&quot;</td>
<td></td>
<td></td>
<td></td>
<td>INSERTION ALITUDE:</td>
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<tr>
<td>OFT-4</td>
<td>OV-102</td>
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<td>OV-102</td>
<td>Columbia</td>
<td>KSC 39A</td>
<td>100/100/100</td>
<td>204/204/204</td>
<td>SWT ET-4</td>
<td>END: +20.5&quot;</td>
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<td></td>
<td></td>
<td>POST OMS-2 139.2 X 131.05 NM</td>
</tr>
<tr>
<td>PAD</td>
<td>39A-4</td>
<td>MCC</td>
<td>MCC-4</td>
<td>Columbia</td>
<td>KSC 39A</td>
<td>100/100/100</td>
<td>204/204/204</td>
<td>SWT ET-4</td>
<td>END: +20.5&quot;</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**STS-4**

**SEQ FLT # 4**

**KSC-4**

**OFT-4**

**PAD 39A-4**

**FLIGHT DIRECTORS:**
- Chief: T. W. Holloway
- SLS - KSC:
- CLS - NDR:
- AOA - EDW:
- TAL - DAKAR:
- TAL - ROTA:
- (Selected)

**FLIGHT TIMES:**
- MAX Q = 721 M = 1.74
- SRB SEP: 2:10 MET
- MCC Q: 8.327 MET
- ET SEP: 8:50.4 MET
- CMS-1: 10.326 MET 88 Seconds
- CMS-2: 37.406 MET 104 Seconds

**FLIGHT DURATION:**
- 4.4 hours

**LANDING SITE:**
- 581 NM

**ORBIT DIR:**
- DL (1)
- AIMPT: NOM

**LANDING SITE/ABORT TIMES:**
- 1 = 2007 (4)
- 2 = 2006 (4)
- 3 = 2005 (4)

**SRB**

**RSRM**

**ORBIT**

**FSW**

**PAYLOAD WEIGHTS**

**PAYLOADS/EXPERIMENTS**

**MISSION HIGHLIGHTS (LAUNCH DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

- **KSC ON PAD:**
  - OFF 41, VAB 7, PAD 29=77
- **LAUNCH DELAYS:**
  - None.
- **LAUNCH SCRUBS/DELAIES:**
  - None.
- **TAL WX:**
  - Dakar no go - crosswinds.
- **FLIGHT DURATION CHANGE:**
  - None.
- **FIRSTS:**
  - First flight with student experiments.

**SIGNIFICANT ANOMALIES:**
- hail stones on tile at L-1 day (repaired tiles).
- Water found in thrusters F2R & F4R.
- During prelaunch rain storms, approximately 500 lbs water absorbed by tiles requiring bottom-to-sun for many hours to dry-out water (to prevent ice damage to tile).
- GAS activation problems - successful workaround.
- VTR would not rewind.
- AFT bulkhead actuator on port PLBD stalled during latch closure.
- AFT STBD, FWD port, and FWD bulkhead floodlights failed.
- Thermal conditioning required to close PLBD's.
- WMS slinger slowed down.
- Mid-deck TV camera operation erratic.
- DFI PCM recorder data lost.
- Both SRB's lost ... extremely high velocity).
- Right and left inboard brakes damaged.

**S82-33394:** Columbia stopover at Ellington during return to KSC.

**S82-31207:** CDR Mattingly (right) & PLT Hartsfield ready to fly fourth & final Orbital Flight Test (OFT).

**S04-23-131:** Mattingly floats in mid-deck with cameras.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE &amp; NAMES</th>
<th>CREW EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING SITE/ RUNWAY, CROSSRUNWAY</th>
<th>LANDING TIMES PROFILE ENG, S.N.</th>
<th>SSME-TL NON-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>PAYLOAD</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flight 5</td>
<td>PLT Robert F. Overmyer</td>
<td>P10/R10/M10</td>
<td>KSC 39A-5 100/100/65</td>
<td>X RANGE: 580 NM</td>
<td>ORBIT ALTITUDE POST OMS-2 182.07 X 160.67 NM</td>
<td>98.6°</td>
<td>SWIT</td>
<td>END</td>
<td>-7.2°</td>
<td>A15/16</td>
<td>107/95/65/6</td>
<td>MARGINS (LBS)</td>
</tr>
<tr>
<td></td>
<td>Columbia</td>
<td>MIS: Williams B. Lenoir</td>
<td>P11/R11/M11</td>
<td>39 Minutes (SBS Day 2 Deploy Opportunity)</td>
<td>ORB DIR 89.8°</td>
<td>POST OMS-2 DEORBIT 162.07 X 160.67 NM</td>
<td>INSERTION</td>
<td>ET RPT</td>
<td>FPR: 5312</td>
<td>FUEL BIAS: 1479</td>
<td>108883 lbs</td>
<td>1078 lbs</td>
<td>14585 lbs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M/S: Joseph P. Allen</td>
<td>P12/R12/M12</td>
<td>39A-5 14585 lbs</td>
<td>FRC2 - 5</td>
<td>70200 lbs CARGO TOTAL</td>
<td>NON-DEPLOYED</td>
<td>EV-1 END</td>
<td>XCG: 1096.3</td>
<td>108883 lbs</td>
<td>108883 lbs</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FIRST SPACE SHUTTLE</td>
<td>EVA SCHEDULED, BUT NOT ACCOMPLISHED BECAUSE OF EMU PROBLEMS.</td>
<td>320:14:34:29Z</td>
<td>6.7 FPS/S</td>
<td>4675 FT</td>
<td>3 flow during PCS switchover.</td>
<td>RIRK INT: 167 KGS</td>
<td>AVE BRK DECEL: 6.7 FPS/S</td>
<td>WHEELS STOP: 320:14:34:26Z</td>
<td>11190 FT</td>
<td>1,850,000 sm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCC FCR-2 (1)</td>
<td>Flight Directors: Ld/Asc/Ent - T. W. Holloway</td>
<td>1090/68 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SBS SEP: 2:09.08 MET</td>
<td>2:09.08 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>MECCO: 8:30.68 MET</td>
<td>8:30.68 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ET SEP: 8:48.77 MET</td>
<td>8:48.77 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMS-1: 10:30.8 MET</td>
<td>10:30.8 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMS-2: 44:40.8 MET</td>
<td>44:40.8 MET</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DISTANCE: 1,850,000 sm</td>
<td>1,850,000 sm</td>
<td>320:14:34:26Z</td>
<td>11190 FT</td>
<td>ROLLOUT: 9563 FT</td>
<td>63 SEC</td>
<td>WIND 21 H, 0X KNOTS</td>
<td>OFFICIAL 21 H, 0X</td>
<td>3545.5 FT</td>
<td>95.6°</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STSO-05-267:** First four-member crew, first operational flight, delivered by the “Ace Moving Co.” Clockwise from bottom left: CDR Brand, Lenoir/MS, PLT Overmyer, & Allen/MS.
## SPACE SHUTTLE MISSIONS SUMMARY

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<th>LANDING SITE, ABORT TIMES</th>
<th>LANDINGS TIMES/FLIGHTS, CROSSRANGE</th>
<th>SSME-TL ENG. NORM-ABORT ENG.</th>
<th>SRB ENG. S/N</th>
<th>ORBIT</th>
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<tbody>
<tr>
<td>STS-6</td>
<td>OV-099</td>
<td>CDR Paul J. Weitz</td>
<td>KSC 39A 94:18:30:00.16Z</td>
<td>EDW 22 CONC (EDW 5, CONC 3) 10:44:02 AM EST PT 10:44:02 AM EST (A) Saturday 2 April 83</td>
<td>AOV-099 99:18:54:31Z</td>
<td>28.48° 18.97° 18.97°</td>
<td>R1718 100/104/104</td>
<td>A17/18</td>
<td>18791 lbs</td>
<td>Standard Insertion 9.3 X 13.7 E1/2 A17/18 100/104/65</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT Kari J. Bobko</td>
<td>KSC 39A 94:18:30:00.16Z</td>
<td>EDW 22 CONC (EDW 5, CONC 3) 10:44:02 AM EST PT 10:44:02 AM EST (A) Saturday 2 April 83</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>M/S F. Story Musgrave</td>
<td>KSC 39A 94:18:30:00.16Z</td>
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<tr>
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<td>EVA Donald H. Peterson</td>
<td>KSC 39A 94:18:30:00.16Z</td>
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<td></td>
<td>EMU Tethered EVA</td>
<td>KSC 39A 94:18:30:00.16Z</td>
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<td>A17/18</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>EVA 47783</td>
<td>KSC 39A 94:18:30:00.16Z</td>
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<tr>
<td></td>
<td></td>
<td>EVA 47783</td>
<td>KSC 39A 94:18:30:00.16Z</td>
<td>EDW 22 CONC (EDW 5, CONC 3) 10:44:02 AM EST PT 10:44:02 AM EST (A) Saturday 2 April 83</td>
<td>AOV-099 99:18:54:31Z</td>
<td>28.48° 18.97° 18.97°</td>
<td>R1718 100/104/104</td>
<td>A17/18</td>
<td>18791 lbs</td>
<td>Standard Insertion 9.3 X 13.7 E1/2 A17/18 100/104/65</td>
<td></td>
</tr>
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<td></td>
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<td>EVA 47783</td>
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<td>Standard Insertion 9.3 X 13.7 E1/2 A17/18 100/104/65</td>
<td></td>
</tr>
</tbody>
</table>

**First crew to man Challenger. Seated are CDR Weitz (left) and PLT Bobko. Standing are Peterson/MS (left) and Musgrave/MS.**

S06-10-417: First Shuttle EVA: Musgrave (left) Peterson (right) in cargo bay.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW NAMES &amp; EVA'S</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ABORT TIMES</th>
<th>SSME-TL-NOM/ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-7</td>
<td>OV-099</td>
<td>CDR: Robert L. Crippen (Flt 2 - STS-1) P17/R2/V1/M2</td>
<td>KSC 7  16:55.59 AM PDT Friday 1 6/18/83 (1)</td>
<td>EDW 15, LAREBED (EDW, LKBD 3) 6/19/83 (2)</td>
<td>101/4/104 (109) 100/10/7/104/65</td>
<td>2017 (2) 2015 (2) 2012 (2)</td>
<td>M = 1.56</td>
<td>28.484°</td>
<td>STANDARD INSERTION 760 lbs</td>
<td>REDUCED CABIN PRESSURE DEMONSTRATION (10.2 PSIA).</td>
</tr>
<tr>
<td>SEQ</td>
<td>FLT #7</td>
<td>PLT: Frederick H. Hauck P19/R17/M17</td>
<td>KSC W/D 169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>SSME-TL LIFTOFF 8/18/83 (2)</td>
<td>1 = 2017 (2) 2 = 2015 (2) 3 = 2012 (2)</td>
<td>KSC 7  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>204340</td>
<td>204034</td>
<td>PALAPA DEPLOY 162.61 NM</td>
<td>FIRST FLIGHT WITH 5 CREWMEMBERS. FIRST US FLIGHT WITH FEMALE ASTRONAUT. FIRST PAYLOAD DEPLOYED AND RETRIEVED SAME FLIGHT (SPAS-01). FIRST PROXOPS AND REBOREFUL OF PAYLOAD (SPAS-01). FIRST PROXOPS WITH (SPAS-01).</td>
</tr>
<tr>
<td>KSC 7</td>
<td>PAD 3A-7</td>
<td>MIS: John M. Fabian P19/R18/M18</td>
<td>KSC 7  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>LANDING POSTPONEMENTS START AT: 738 NM</td>
<td>SRB SEP: 2016.2 M ET: 3356 FT</td>
<td>120 SECONDS</td>
<td>acciuated</td>
<td>R19/T12</td>
<td>372/4 lbs</td>
<td>FIRST FLIGHT WITH 5 CREWMEMBERS. FIRST US FLIGHT WITH FEMALE ASTRONAUT. FIRST PAYLOAD DEPLOYED AND RETRIEVED SAME FLIGHT (SPAS-01). FIRST PROXOPS AND REBOREFUL OF PAYLOAD (SPAS-01). FIRST PROXOPS WITH (SPAS-01).</td>
</tr>
<tr>
<td>MIS: 1</td>
<td>Sally K. Ride P20/R19/F1</td>
<td>OM-099  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>KSC 7  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>ET-6 100/104/75/104/65</td>
<td>202 KEAS</td>
<td>PALAPA DEPLOY 162.61 NM</td>
<td>372/4 lbs</td>
<td>372/4 lbs</td>
<td>372/4 lbs</td>
<td>FIRST FLIGHT WITH 5 CREWMEMBERS. FIRST US FLIGHT WITH FEMALE ASTRONAUT. FIRST PAYLOAD DEPLOYED AND RETRIEVED SAME FLIGHT (SPAS-01). FIRST PROXOPS AND REBOREFUL OF PAYLOAD (SPAS-01). FIRST PROXOPS WITH (SPAS-01).</td>
</tr>
<tr>
<td>MIS: 2</td>
<td>Norman E. Thagard P21/R20/M19</td>
<td>OMS: 1-2  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>KSC 7  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>SWF: STD 161 X 159.96 NM</td>
<td>2017 (2) 2015 (2) 2012 (2)</td>
<td>3 M/S</td>
<td>120 SECONDS</td>
<td>LANDING POSTPONEMENTS START AT: 738 NM</td>
<td>REDUCED CABIN PRESSURE DEMONSTRATION (10.2 PSIA).</td>
<td></td>
</tr>
<tr>
<td>MIS: 3</td>
<td>Sally K. Ride P20/R19/F1</td>
<td>OMS: 1-2  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>KSC 7  169:11:33:00.33Z 7:33:00 AM  EDT (P) 7:33:00 AM  EDT (A) Saturday 1 6/18/83 (2)</td>
<td>SWF: STD 161 X 159.96 NM</td>
<td>2017 (2) 2015 (2) 2012 (2)</td>
<td>3 M/S</td>
<td>120 SECONDS</td>
<td>LANDING POSTPONEMENTS START AT: 738 NM</td>
<td>FIRST FLIGHT WITH 5 CREWMEMBERS. FIRST US FLIGHT WITH FEMALE ASTRONAUT. FIRST PAYLOAD DEPLOYED AND RETRIEVED SAME FLIGHT (SPAS-01). FIRST PROXOPS AND REBOREFUL OF PAYLOAD (SPAS-01). FIRST PROXOPS WITH (SPAS-01).</td>
<td></td>
</tr>
</tbody>
</table>

**S07-30-1574: 1st 5 member crew: In rear (rt) to (rt): CDR Crippen (1st Shuttle veteran re-flight), PLT Hauck, & Fabian/MS. Front: Ride/MS (1st U.S.Female astronaut) & Thagard/MS.**
## Space Shuttle Missions Summary

**STS-8**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE</th>
<th>CREW NAMES &amp; EVAS</th>
<th>LAND DATE/TIME</th>
<th>LANDING SITE/ABORT TIMES</th>
<th>LANDING TYPE</th>
<th>ORBIT</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-8</td>
<td>OV-099</td>
<td>CDR</td>
<td>Richard H. Truly</td>
<td>242:06:32:00.006Z</td>
<td>1 = 2017 (3) 2 = 2015 (3) 3 = 2012 (3)</td>
<td>POST OMS-2</td>
<td>ET-6</td>
<td>INSAT DEPLOY</td>
<td>159.18 NM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT</td>
<td>Daniel G. Brandenstein</td>
<td>248:07:40:43Z</td>
<td>100/104</td>
<td>ORBIT</td>
<td>A53/54</td>
<td>STANDARD INSERTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT</td>
<td>Guion S. Bluford, Jr.</td>
<td>248:07:40:43Z</td>
<td>100/69/104</td>
<td>ALTITUDE</td>
<td>161.07 X 160.14 NM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT</td>
<td>Dale A. Gardner</td>
<td>248:07:40:43Z</td>
<td>100/65</td>
<td>POST</td>
<td>160.14 NM</td>
<td>INSAT DEPLOY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT</td>
<td>William E. Thornton</td>
<td>248:07:40:43Z</td>
<td>100/65</td>
<td>POST</td>
<td>160.14 NM</td>
<td>INSAT DEPLOY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT</td>
<td>Gordon D. Fullerton</td>
<td>248:07:40:43Z</td>
<td>100/65</td>
<td>POST</td>
<td>160.14 NM</td>
<td>INSAT DEPLOY</td>
<td></td>
</tr>
</tbody>
</table>

**Flight 1**

- **STS-8**
  - **Flight Date**: 8/4/83
  - **Abort Times**: 26 days to 8/30/83 due to removal of TDRS-B from flight (IUS not ready because of problem on STS-6) and time required to checkout TDRS-A on orbit.
  - **Launch Scrubs/Delays**: 25-day slip.

**Flight 2**

- **Flight Date**: 8/30/83
  - **Launch**: 2:32:00 AM EDT (A)
  - **Insertion**: 2:04.34 MET MECO
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**Flight 3**

- **Flight Date**: 9/5/83
  - **Launch**: 12:40:43 AM PDT Monday 1 9/5/83 (1)
  - **Insertion**: 41 Minutes (INSAT Dply Rev 18)
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**Oriental Express**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**Ariane 5**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-1**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-2**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-3**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-4**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-5**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-6**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds

**SIM-7**

- **Flight Date**: 10/4/83
  - **Launch**: 2:04.34 MET MECO
  - **Impact**: 161.07 X 160.14 NM
  - **Decorbit**: 44:51.7 MET 116.5 Seconds
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE/LIFTOFF SITE</th>
<th>LANDING SITE/LANDOFF SITE</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-9</td>
<td>OV-102</td>
<td>CDR</td>
<td>KSC 39A</td>
<td>KSC 38A</td>
<td>s9-32-1112-- First flight after Spacelab only modifications to OV-102.</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

**STS-9 (STS-41-A)**

**Flight 6**

- **Orbiter:** Columbia
- **Launch Site:** KSC 39A
- **Launch Time:** 2:06.24 MET
- **Landing Site:** EDW 8, LKBD 4
- **Flight Duration:** 10 days
- **Payload:** Spacelab 1
- **Firsts:** First flight with 6 crewmen, first flight of Spacelab after Spacelab only modifications to OV-102.
- **Significant Anomalies:**
  - GPC 1 hard failure, GPC 2 failure, re-IPL'ed, memory altered, failed again at NLG contact (delayed landing 7-3/4 hours).
  - IMU 1 failed (power supply failure).
  - APU 1 and 2 hydrazine leak/fire shutdown after landing (APU 1 and 2... 8 hours extension to analyze GPC and IMU failures. - LH OMS pod removed for repair after burn-through (missing tile).

**Payload:**

- **Chargeable:** 32,661 lbs
- **Non-Chargeable:** 32,934 lbs
- **Cargos:**
  - 147,736 lbs
  - 250,318 lbs

**Mission Highlights:**

- **Launch Scrubs:** None.
- **Launch Delays:** None.
- **Flight Duration Change:** - Landing delay 5 revs after GPC 1 and GPC 2 hard failures - Total extension - 1 day + 5 revs.
- **Significant Anomalies:**
  - GPC SV time tag to S/L incremented by 1 day.
  - S-band power amp no. 2 failed. - Noises and oscillations reported by crew. - GPC 1 hard failure GPC 2 failure, re-IPL'ed, memory altered, failed again at NLG contact (delayed landing 7-3/4 hours). - IMU 1 failed (power supply failure). - APU 1 and 2 hydrazine leak/fire shutdown after landing (APU 1 and 2... 8 hours extension to analyze GPC and IMU failures. - LH OMS pod removed for repair after burn-through (missing tile).
## Space Shuttle Missions Summary

### STS-11 (STS-41-B)

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, TIME</th>
<th>LANDING SITE, TIME</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PLT</td>
<td>Robert L. Gibson</td>
<td>P34/R300 M29</td>
<td>21/04/1</td>
<td><strong>FREE FLYER</strong> EVA's #1 &amp; #2 MMU CHECKOUT EVAS</td>
</tr>
<tr>
<td></td>
<td>MS 1</td>
<td>Bruce McCandless II</td>
<td>P35/R31 M60</td>
<td>2/7/84</td>
<td><strong>FREE FLYER</strong> EVA's #1 &amp; #2 MMU CHECKOUT EVAS</td>
</tr>
<tr>
<td></td>
<td>MS 2</td>
<td>Ronald E. McNair</td>
<td>P36/R32 M61</td>
<td>2/8/84</td>
<td><strong>FREE FLYER</strong> EVA's #1 &amp; #2 MMU CHECKOUT EVAS</td>
</tr>
<tr>
<td></td>
<td>MS 3</td>
<td>Robert L. Stewart</td>
<td>P37/R33 M62</td>
<td>2/9/84</td>
<td><strong>FREE FLYER</strong> EVA's #1 &amp; #2 MMU CHECKOUT EVAS</td>
</tr>
</tbody>
</table>

### First Landing at KSC

Feb. 4, 1984: McCandless performed the first untethered excursions wearing the McCandless Maneuvering Unit, a rocket propelled backpack. He flew 320 ft from Obiter, further than any previous astronaut.

---

**Launch Parameters:**
- **Liftoff Time:** 13 Minutes (PALAPA SUN SHIELD FAIL OPEN)
- **Eng. S.N.:** 34:12:59:59:998Z 8:00:00 AM EST (P)
- **Launch Window:** 15073 LBS
- **Profile:** 165.88 X 164.61 NM
- ** closets:** 7981 feet
- **Velocity:** 25752 FPS
- **Accumulated margins (LBS):** 28252 LBS
- **Cargos:** 524 NM
- **Launch Window:** 7:15:55 AM EST Saturday 3/2/84 (1)
- **Putdown Site:** 52812 FEET
- **Performance Margins (LBS):** 28252 LBS
- **M/S 1:** EV1=McCandless
- **M/S 2:** EV2=Stewart
- **M/S 3:** EVA - J. T. Cox

**Key Events:**
- **Free Flyer EVA's #1 & # 2 MMU CHECKOUT EVAS**
- **First Untethered EVA's:**
  - EV1=McCandless
  - EV2=Stewart
- **First Manned Maneuvering Unit (MMU) on EVA:**
- **First Untethered EVA's:**
  - EV1=McCandless
  - EV2=Stewart
- **First use of 10.2 PSIA cabin for EVA prep.:**
- **First flight with spare GPC in locker (STS-9 GPC failures reaction):**

**Significant Anomalies:**
- RMS wrist joint failure (RMS/SPAS-01 operations canceled). RMS used for PALAPA PKM burn witness plate ops.
- Left OMS POD damage from waste water dump nozzle ice (during entry).
- IRT failed to inflate properly after deployment.
- PALAPA-B deployed on rev 6. - WESTAR-IV deployed on rev 48. - Saw Challenger entry trail from Houston during landing at KSC.

**Events:**
- Made Orbiter maneuver to recover foot restraint in PLB.
- PALAPA-B deployed on rev 6.
- WESTAR-IV deployed on rev 49.
- Saw Challenger entry trail from Houston during landing at KSC.

**Payloads/Experiments:**
- **Payloads/Experiments:**
  - PALAPA-B deployed on rev 6.
  - WESTAR-IV deployed on rev 49.
- **Launch Postponements:**
  - 1/24/84 launch was postponed 10 days to 2/3/84 because of ongoing analysis of APU failures on STS-9. 10-day slip.

**Launch Scrubs/Delays:**
- None.
- **Launch Delays:**
  - None.
  - **Flight Duration:**
  - 25:03:12:19 DISTANCE
  - 2,870,000 nm

**Payload Weights:**
- **Weight:** 201529 x CG: 1087.9
- **Weight:** 201239 x CG: 1089.3

**Orbit Parameters:**
- **Start:** 21/04/1
- **Insertion Altitude:** 153.52 NM
- **Decret:** 145 NM
- **Range:** 4137 NM
# SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LAUNCH SITE, RUNWAY, CROSSROADS</th>
<th>ORBITER</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 41-C</td>
<td>Challengner</td>
<td>CDR: Robert L. Crippen (F3)</td>
<td>07/13/57-59.99EZ</td>
<td>EDW 17, LAKEBED (EDM 9, LBD 5)</td>
<td>ORS 2-3</td>
<td>DIRECT</td>
<td>EMERG</td>
<td>KSC W/D, OFF 31, VAB 4, PAD 18 = 53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLT: Terry J. Hart</td>
<td>5:38:07 AM PST (2)</td>
<td>8:48:07 AM EST (A)</td>
<td>2/11/84 (3)</td>
<td>INSERTION</td>
<td>CASE</td>
<td>-4/4/84 launch postponed 2 days to 4/6/84 to upgrade RMS pod to SPS (STS-1 B problem during entry). 2 day slip.</td>
</tr>
<tr>
<td>SEQ</td>
<td></td>
<td>LV: James D. van Hoften</td>
<td>268 X</td>
<td>12394 lbs</td>
<td>NON-DEPLOYED</td>
<td>SHUTTLE</td>
<td>DEPLOYED</td>
<td>LAUNCH SCRUBS: None.</td>
</tr>
<tr>
<td>MCC FCR-2</td>
<td></td>
<td>MS: KSC 39A</td>
<td>5:22:45 PM PST</td>
<td>1912 FT</td>
<td>7170 lbs</td>
<td>ORBIT</td>
<td>252 NM 12394 lbs</td>
<td>LAUNCH DELAYS: None.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>104/104</td>
<td>HDOT: -1.5 FPS</td>
<td>NON-DEPLOYED</td>
<td>M/S</td>
<td>251.6 X 115.4 NM</td>
<td>FLY DURATION: 1 day to replan use of RMS to grapple SM after TPAD docking failure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>67/104/65</td>
<td>197170</td>
<td>FPR: 5052</td>
<td>NON-DEPLOYED</td>
<td>DEPLOYED</td>
<td>Extended flight 1 day to replan use of RMS to grapple SM after TPAD docking failure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(109) 100/104/67/104</td>
<td>1 = 2109 (2)</td>
<td>2 = 2020 (1)</td>
<td>NON-DEPLOYED</td>
<td>DEPLOYED</td>
<td>Extended flight 1 rev to land at EDW because of unacceptable weather (overcast) at KSC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M = 1.03</td>
<td>08716 FT</td>
<td>328452 lbs</td>
<td>M/S</td>
<td>DEPLOYED</td>
<td>- Total extension: 1 day + 1 rev.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MAX X CG: 173350 lbs CARGO TOTAL</td>
<td>324152 lbs</td>
<td>RANGE</td>
<td>M/S</td>
<td>173560 lbs</td>
<td>- First flight to use direct insertion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 MARGINS (LBS)</td>
<td>4000 NM</td>
<td>DEPLOYED</td>
<td>17KGS</td>
<td>324152 lbs</td>
<td>- First rendezvous/satellite repair flight.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7167 FT</td>
<td>9970 lbs</td>
<td>NON-DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- First use of TPAD. Nelson used MMU to translate to SM and to dock using TPAD. TPAD failed to fire because of a thermal insulation button prevented it from firing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3505 FT</td>
<td>19170 lbs</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- First grasp of satellite using RMS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7167 FT</td>
<td>228K 2012-01-01</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- Direct insertion (no CMS-1 burn).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>104:13:38:07Z</td>
<td>144 KGS</td>
<td>7167 FT</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>RENDEZVOUS I &amp; 2: - To capture, repair, and release SM.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>104/104</td>
<td>HDOT: -4.6 FPS</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>EVENTS: - Nelson held onto solar panel during MMU ops to attempt to slow SMM rotation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>67/104/65</td>
<td>110 KGS</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- Rendezvous with SM on 5th day &amp; RMS grappled of SMM. Repair and redeploy of SM on 6th day by van Hoften &amp; Nelson.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M = 1.03</td>
<td>8716 FT</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- RMS used to survey OMS pods and monitor water dumps to ensure no ice chunks on nozzles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 MARGINS (LBS)</td>
<td>9165 FT</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>ET TRACKING DTO 331/318 NEAR HAWAII.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7167 FT</td>
<td>1997976</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- 1st. EPS recovery vehicle with RMS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>104:13:38:07Z</td>
<td>18.00'S</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- First EPS recovery vehicle with RMS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3502 FT</td>
<td>1997976</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- EPS - MFS - EV2=van Hoften.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>104/104</td>
<td>122:45</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- EPS - MFS - EV2=van Hoften.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>67/104/65</td>
<td>228K</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- EPS - MFS - EV2=van Hoften.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M = 1.03</td>
<td>1997976</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- EPS - MFS - EV2=van Hoften.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 MARGINS (LBS)</td>
<td>149.9°W</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>DEPLOYED</td>
<td>- EPS - MFS - EV2=van Hoften.</td>
</tr>
</tbody>
</table>

**STS41C-36-1618** - LDEF, Deployed by RMS, contained material samples for long term exposure to space by NASA LRC. To be retrieved by STS-32 in 1990.
<table>
<thead>
<tr>
<th>No.</th>
<th>FLT ORBITER</th>
<th>CREW (6)</th>
<th>LANDING SITE/</th>
<th>LANDING TIMES</th>
<th>SSME-TL</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD LOADS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-41-DR (STS-14)</td>
<td>OV-103</td>
<td>CDR</td>
<td>KSC, 3A</td>
<td>243:12:41:50Z</td>
<td>104/104</td>
<td>104/104</td>
<td>BI-011</td>
<td>28.489°</td>
<td>(8)</td>
<td>CARGO</td>
</tr>
<tr>
<td>SEQ FLT # 12</td>
<td>Discovery</td>
<td></td>
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</tr>
<tr>
<td>KSC 12</td>
<td>OV-103</td>
<td>PLT</td>
<td>KSC, 3A</td>
<td>243:12:41:50Z</td>
<td>104/104</td>
<td>104/104</td>
<td>BI-011</td>
<td>28.489°</td>
<td>(8)</td>
<td>CARGO</td>
</tr>
<tr>
<td>PAD 39A-12</td>
<td>OV-103</td>
<td>MS</td>
<td>KSC, 3A</td>
<td>243:12:41:50Z</td>
<td>104/104</td>
<td>104/104</td>
<td>BI-011</td>
<td>28.489°</td>
<td>(8)</td>
<td>CARGO</td>
</tr>
</tbody>
</table>

**41D-37-050 -- Telstar, last of three satellites deployed.**

**SPACE SHUTTLE MISSIONS SUMMARY**

**CREW**

**CDR**

H. W. Hartsfield [FLT 2 - STS-4]

**PLT**

M. L. Coats [PP4/R6/M8]

**MS**

A. Hawley [PP4/R6/M8]

**MS**

J. Mulane [PP4/R6/M8]

**MS**

J. A. Resnik [PP4/R4/F2]

**PS**

C. Walker [PP4/R6/M10]

**MCC FCR-1 (5)**

E. E. Coen [PP4/R6/M10]

**B/CFT DIRECTORS**

L. L. Ely [L-82 E. R. Stone]

**ORBIT 2 - J. T. Cox**

**P/L**

M. C. Briscoe [MOD - E. F. Krag]

**41D-37-050: Crew members**

(Cc from ctrl)

CDR Hartsfield, PLT Coats, MS Hawley, MS Resnik, PS Walker, & MS Mulane

**KSC WX**

**1/11/84**

**TAL WX**

**DAKAR & MORON go.**

**FIRSTS**

- First flight of Discovery
- First flight to deploy 3 payloads.
- First flight with commercial company PFS.

**SIGNIFICANT ANOMALIES**

- CRT-2 failed (IFM replaced DU-2 with DU-4)
- Supply/waste water nozzle iced.
- Ice from supply water nozzle removed using RMS impact.
- Unable to dump waste water for remainder of flight.
- Os leak (30 lbs/hr).
- Fuel cell performance monitor failed.
- Vehicle pulled to right after NLGTD.
- Schrader valve leaking GN2 caused anomalies in RCS & OMS.
- RH SRM forward field joint erosion.
- LH SRM gas leak and erosion to primary O-ring of nozzle-to-case joint (blowby).

**41D-37-050 -- Telstar, last of three satellites deployed.**
<table>
<thead>
<tr>
<th>FLIGHT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE/ LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY/CROSSRANGE</th>
<th>SSME-TL NOM/ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-41-G (STS-17)</td>
<td>OV-999</td>
<td>CDR: Robert L. Crippen (Flt 4 - STS-1, STS-7) &amp; STS-41-C) P49/R2/V1M2 PLT: Jon A. McBride PS4/R3M3M1 MS: Sally K. Ride FLR-2 - STS-2) PS1/R19/V6F1 MFS: Kathryn D. Sullivan PS2/R4A/F3 MS: David C. Leestma PS3/R4S/M2 PS: Paul D. Scully-Power (Civilian - Navy) PS4/R6S/M3 PS: Mark Garneau (Canadian) PS5/R47/M44</td>
<td>KSC 39A 279.11.03.OZ 7:03:00 AM EDT (P) Friday 3 10/5/84 (1) LAUNCH WINDOW 2 hours (ECM - LANDING KSC REV 7)</td>
<td>KSC 39A 279.11.03.OZ 7:03:00 AM EDT (P) Friday 3 10/5/84 (1)</td>
<td>100/104 109</td>
<td>A63/64 117/84 01/013</td>
<td>57.08° (2)</td>
<td>STANDARD INSERTION</td>
<td>CR/4</td>
<td>23456 lbs</td>
</tr>
<tr>
<td>SEQ</td>
<td>FLT # 13</td>
<td></td>
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<td>CHARGEABLE</td>
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<tr>
<td>KSC 13</td>
<td>CMS PODS</td>
<td>ORBITER: OV-099</td>
<td></td>
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<td>DEPLOYED</td>
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<tr>
<td>PAD 39A-13</td>
<td>LP01 - 5</td>
<td>FLF: 614 NM</td>
<td></td>
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<td></td>
<td>NON-DEPLOYED: None.</td>
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<tr>
<td></td>
<td>RPO1 - 6</td>
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<td>LPO1 - 5</td>
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<td>FR01 - 6</td>
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<td>FRC9 - 6</td>
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<td>MCC FOR-2 (8)</td>
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<tr>
<td>FLIGHT DIRECTORS</td>
<td>Ascent: G. E. Cern</td>
<td>OV-099</td>
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<td></td>
<td>Orbit: Sullivan</td>
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<td>Landing: OV-099</td>
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<td></td>
<td>36:29:23/7</td>
<td>10/11/84 - SS EVA #6</td>
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<td>DEMO ON ORBIT</td>
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<tr>
<td></td>
<td>REFUELING SYSTEM</td>
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<tr>
<td></td>
<td>KU-BAND ANTENNA STOW</td>
<td></td>
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</tr>
<tr>
<td>S84-43433 --- EVA: Leestma, left, &amp; Sullivan, 1st U.S. woman to conduct EVA.</td>
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</tr>
<tr>
<td></td>
<td>41-G-19-006 --- Crew: CDR Crippen (center back row); front row l.to.r. are: PLT McBride, Ride/MS, Sullivan/MS, and back row (left) Scully-Power/Civilian Oceanographer and (right) Garneau/Canadian Researcher.</td>
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</tr>
</tbody>
</table>
### Space Shuttle Missions Summary

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY</th>
<th>SSME-TL</th>
<th>CREW</th>
<th>LANDING TIMES FLT DURATION, VANDS</th>
<th>THROTTLE PROFILE ENG. S/N</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAD S84-40082 (August)</td>
<td>KSC 39A 13:12:15:00Z 7:15:00 AM EST (P) 7:15:00 AM EST (A) Thursday 4 11/8/84 (4)</td>
<td>CREW: David M. Walker (FLT 2 - STS-8) P59R202A/M8/M22</td>
<td>LAUNCH WINDOW: 16 Minutes PLANAR WINDOW (MAX YAW) STEERING MPS LIMIT 1000 LBS FOR RENDEZVOUS</td>
<td>M/L GTD: 2724 FT VEL: 192 KGS HDOT: -1.0 FPS</td>
<td>ET: 1081.4 X CG: 1081.4 161.22 X 151.17 NM 163.48 NM 168.14 NM ETH: 168.14 NM</td>
<td>TAL-RXM: 191 X 188 NM</td>
<td>SHUTTLE ACCUMULATED WEIGHTS: 250893 lbs</td>
<td>TELESCOPE DEPLOY 163.48 NM</td>
<td>11/7/84 launch scrubbed because winds aloft exceeded Orbiter structural limits (excessive wind shear) 1-day slip.</td>
<td></td>
</tr>
</tbody>
</table>

**51A-104-0046: Gardner donned MMU for traverse to Westar VI for first satellite retrieval, by he and Allen, for return to Earth.**

**Firsts:**
- First retrieval and return of satellites. PALAPA-B and WESTAR-IV were deployed on STS 41-B but PAM Upper Stages failed.
- EVA crewmen captured spacecrafts using MMU/Stinger and stowed in payload bay.

**Significant Anomalies:**
- Arriflex camera repaired, EVA helmet light repaired
- Both left side EMU helmet lights failed (Bad Batteries).
- Antiflux 16mm camera failed (IFM bypassed failed microswitch).
- FAD RCS Manifold 3 fuel and oxidizer iso valves lost open indications.
- LIRS Sys B Fuel tank Iso Valve for manifold 3/4/5 lost open indication.
- PLB blankets and metal discolored.
- Brake hydraulic pressure increased when iso valves opened at 200K (iso valve leak).
- IFMs - Antiflux camera repaired, EVA helmet light repaired and SHP key changeout

---

**S84-40082 -- CDR Hauck, seated, PLT Walker, stands next to the Eagle, 51-A mascot. Others on back row, I. to r., are Gardner/MS, Fisher/MS & Allen/MS.**
## SPACE SHUTTLE MISSIONS SUMMARY

### FLT ORBITER CREW (5) LAUNCH SITE, LIFTOFF TIME LANDING SITES, ABDORT TIMES LANDING TIMES FLT DURATION (H, M, S) SSME-TL NOM-ABORT EMERG THROTTLE PROFILE ENG. S/N ORBIT FSW PAYLOAD WEIGHTS MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVA'S</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITES, ABDORT TIMES</th>
<th>LANDING TIMES FLT DURATION (H, M, S)</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>THROTTLE PROFILE ENG. S/N</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 51-C</td>
<td>OV-103</td>
<td>Discovery Thomas. K. Mattingly (Flt 2 - STS-4) P61/R7/V10/M7</td>
<td>KSC 39A 24:19:50:00Z 2:50:00 PM EST Thursday 5 1/24/85 (1)</td>
<td>KSC 15 (KSC-4) 4:23:23 PM EST Sunday 2 1/27/85 (1)</td>
<td>KSC 15 100/920 65/104/65 1 = 2109 (5) 2 = 2018 (4) 3 = 2012 (7)</td>
<td>BI-015 MTR HPD 115 FT Chutes LWT-7 ET-14</td>
<td>M3 ECM WEIGHT: ET RPT 185 X 46:11 MET</td>
<td>185 NM VELOCITY 227K 46:31 MET</td>
<td>OI-4 185 X 185 NM VELOCITY 25855 FPS RANGE 4144 NM</td>
<td></td>
</tr>
<tr>
<td>SEQ FLT # 15</td>
<td>OV-103</td>
<td>Discovery / 06/07/10/10</td>
<td>KSC 39A 24:19:50:00Z 2:50:00 PM EST Thursday 5 1/24/85 (1)</td>
<td>KSC 15 (KSC-4) 4:23:23 PM EST Sunday 2 1/27/85 (1)</td>
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<td>OI-4 185 X 185 NM VELOCITY 25855 FPS RANGE 4144 NM</td>
<td></td>
</tr>
</tbody>
</table>

**STS 51-C (STS-20)**

**SEQ FLT # 15**

**KSC 15**

**PAD 39-A-15**

**OV-103**

**Flight 3**

**Discovery**

**CMC PODS**

**LPOD - 4**

**RPOD - 3**

**FRC3 - 3**

**CMC**

**CDR:**

- Thomas K. Mattingly (Flt 2 - STS-4) P61/R7/V10/M7

**PLT:**

- Loren J. Shriver P62/R50/M48

**MYS:**

- Ellison S. Onizuka P63/R51/M7

**M/S:**

- James F. Buchli P64/R52/M7

**P/S:**

- Gary E. Payton P65/R53/M7

**MCC FCR-2**

- (9)

**FLIGHT DIRECTORS**


**KSC 39A**

- 24:19:50:00Z 2:50:00 PM EST Thursday 5 1/24/85 (1)

**TAL WEATHER:**

- Dakar & Moron NO GO - haze. Zaragoza GO.

**SIGNIFICANT ANOMALIES:**

- Right inboard elevon CH4 secondary delta pressure force flight preslaunch (cleared when APU’s to full pressure).
- IMU 1 and 3 excessive bias.
- GHE leak in T-O umbilical.
- FWD RCS debris during descent.
- BIFS did not proceed to MM104 after ET sep.
- BIFS debris ignition time was 8 seconds late.
- TACAN 3 did not lock up.
- RA2 erratic at high altitude.
- TPS had long gouge under left wing.
- RH SRM primary O-ring gas leak and erosion at center field joint (blowby).
- LH SRM forward field joint gas leak and erosion to primary O-ring (blowby).
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABBORT TIMES</th>
<th>FLIGHT DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, MISSION HIGHLIGHTS</th>
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</thead>
<tbody>
<tr>
<td>STS 51-E</td>
<td>OV-099</td>
<td>Flight Challenger</td>
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<tr>
<td>SEQ</td>
<td>FLT #</td>
<td>PAD</td>
<td>CDR</td>
<td>Karol J. Bobko</td>
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<td></td>
<td>PLT</td>
<td>Donald E. Williams</td>
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<td>M/S</td>
<td>M. Rhea Seddon</td>
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<td>M/S</td>
<td>S. David Griggs</td>
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<td></td>
<td>M/S</td>
<td>Jeffrey A. Hoffman</td>
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<td>P/S</td>
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<td>(U.S. Senator from Utah)</td>
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</tbody>
</table>

**Mission Highlights**

- **Launch Postponements:**
  - Launch rescheduled from 2/20/85 to 2/27/85 due to tile replacement caused by deteriorated screen on OV-099.
  - Launch rescheduled to 3/3/85 due to LH2 primary seal leak (17” ET/Orbiter) but decision was made that secondary seal would hold.

- LAUNCH SCRUBS:
  - Flight canceled on 3/7/85 due to a TDRS-B problem and TELESAT-I was remanifested on OV-103 STS-51D. (Challenger was destacked.)
  - Rolled back to VAB, changed payload to Spacelab 3 for STS 51-B.
  - These data are included because the flight was scrubbed after going through all of the flight reviews, etc.
  - 17”-inch LH2 primary seal redesigned reducing width & depth with STS 61-A as first flight.

**JSC Flight Directors of 1984**

(Left to right) Front row: Milt Heflin, Bill Reeves, Chuck Lewis, Al Pennington, & Cleon Lacefield.
Middle row: Jay Greene, Gary Coen, John Cox, & Harold Draughon.
Back row: Randy Stone, Chuck Shaw, Tommy Holloway, Chuck Knarr, Larry Bourgeois, & Lee Briscoe.
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>SCREW</th>
<th>LAUNCH SITE</th>
<th>LIFTOFF TIME</th>
<th>LANDING SITE</th>
<th>ABORT TIMES</th>
<th>LAND TIMES</th>
<th>FUEL BIAS</th>
<th>DIRECT</th>
<th>PAYLOADS/ EXPERIEMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQ</td>
<td>FLT 16</td>
<td>ORBIT</td>
<td>Donald E. Williams</td>
<td>KSC 39A</td>
<td>102:13:59:05Z</td>
<td>8:00:00 AM EST</td>
<td>3:19:55 AM EST</td>
<td>8/19:25:00</td>
<td>109/109</td>
<td>160.06 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
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<tr>
<td>KSC 16</td>
<td>P/C 3-5</td>
<td>MS</td>
<td>M. Rhea Seddon</td>
<td>P6/1545/56</td>
<td>LPO-1</td>
<td>10:13:54:26Z</td>
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<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
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<tr>
<td>PAD 39A-16</td>
<td>P/C 3-4</td>
<td>PS</td>
<td>Jeffrey A. Hoffman</td>
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<td>2018 lbs</td>
<td>2500 lbs</td>
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<tr>
<td>MCC FCR-2</td>
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<td>EV</td>
<td>Jake Garn</td>
<td>10:19:54:26Z</td>
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<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
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<tr>
<td>FLIGHT DIRECTORS</td>
<td>10</td>
<td>MS</td>
<td>Charles Walker</td>
<td>1110 FT</td>
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<td>2018 lbs</td>
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<td>ASC/ENT</td>
<td>- T.C. Lassoefield</td>
<td>EV</td>
<td>Rick Heflin</td>
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<td>151 X 180 NM</td>
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<tr>
<td>LV/O2</td>
<td>- B. R. Stone</td>
<td>MS</td>
<td>Jake Garn</td>
<td>10:19:54:26Z</td>
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<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
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</tr>
<tr>
<td>MOD</td>
<td>- E. F. Kranz</td>
<td>MS</td>
<td>E. F. Kranz</td>
<td>10:19:54:26Z</td>
<td>4:00:00 AM EST</td>
<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
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</tr>
<tr>
<td>PLT Williams</td>
<td>10</td>
<td>MS</td>
<td>Hoffman/MS</td>
<td>10:19:54:26Z</td>
<td>4:00:00 AM EST</td>
<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
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<tr>
<td>CDR Bobko</td>
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<td>Hoffman/MS</td>
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<td>4:00:00 AM EST</td>
<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
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<td>2500 lbs</td>
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</tr>
<tr>
<td>M/S Hoffman/MS</td>
<td>10</td>
<td>MS</td>
<td>Hoffman/MS</td>
<td>10:19:54:26Z</td>
<td>4:00:00 AM EST</td>
<td>4/19:05</td>
<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
<td>2500 lbs</td>
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<tr>
<td>M/S Hoffman/MS</td>
<td>10</td>
<td>MS</td>
<td>Hoffman/MS</td>
<td>10:19:54:26Z</td>
<td>4:00:00 AM EST</td>
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<td>200 Kgs</td>
<td>151 X 180 NM</td>
<td>2018 lbs</td>
<td>2018 lbs</td>
<td>2500 lbs</td>
<td></td>
</tr>
</tbody>
</table>

51D-09-014: First sitting member of Congress, Senator Garn/PS (left) & CDR Bobko with Doonesbury comic strip. Sen. Garn was subject of awardee Trudeau's creations prior to the mission.
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ Runway, Crossrange</th>
<th>SSME-TL, FSRM</th>
<th>PAYLOAD WEIGHTS,</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 51-B (STS-24)</td>
<td>OV-099</td>
<td>CDR: Robert F. Overmyer (Flt 2 - STS-5)</td>
<td>KSC 39A</td>
<td>11/16/2016 12:00 PM EDT</td>
<td>104/104</td>
<td>BL-016</td>
<td>STANDARD INSERTION</td>
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<td>MTR</td>
<td>INSERTION</td>
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<td>KSC-17</td>
<td>P75/R09/V13/M10</td>
<td>PLT: Frederick D. Gregory</td>
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<td>10994/65/104</td>
<td>HPM</td>
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<td>PAD</td>
<td>39A-17</td>
<td>MS: Don L. Lind</td>
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<td>MSN: Norman E. Thagard</td>
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<td>104/52</td>
<td>LWC</td>
<td>MAX</td>
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<td>MSN: William E. Thornton</td>
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<td>MSN: Taylor Wang</td>
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<td>101</td>
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<td>MSN: Lodewijk Van den Berg</td>
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<td>FLIGHT DIRECTORS: Astrodent - T. C. Lachapelle</td>
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<td>LEO/1 - G. E. Coen</td>
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<td>189</td>
<td>ET</td>
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<tr>
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<td>O 2 - W. D. Reeves</td>
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<td>189</td>
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<td>O 3 - G. A. Pennington</td>
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<td>MOD - E. F. Kranz</td>
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<td>OMS PCDS</td>
<td>LPO-1 - 6</td>
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<td>CMS-1 (17)</td>
<td>OV-099</td>
<td></td>
<td>213,750</td>
<td>ET</td>
<td>ET-10</td>
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<td>CMS-2</td>
<td>47/05/24:50</td>
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<td>213,750</td>
<td>ET</td>
<td>ET-10</td>
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**STS 51-B (STS-24)**

- **CDR**: Robert F. Overmyer (Flt 2 - STS-5)
- **PLT**: Frederick D. Gregory
- **MS**: Don L. Lind
- **MSN**: Norman E. Thagard
- **MSN**: William E. Thornton
- **MSN**: Taylor Wang
- **MSN**: Lodewijk Van den Berg
- **MCC FCR-1**: Astrodent - T. C. Lachapelle
- **LEO/1**: G. E. Coen
- **O 2**: W. D. Reeves
- **O 3**: G. A. Pennington
- **MOD**: E. F. Kranz
- **CMS-1**: 10:35 MET 340 FT
- **CMS-2**: 46.5 MET 147.5 MET

**51B-116-005**: CDR Overmyer captured this auroral observation in southern hemisphere halfway between Australia & Antarctic continent. There are moonlit clouds on Earth. The blue-green band and the tall red rays are aurora. Brown Streak is atmospheric luminescence.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFT OFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>FLIGHT DURATION, WINDS</th>
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</thead>
<tbody>
<tr>
<td><strong>STS 51-G</strong> (STS-25)</td>
<td>OV-103</td>
<td>CCD: Daniel C. Brandenstein (Flt 2 - STS-5)</td>
<td>KSC-39A 168:13:33:00Z 7:33:00 AM EDT (P)</td>
<td>EDW/LKBD 104/104 83/65/104/65</td>
<td>6:11:52 AM PDT Monday 3 5/6/85</td>
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</tbody>
</table>

#### MISSION HIGHLIGHTS

- **DIRECT INSERTION**
- **POST-OMS-2**
- **NON-DEPLOYED**
- **MORELOS AND TELESTAR**
- **DEPLOYED**
- **ARABSAT AND SPARTAN**
- **DEPLOYED**
- **MORELOS AND TELESTAR**
- **DEPLOYED**
- **ARABSAT AND SPARTAN**
- **DEPLOYED**
- **MORELOS AND TELESTAR**
- **DEPLOYED**
- **ARABSAT AND SPARTAN**
- **DEPLOYED**
- **MORELOS AND TELESTAR**
- **DEPLOYED**
- **ARABSAT AND SPARTAN**
- **DEPLOYED**

**EVENTS:**
- MORELOS deployed orbit 6D.
- ARABSAT deployed orbit 18D.
- TELESTAR deployed orbit 32D.
- SPARTAN deployed orbit 51D.
- Reboost with SPARTAN.

**REENTRY:**
- With SPARTAN for retrieval and return.

**SIGNIFICANT ANOMALIES:**
- WACS Fan Separator 1 motor current high.
- RCS microswitch problems.
- Right RCS fuel x-feed valve 3/4/5.
- Left RCS fuel x-feed valve 3/4/5.
- Right RCS fuel tank isolation valve.
- Left RCS fuel tank isolation valve.
- SPARTAN solar array survey.
- Gas leaks and erosion on both SRM nozzle-to-case joints (blowby).
## SPACE SHUTTLE MISSIONS SUMMARY

### STS 51-F (STS-26)

**FLT NO.** OV-099  
**ORBITER** Challenger (Flight 8)  
**CREW** Captain C. Gordon Fullerton (FLT 2 - STS-3), Mission Specialist Piers E. Sellers, Mission Specialist Gregory J. Harbaugh, Mission Specialistancel R. William Loesberg, Mission Specialist Thomas D. Jernigan, Payload Specialist Steven A. Hawley, Payload Specialist Joseph H. Allen

### LANDING SITES/ 
**RUSSIAN LANDING SITES**  
**SRB-47**  
**SSME-TL**

**CREW** Captain C. Gordon Fullerton (Flight 5), Mission Specialist Piers E. Sellers, Mission Specialist Gregory J. Harbaugh, Mission Specialistancel R. William Loesberg, Mission Specialist Thomas D. Jernigan, Payload Specialist Steven A. Hawley, Payload Specialist Joseph H. Allen

### LANDER SITE/ 
**RUSSIAN LANDING SITES**  
**SRB-47**  
**SSME-TL**

**CREW** Captain C. Gordon Fullerton (Flight 5), Mission Specialist Piers E. Sellers, Mission Specialist Gregory J. Harbaugh, Mission Specialistancel R. William Loesberg, Mission Specialist Thomas D. Jernigan, Payload Specialist Steven A. Hawley, Payload Specialist Joseph H. Allen

### PAYLOAD WEIGHTS/ 
**EXPERIMENTS**

**CARGO**

**PAYLOAD EXPERIMENTS**

**FLIGHT DURATION**

**TOTAL**

### MISSION HIGHLIGHTS

**RETURNED**

**TOTAL**

**PAYLOAD/ EXPERIMENTS**

**PERFORMANCE INVESTIGATIONS**

**FIRSTS**

**SIGNIFICANT ANOMALIES**

**FSC**

**OBLIQUE**

**OMS Pods**

**PREO-1 - G. A. Pennington**

**PREO-2 - J. T. Cox**

**PREO-3 - A. L. Briscoe**

**MOD - E. F. Kranz**

**MOVEMENTS:**

**FRC9 - 8**

**LPO1 - 7**

**P/S**

**INV.**

**VELOCITY**

**IMPACT**

**LATITUDE**

**LONGITUDE**

**MCC FCR-1 (8)**

**FLIGHT DIRECTORS**

**Asc/Ent - T. C. Lacefield**

**O 1 - G. A. Pennington**

**LaV 2 - J. T. Cox**

**O 3 - A. L. Briscoe**

**MOD - E. F. Kranz**

**51-F-33-006:**

**EXPLOSIONS I/P: SPACELAB 2 are backdropped against the Libya/Tunisia Mediterranean coast.**

---

**STS-51F Flight Crew**
SPACE SHUTTLE MISSIONS SUMMARY

STS-51-I  (STS-27)  

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES &amp; DURATION, WINDS</th>
<th>SSM=TL, NOM/ABORT TIMES</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OV-103</td>
<td>Discovery (FLT 6)</td>
<td>Joe H. Engle</td>
<td>KSC-39A</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
</tr>
<tr>
<td>SEP FLT 20</td>
<td></td>
<td>(Flt 2-STS-41-C)</td>
<td>P97/R74/M65</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
</tr>
<tr>
<td>KSC-20</td>
<td></td>
<td>Richard O. Covey</td>
<td>KSC-39A</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
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<tr>
<td>PAD</td>
<td></td>
<td>James D. Van Hoften</td>
<td>KSC-39A</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
</tr>
<tr>
<td>39A-20</td>
<td></td>
<td>John M. Lounge</td>
<td>KSC-39A</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
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<td></td>
<td></td>
<td>William F. Fisher</td>
<td>KSC-39A</td>
<td>EWD 23, LAKEBED (EDW 14, LHSD 10)</td>
<td>104/104/109%</td>
<td>100/104/28.541&quot;</td>
<td>MTR</td>
<td>BI-200</td>
<td>POST_CMS-2</td>
<td>190.01 X</td>
<td>190.2 NM</td>
</tr>
</tbody>
</table>

**STS-51-I Flight Crew**

- **CDR**: Joe H. Engle
- **FLT ORBITER**: Richard O. Covey
- **CM**: James D. Van Hoften
- **P**: John M. Lounge
- **S**: William F. Fisher

**51I-S-237**: Syncom IV-3 after shove-off by Hofton/MS. Errant satellite was earlier captured & repaired by Shuttle.

**EMUTETHERED EVAS**
- **EV1 - Van Hoften**
- **EV2 - Fisher**

**MCC FCR-2 (12)**

- **FLIGHT DIRECTORS**: Asst/Ent - G. E. Coen
  - **LiO 2 - J. H. Greene**
  - **O - C. D. Reeves**
  - **P: C. H. Kerri**
  - **MOD - E. F. Kranz**
SPACE SHUTTLE MISSIONS SUMMARY

**MISSION HIGHLIGHTS**

- **STS 51-J**
  - **SEQ. FLT NO.** 21
  - **ORBITER** OV-104 Atlantis (Flight 1)
  - **CREW**
    - **CDR**: Karol J. Bobko (Flt 3 - STS-6 & STS 51-D)
    - **P99/R14/V11/M14**: Ronald J. Grabe
    - **P100/R76/M70**: Robert L. Stewart (Flt 2 - STS 41-B)
    - **P101/R33/V22/M32**: David C. Hilmers
    - **P102/R77/M71**: William A. Pailes
    - **MCC FCR-2**: Asc/Ent - G. E. Coen
    - **Ld/O 2**: B. R. Stone
    - **Plng**: J. M. Heflin
    - **MOD**: T. W. Holloway
  - **LAUNCH SITE**: KSC-21 Pad 39A-21
  - **LIFTOFF TIME**: 11:15:30 AM EDT Thursday 6 10/3/85 (2)
  - **Landing Sites**:
    - EDW: 23, LAKEBED (EDW 15, LKB 11)
    - EDW 15, LAKEBED (EDW 15, LKB 11)
    - XCG: 7.3 FPS/S
  - **LANDING TIMES**:
    - **EDW23, LAKEBED**:
      - 10/3/85 (2)
    - **RANGD**: 1:23:04 MET
    - **IMPACT**: 1:23:25 MET
    - **ET**: 230K
    - **BI-021**: 28.5°
    - **LD**: 254 X 254 NM
  - **VX**: 26023 FPS
  - **RANGE**: 3866 NM
  - **VELOCITY**: 254 KGS
  - **WEIGHT**: 190765 X CG: 1101.2
  - **LANDING TIMES**:
    - **FLIGHT DURATION**: 4:01:44:38 97:44:38 S/T
    - **104/104**
    - **109**
    - **100/104**
    - **100/109**
    - **69/65/104/102**
    - **74/65**
    - **1 = 2017 (4)**
  - **OCEANS**:
    - **VFT-1**: 2011
    - **VFT-2**: 2019
    - **AMOS**: CSTS
    - **WINCON**: 100/104

**LAUNCH DELAY**
- Launch delayed because of MPS PV# 6 RPCA erratic. (LH2 prevalve close indicator.)
- Port MPM shoulder “A” pyro initiator circuit failed self test.
- APU Exhaust Gas temp 2 failed.
- WSB 2 regulator pressure decayed.
- OPS Recorder 2 tracks 7, 8, & 9 intermittent.
- ROMS fuel total quantity reading offset.
- TPS damage on left inboard elevon leading edge and in nose cap area.
- Fuel Cell 3 O2 flowmeter failed.
- SSME 1 and 2 pitch and yaw actuator secondary delta pressures high.
- PLB camera “B” difficult to focus and camera “C” Azimuth and elevation failed.
- Airlock hatch “A” tapered pin did not latch in open position.
- Slide latch “T” handle difficult for crew to operate.

**LAUNCH POSTPONEMENTS**: None.
**LAUNCH SCRUBS**: None.
**FLIGHT DURATION CHANGES**: None.

51J-143-126:
 Atlantis’ vertical stabilizer (North side of photo) partially frames over-flight scene of Metropolitan Houston, muddy Galveston & Trinity Bays, Galveston Island, & Coastline of Gulf of Mexico.
**SPACE SHUTTLE MISSIONS SUMMARY**

**FLT NO.** | **ORBITER** | **CREW TITLE, NAMES & EVAS** | **LANDING SITE/ RUNWAY, CROSSRANGE** | **SSION/TL ORBIT, NOM-ABORT EMERG** | **THRUST PROFILE, ENG. S/N** | **SFB RSRRM** | **ORBIT** | **FSW** | **PAYLOAD WEIGHTS, PERFORMANCE** | **PAYLOADS/ EXPERIMENTS** | **MISSION HIGHLIGHTS (LAUNCH SCRUBS/DAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**
---|---|---|---|---|---|---|---|---|---|---|---
**STS 61-A**
**(STS-30)**
SEQ FLT # 22
KSC-22
PAD 39A-22
CDE
Flt 22
STS-61-A

**KSC-39A**
**LM (3)**
**MS**
**P/S**
Bonnie J. Durbair
Reinhard Furrer
 Bonnie J. Dunbar

**ORBITER**
Challenge
SpaceLab
LM

**CREW**
Henry W. Hartsfield
James F. Buchli
Steven R. Nagel

**LAUNCH SITE, RUNWAY, CROSSRANGE**
KSC-39A

**LANDING TIMES FLT DURATION, S/T**
EDW 17, LAKEBED (EDW 16, LRBD 12)

**THRU PROFL, ENG. S/N**
104/104

**SRB RSRRM**

**ORBIT**

**PAYLOADS/ EXPERIMENTS**

**MISSION HIGHLIGHTS (LAUNCH SCRUBS/DAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

**CARGO**

**CHARGEABLE**

**DEPLOYABLE**

**NON-DEPLOY**

**DEPLOYED**

**ACCUMULATED MARGINS (LBS)**

**WEIGHTS**

**PERFORMANCE**

**SIGNIFICANT ANOMALIES**

- Fuel cell 1 condenser exit temperature oscillated.
- Cryo hydrogen tank 1 control pressure failed.
- RRCS helium leg A operated on secondary.
- RRCS helium leg B failed closed.
- APU 1 gearbox GN.
- RMS deploy microswitches for shoulder manipulator positioning pedestal went to zero.
- Stream of particulate matter hit Orbiter.
- WCS fan separator 1 fails.
- Primary RCS Thruster L2L injector heater failed on.
- RMS deploy microswitches for shoulder manipulator positioning pedestal went to zero.
- Stream of particulate material hit Orbiter.
- WCS fan separator 1 fails.
- LH SPM center and aft field joint gas leaks to primary O-rings (blowby).

**S85-40783 --- Front row (left to right) Furrer/PS (Germany), Dunbar/MS, Buchli/MS, & CDR Hartsfield. Back row (left to right) PLT Nagel, Bluford/MS, Messerschmid/PS (German), & Ockels/PS (Dutch).**

---

STS61A-45-0098 One of many Earth views: Lake Kronotskaya on the Kamchatka Peninsula (Russia) and nearby volcanic mountains in the Pacific 100 volcano “Ring of Fire’ - 30 are still active.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS 61-B

#### (STP-31, SEQ FLT #23)

**KSC-23**

**PAQ 39A-23**

**ORBITER**
OV-104

**CREW (7)**

**CDD**
Brewster H. Shaw, Jr.

**FLT ORBITER**

**Crew**

Bryan D. O’Connor

**LOT**

Charles Walker

**P115/R85/F8**

Mary L. Cleave

**P116/R86/M78**

Jerry L. Ross

**P117/R42/V12/M40**

Charles Walker

**P118/R87/M79**

Rudolpho Neri Vela (Mexico)

**EDW 22 Concrete**

**KSC 39A**

331.00.26.03Z

**LANDING TIMES**

**FLT DURATION**, WINDS

**LANDING SITES**, ABORT TIMES

**LAUNCH DURATION**, WINDS

**TAL WEATHER**, ASCent LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.

### 61B-41-019:

During 2nd EVA Ross (above) & Spring erected a Tower known as Assembly Concept for Construction of Erectable Space Structures.
<table>
<thead>
<tr>
<th>FLIGHT NO.</th>
<th>ORBITER</th>
<th>CREW &amp; EVA’S</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES ORBIT DURATION, WINDS</th>
<th>SSME-TL NO-AVOID THROTTLE PROFILE ENG. S.N.</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 61-C</td>
<td>OV-102</td>
<td>CDR: Robert L. Gibson (Flight 7)</td>
<td>KSC 39A 12:11:55:00Z 6:56:00 AM EST (P)</td>
<td>EDW/22, Concrete (EDW 18, CONC 6) 104/104 109% BI-024 28.446° (16)</td>
<td>STANDARD INSERTION</td>
<td>C7-32 (1)</td>
<td>CARGO</td>
<td>32733 lbs</td>
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<tr>
<td>(STS-32)</td>
<td>Columbia (Flight 7)</td>
<td></td>
<td>KSC-24</td>
<td>MTR</td>
<td>POST</td>
<td>OMS-2</td>
<td>PAYLOAD CHARGEABLE</td>
<td>28695 lbs</td>
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<tr>
<td>SEQ FLT #24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>176.13 X</td>
<td>175.14 NM</td>
<td>DEPLOYABLE</td>
<td>12351 lbs</td>
<td></td>
<td></td>
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<tr>
<td>KSC-24</td>
<td>OMS PODS</td>
<td>MTS: Charles F. Bolden</td>
<td>LPO4 - 3</td>
<td>ET-30</td>
<td>SAT COM</td>
<td>DEPLOY</td>
<td>NON-DEPLOY</td>
<td>15037 lbs</td>
<td></td>
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<tr>
<td>PAD</td>
<td>OV-102</td>
<td>Crew: George D. Nelson</td>
<td>KSC 39A-24</td>
<td>SATCOM-KU</td>
<td>BI-STABLE</td>
<td>HPOP (2)</td>
<td>MOD</td>
<td>437 lbs</td>
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<td>39A-24</td>
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<td>TELCOR 8A</td>
<td>ET</td>
<td>239K</td>
<td>RETURNED</td>
<td>20111 lbs</td>
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<td>CDR: Robert L. Gibson (Flight 7)</td>
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<td>MET</td>
<td>46:25</td>
<td>182.63 NM</td>
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<td>MVS: Steven A. Hawley</td>
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<td>M/S: Franklin Chang-Diaz</td>
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<td>M/S: C. W. Nelson (Congressman)</td>
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<td>M/S: R. J. Carver (RCA)</td>
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<td>MOC FCR-1 (10)</td>
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</tbody>
</table>

**LAUNCH POSTPONEMENTS:**
- None.

**LAUNCH SCRUBS:**
- 12/19/85 launch scrubbed to complete RCS crossfeed work in aft compartment (rescheduled before PRSD loading). 1-day slip.
- 1/10/86 launch scrubbed due to T-14 seconds due to RH SRB tilt HPU exceeding RPM redline (oversensitivity in control circuit). Launch rescheduled after holidays for 1/6/86. 18-day slip. - 1/6/86 launch scrubbed at T-31 seconds when GSE LO2 SSME replenish valve failed to close. Wrong manual command sequence resulted in TSM vent and drain valves opening without closing Orbiter fill/drain valve causing off-loading of approximately 18,000 lbs LO2 via F/D valve. LO2 SSME temperature dropped below redline limit and count recycled to T-20 minutes. Did an IMU alignment; however, launch was scrubbed when SATCOM launch window expired. Detanked and found a broken GSE LOX temperature probe lodged in SSME #2 prevalve (would have precluded full prevalve closure). Launch rescheduled for 1/7/86. 1-day slip.
- 1/7/86 launch was scrubbed at T-9 hold due to bad weather at TAL sites (Deaker & Moron) and marginal KSC weather. Forty-eight hour turnaround for ovality check on TAL weather. Rescheduled launch for 1/8/86. 2-day slip.
- 1/10/86 launch was scrubbed on 1/8/86 because of predicted bad weather at KSC, and temperature GSE probe found in SSME #2 prevalve. Rescheduled launch for 1/10/86. 1-day slip.
- 1/10/86 launch scrubbed due to rain showers at KSC with 45 minutes remaining in window. Rescheduled launch for 1/12/86. 2-day slip.
- 25-day total slip.

**LAUNCH DELAYS:**
- None.

**TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.:**
- First flight of OV-102 after major mod (included removal of ejection seats and modifying display panels). Continued . . .
### STS 61-C

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, LANDING TIMES, FLY DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG. THROTTLE PROFILE ENG. S.N.</th>
<th>SRB RSRM ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tbody>
<tr>
<td>STS 61-C</td>
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<td>FLIGHT DURATION CHANGES:</td>
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<td>- Management decision made to change flight duration to 4 days from 5 days.</td>
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<td>- Extended flight from 4 to 5 days due to bad weather at KSC (was 1/16/86).</td>
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<td>- Extended flight from 5 to 6 days due to bad weather at KSC (was 1/17/86).</td>
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<td>- Waived off KSC landing on 1/18/86 due to bad weather and landed at EDW (one rev extension).</td>
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<td>- Flight extensions, 2 days + 1 rev.</td>
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<td>LANDING SITE CHANGE:</td>
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<td>- KSC to EDW.</td>
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<td>NIGHT LANDING:</td>
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<td>- Second Shuttle night landing.</td>
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<td>EVENTS:</td>
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<td>- SATCOM deployed at 9:32 MET (REV 7).</td>
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<td>- Bi-stable Pump - HPOTP required minimum throttle of 67 percent (second flight).</td>
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<td>SIGNIFICANT ANOMALIES:</td>
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<td>- Fuel cell power source to essential bus 1 BC erratic.</td>
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<td>- APU 1 gearbox GN pressure high.</td>
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<td>- APU's 1 and 3 isolation valve temperatures low.</td>
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<td>- APU 3 fuel line system B heater failed .</td>
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<td>- Vernier RCS jets fired excessively .</td>
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<td>- S-band U/I and L/R antenna performance erratic.</td>
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<td>- ECLSS pressure control system 2 oxygen flow transducer read low.</td>
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<td>- WSB 3 System &quot;A&quot; heater operation erratic.</td>
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<td>- Left RCS Helium Reg &quot;B&quot; leaked.</td>
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<td>- WSB 1 system &quot;A&quot; cooling water use high.</td>
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<td></td>
<td>- Gas leak in LH SRM nozzle-to-case joint (blowby).</td>
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<td></td>
<td>- Gas leak and erosion in RH SRM nozzle-to-case joint.</td>
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<td>ABOVE: 61C-005-0036 -- SATCOM Ku-1 Communications Satellite deployed from Columbia.</td>
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<td>BELOW: 61C-S-050 (18 January 1986) --- Second Shuttle night landing. View is of the Shuttle's main landing gear touching down at EAFB with streams of light trailing behind the orbiter.</td>
</tr>
</tbody>
</table>

**AT LEFT:** 61C-13-005 - The crew, having received excellent service from the Waste Management System, showed this photo at their Jan. 23, 1986 Post-Flight Press Conference.

**ABOVE:** 61C-005-0036 -- SATCOM Ku-1 Communications Satellite deployed from Columbia.

**BELOW:** 61C-S-050 (18 January 1986) --- Second Shuttle night landing. View is of the Shuttle's main landing gear touching down at EAFB with streams of light trailing behind the orbiter.
STTS 51-L Crew photo with Commander Francis R. Scobee, Pilot Michael J. Smith, Mission Specialists Judith A. Resnik, Ellison S. Onizuka, Ronald E. McNair and Payload Specialists Gregory B. Jarvis and Sharon Christa McAuliffe. (S85-44253)

IN MEMORIAM

CHALLENGER TRIBUTE

KSC-2010-4451 (http://mediaarchive.ksc.nasa.gov/index.cfm). This Tribute Display features Challenger, which blazed a trail for other vehicles with the first night landing (STS-4) and also the first landing at Kennedy Space Center (STS-3B). The spacewalker represents Challenger’s role in the first spacewalk during a space shuttle mission (STS-3B). Crew-designed patches for each of Challenger’s missions lead from earth toward our remembrance of the STS-51L crew. Other significant accomplishments include the first night launch with STS-4, the first in-flight capture, repair, and redeployment of an orbiting satellite during STS-41C, the first American woman in space (Sally Ride on STS-7), the first African-American in space (Guion Bluford on STS-8), and the first American woman to walk in space (Kathryn Sullivan during STS-41G). By Mike Leinbach/Launch Director & Amy Simpson/KSC PH-2 in May 2010

CHALLENGER TRIBUTE

Shuttle Legacy Mural - In KSC LCC Firing Room

IN MEMORIAM

KSC-2010-4451 (http://mediaarchive.ksc.nasa.gov/index.cfm). This Tribute Display features Challenger, which blazed a trail for other vehicles with the first night landing (STS-4) and also the first landing at Kennedy Space Center (STS-3B). The spacewalker represents Challenger’s role in the first spacewalk during a space shuttle mission (STS-3B). Crew-designed patches for each of Challenger’s missions lead from earth toward our remembrance of the STS-51L crew. Other significant accomplishments include the first night launch with STS-4, the first in-flight capture, repair, and redeployment of an orbiting satellite during STS-41C, the first American woman in space (Sally Ride on STS-7), the first African-American in space (Guion Bluford on STS-8), and the first American woman to walk in space (Kathryn Sullivan during STS-41G). By Mike Leinbach/Launch Director & Amy Simpson/KSC PH-2 in May 2010

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STSC W/D
Page 2-28 - STS-26

SPACE SHUTTLE MISSIONS SUMMARY

LANDING SITE/RRUNWAY, CROSSWINDS

Crew

Mission:

STS-26 (STS-26R)
SEQ FLT #26
KSC-26
PAD 39B-2

Orbiter:

OV-103 (Flight 7) Discovery

Launch Site, Runway, Crossrange, Winds

Payload, Experiments

Mission Highlights (Launch Scrubs/Delays, TAL Weather, Ascent I-loads, Firsts, Significant Anomalies, etc.)

Launch Postponements:
- 9/26/88 launch postponed 3 days to 9/29/88 for Orbiter aft critical path. 3-day slip.

Launch Scrubs: None.

Launch Delays:
- 1H38M delay from 9:59 a.m. EDT due to: (1) winds aloft differed from planned autumn winds with exceedences of 3 ms
cm; (2) PLT and M/S 1 suit fan fuses blew (replaced with 10A fuses but intended 5 amp fuses).

Flight Duration Changes: None.

TAL WX: - Alternate TAL Moron selected due to rain showers and crosswind violations at Ben Guerir (Prime).

Firsts:
- Return to flight 2 yrs 8 mos after STS 51-L.

Events:
- Two engines CMS SEP burn at 06:28:03 MET (16.6 sec, 30.85 FPS).
- Decibel burn 168 sec, 324.86 FPS.
- ET Reentry (tumble) - CAST GLANCE violent rupture.

Significant Anomalies:
- Prelaunch H2 leak at 4" disc.
- RCS dye tube repair early in flow using clamshell.
- GSSM gimbal standby enable 1 fail.
- FES high load evap freezing during ascent.
- Ku-Band failed self test. Antenna would not follow pointing commands. (Had to use alternate slow procedure.)
- GOX flow control valves 1 and 2 operated sluggish on first cycle.
- WGS fan separator 1 flooded exhibiting stall currents for 80 sec.
- STBD PLBD Forward R-T-L "A" Talkback failed to function.
- APU's chamber pressure low.
- R1 wing TPS damage.

Return - To - Flight

In MCC: G. Kranz, T. Holloway, A. Cohen, & unidentified.
STSTS-27

**PAYLOADS/EXPERIMENTS**

- OASIS-II
- AMOS
- APE
- CLOUDS
- CRUX
- RME-III
- VFT-2

**PAYLOADS/WEIGHTS**

- WEIGHT: 190,956 lb
- X CG: 1095.1

**MISSION HIGHLIGHTS**

- FIRSTS:
  - First flight with alternate ascent I-loads capability.
  - First flight using East and West TDRS.
  - First flight with no communications blackout during entry (due to favorable comm look angle to West TDRS).
  - First flight of PDRS console position.

- SIGNIFICANT ANOMALIES:
  - Left inboard tire leaking since OPF (over-inflation plug seal).
  - APU #2 GG heater system malfunction.
  - Humidity separator B flooded.
  - TAGS paper jam.
  - TPS damage worst to date (707 hits, 298 hits > 1”, most on right side bottom of wing and fuselage).
  - Tile survey conducted using RMS end effector camera.
  - RCS Oxidizer B He regulator slow response.
  - Cabin temp controller #2 non-responsive.
  - L OMS GN2 Isolation valve coil failure.
  - Engine #3 HPOTP #3 bearing inner race crack due to stress corrosion. Liquid stains, pitting, spalling - chlorine contaminant.

**LAUNCH POSTPONEMENTS**

- None.

**LAUNCH SCRUBS**

- 12/1/88 launch scrubbed due to winds aloft exceedences. Launch rescheduled for 12/2/88. 1-day slip.

**LAUNCH DELAYS**

- Countdown held at T-9 due to winds aloft and at T-31 seconds for TAL weather.

- TAL WX:
  - Zaragoza (prime) selected, alternate sites were no go - low ceilings at Moron and Ben Guerir.

**DEORBIT**

- 244 X 239 NM
- VELOCITY: 25,956 FPS
- RANGE: 4220 NM

**TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**

*After his smooth landing at EDW, Gibson and others were astonished at severity of tile damage.*
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ Runway, Cross Range</th>
<th>LANDING TIMES - FLT DURATION, WINDS</th>
<th>SSME/TLM NO/ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHS, EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-29 (STS-29R)</td>
<td>OV-103 (Flight 8) Discovery</td>
<td>CDR: Michael L. Coats (Flt 2 - STS 41-D) P143</td>
<td>R38V39/M37</td>
<td>KSC 39B 72:14:57:00Z (EDW 21, CONC 7)</td>
<td>EDW 22 (EDW 21, CONC 7) 8:07:00 AM EST (P)</td>
<td>5:36:50 AM EST (A) Saturday, 6/31/89</td>
<td>DIRECT BRK INIT 28.45° (18)</td>
<td>RSRM 3</td>
<td>100/104/ 100%</td>
<td>101/104/ 600L 003</td>
<td>POST</td>
<td>CARGO</td>
</tr>
<tr>
<td>KSC-28</td>
<td>OV-103</td>
<td>FLT NO: 104  RSRM 3 360L 003 ET-38 LWT- 29</td>
<td>1 = 2031 (1) 2 = 2022 (2) 3 = 2028 (2)</td>
<td>KSC 39B 72:14:57:00Z (EDW 21, CONC 7)</td>
<td>3/13/89 (2)</td>
<td>3/14/89 (2)</td>
<td>ET-38 LWT- 29</td>
<td>ET RPT</td>
<td>240K 1:17:11 MET</td>
<td>162.83 NM</td>
<td>NON-DEPLOYED</td>
<td>6727 lbs</td>
</tr>
<tr>
<td>PAD 39B-4</td>
<td>OV-103</td>
<td>FLT NO: 105  RSRM 3 360L 003 ET-38 LWT- 29</td>
<td>1 = 2031 (1) 2 = 2022 (2) 3 = 2028 (2)</td>
<td>KSC 39B 72:14:57:00Z (EDW 21, CONC 7)</td>
<td>3/13/89 (2)</td>
<td>3/14/89 (2)</td>
<td>ET-38 LWT- 29</td>
<td>ET RPT</td>
<td>240K 1:17:11 MET</td>
<td>162.83 NM</td>
<td>NON-DEPLOYED</td>
<td>6727 lbs</td>
</tr>
</tbody>
</table>

STS-029-71-000A—IUS/TDRS-D deployment from Discovery payload bay.
STANDARD DEVIATION

TABLE 5-1

<table>
<thead>
<tr>
<th>FLIGHT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME, LAT/LON</th>
<th>LANDING SITE, ABORT TIMES, LAT/LON</th>
<th>ORBIT</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-29</td>
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</tbody>
</table>

**continued . . .**

**SIGNIFICANT ANOMALIES:**
- RCS jet R1U failed off at ET Sep.
- Excessive vapor at H/ET/Orbiter umbilical area prelaunch and tower clear.
- TAGS developer overtemp; however, best TAGS performance with more than 660 pages processed.
- Sluggish GCK FOV/S system 1 and 3.
- LH-2 disconnect slow to close.
- FES shutdown during deorbit prep switch reconfiguration.
- Unable to dump ops 2 track 4.
- RMS regulator “A” anomaly (OX & FU tank pressures approx 245 psi).
- SHARE operations had problems due to vapor bubbles in liquid channels.
- IMAX camera drive mechanism problem (belt jumped off track).
- CHROMEX not cooling properly.
- PLBD PORT B CLOSED indicator failed.
- TPS 132 debris hits, 23 greater than 1”

**ABOVE:** S89-28089 & KSC-89PC-26—OV-103, suspended by overhead crane hooked to support structure attached at four points, is lowered for mating to ET & SRBs at KSC VAB Bay 1. SSMEs are covered with protective red shields.

**BELOW:** STS029-04-029—CDR Coats on OV-103’s forward flight deck.

**BELOW:** STS029-S-066—Post Landing: Crew pose with NASA officials. Left to right: PLT Blaha, Bagian/MS, Rear Adm. Richard H. Truly/NASA Associate Administrator for Space Flight, Dr. James C. Fletcher/NASA Administrator, CDR Coats, Buchli/MS and Springer/MS.

**s29-s-0041** — Flight Directors Lee Briscoe and Ron Dittemore on console in MCC Flight Control Room.
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME, LANDING SITES, ABDORT TIMES</th>
<th>LANDING TIMES/FRACK CROSSOVER, ORBIT PROFILE ENG. S.N.</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSC-29</td>
<td>CMS PODS</td>
<td>Norman E. Thagard (Flt 3 - STS-51-B)</td>
<td>CMS PODS 1:48:00 PM EDT (P) 2:46:58 PM EDT (P) Thursday 8 5/4/89 (1)</td>
<td>POST</td>
<td>2027</td>
</tr>
<tr>
<td>PAD 306B-5</td>
<td>CCAFS</td>
<td>Mark C. Lee (Flt 3 - STS-51-C)</td>
<td>CCAFS 1:48:00 PM EDT (P) 2:46:58 PM EDT (P) Thursday 8 5/4/89 (1)</td>
<td>POST</td>
<td>2027</td>
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<td>M1:</td>
<td>None.</td>
<td>Ronald J. Grabe</td>
<td>None.</td>
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<td>M2:</td>
<td>None.</td>
<td>Norman E. Thagard</td>
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<td>M3:</td>
<td>Mark C. Lee</td>
<td>Mark C. Lee</td>
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<td>LoO2 - J. M. Hofflin</td>
<td>LoO2 - J. M. Hofflin</td>
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<td>Ping - W. D. Reeves</td>
<td>Ping - W. D. Reeves</td>
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<td>MOR - C. W. Shaw</td>
<td>MOR - C. W. Shaw</td>
<td>MOR - C. W. Shaw</td>
<td>None.</td>
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</table>

SPACE SHUTTLE MISSIONS SUMMARY

ST-28 (STS-28R)

SEQ FLT: 30

KSC-30

PAD: 39B-6

OV-102

(Flight 8)

Columbia

STS-28

(Columbia, OV-102)

is left at KSC LC Pad 39B by crawler transporter. Crawler transporter pulls out from under mobile launcher platform. View provided by KSC with alternate number KSC-89PC-684.

STS-28 crew portrait on middeck: Clockwise starting with Adamson/MS (mustache) are Leestma/MS, Brown/MS, PLT Richards, and CDR Shaw. In center is tail end of stuffed toy animal.

KSC W/D: OPF 190, VAB 11, PAD 25 = 227

LAUNCH POSTPONEMENTS:
- 8/7/89 launch postponed to 8/8/89 due to MPS He system. 1-day slip.

LAUNCH DELAYS:
- Launch delay at T-9 due to an NSP frame sync error and MMU 1 read problem during G9 to OPS 101 transition.
- 1-day launch delay due to KSC ground fog.

TAL Wx:
- Zaragoza (prime) NO GO - thundershowers, Ben Guerir NO GO - crosswinds.
- Moron (selected) GO throughout.

LAUNCH SCRUBS:
- None.

I-LOADS:
- LSEAT selected nominal ascent I-loads - no uplink required.

EVENTS:
- No blackout during entry, comm via TDRS-W.

SIGNIFICANT ANOMALIES:
- Prelaunch problem, one of nose gear WOW proximity sensors began indicating weight on nose gear. Indication went away after insertion but returned later in flight causing a WOW dilemma during landing. WOW was enabled by crew by depressing SRB SEP pushbutton.
- MMU input/output error on OPS-1 transition.
- Pilot’s seat moved aft during ascent.
- VOM thrust lever annunciation “tail leak.”
- NLG WOW indication failed off.
- Forward RCS F5L thrust lever heater failed on.
- S-band PAC power output degraded to 60 watts.
- Potable water dump valve failed open.
- Telemetry cable shorted causing a 1.5-second short of STS.
- Freon coolant loop 2 flow degraded about 100 lbs/hr & FCL 1 about 50 lbs/hour.
- Radar altimeter 1 and 2 lost operation out-of-spec.
- Body flap excessive deflection during ascent.
- NSP frame sync errors prelaunch.
- SSME 1 GD flow control valve sluggish.
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>SSME-TL ORBIT</th>
<th>RSM</th>
<th>SBR</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-34</td>
<td>OV-104</td>
<td>DONALD E. WILLIAMS</td>
<td>KSC 30B</td>
<td>EDW 23L, LIQUID</td>
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STS-34 crew portrait from left to right: CDR Williams (holding mission insignia), MS/Baker, MS/Chang-Diaz (holding stuffed toy), MS/Lucid, and PLT McCulley.
KSC W/D
Page 2-35 - STS-33

SPACE SHUTTLE MISSIONS SUMMARY

MISSION HIGHLIGHTS

LAUNCH POSTPONEMENTS:
- 11/21/89 launch postponed to 11/22/89 due to SRB IEA cable replacement. 1-day total slip.

LAUNCH SCRUBS: None.

LAUNCH DELAYS: - Launch held at T-5 because of a ground purge problem for GLS confirmation of Shuttle purge flow rate and completion of APU prestart. TAL WAVEOFFS:
- Waved off landing on fourth day due to high winds at EDW and landed one day later.

FIRST SHUTTLE CREWMEMBER REPLACEMENT:
- David Griggs died in private aircraft accident while in training in June 1989. He was replaced by Blaha. (This was first US spaceflight crewmember changeout since Ken Mattingly was exposed to measles 3 days before Apollo 13 launch on April 11, 1970. Jack Swigert was his replacement.)

SIGNIFICANT ANOMALIES:
- APU 1 lube oil outlet pressure high during ascent.
- Cabin leak through WCS.
- TAGS jam (did not work during flight).
- Galley rehydration station failed to dispense hot or cold water.
- FES primary B shut down (overtemped during deorbit prep).
- +X COAS line of sight shift.
- CDR AMI M/VEL error.
- MSBLS BITE indication.
- WCCS short battery life.
- IFM:
- Hydraulic system 1 and 2 accumulator pressure locked up low.
- Cryo oxygen tank 2 check valve stuck twice.
- ISS: - No entry blackout, comm via TDRS-W.


STSO-033-82-071, 1989-11-27 The island of Timor, Indonesia (9.0S, 125.0E) illustrates the volcanic origin of the over 1500 islands of Indonesia. The linear alignment of the volcanoes indicates the edges of the tectonic plates of the Earth's crust.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT. NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LANDSITE/LIFTOFF TIME</th>
<th>LAUNCH SITE/ RUNWAY, CROSSRANGE</th>
<th>LANDING TIMES</th>
<th>SSME-TL ORBITAL</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS,</th>
<th>MISSION HIGHLIGHTS</th>
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<td>OV-102</td>
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<td>DIRECT INSERTION</td>
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### STS-32 Liftoff (Wikipedia, the free encyclopedia) --- First flight from pad 39A since STS 61-A on 10/30/85.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
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<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SIB/RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<td>STS-32</td>
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**STS-32 Continued**

**SIGNIFICANT ANOMALIES**
- GPC 5 (BFS) registered illegal engage input/output term B during final entry checks. BFS was loaded into GPC2, GPC set restrung and GPC5 powered off. (Landing was delayed one revolution.)
- FM transmitter failed.
- APU 3 lubrication oil outlet pressure high (90 psi)
- TAGS paper jammed.
- GO-FCV 2 open cycle sluggish.
- Humidity separator water bypass anomalies (free water from SEP B and SEP A).
- Waste water dump line blockage at 18:13:29:00Z, no dumps performed subsequently.
- FES topping duct B string heater failure.
- IMU 1 RM failed (transient 4-axis accel-bias).
- Hydraulic systems 1 and 2 circ pump unloader valves excessive leakage.
- BFS GPC errors.
- At 17:23:46:51Z during sleep period, a bad state vector was uplinked just prior to LOS, Orbiter rotated 3°/sec.
- WSB sys 2 and 3 excessive regulator pressure decay.
- RINS was used to conduct external survey (TPS).
- Multiple S-Band dropouts.
- Smoke detector 3A transient alarm.
- WBS 3 controller A over controlling.
- Ku-band antenna feed heater erratic.
- MPS LH, F&D (outboard) relief valve leak.
- Pilot seat would not drive down.
- CCTV camera problems.
- Heaviest landing at 228,335 lbs.

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**STS032-87-030, 1990-01-20 --- SYNCOM IV-5 is deployed from Columbia's payload bay.**

**STS032-85-051, 1990-01-20 --- LDEF Retrieval over South America. LDEF proposed by NASA LRC was deployed by STS-41C on 04/13/1984.**

**STS032-15-022, STS-32 Commander Brandenstein celebrates birthday on OV-102’s aft flight deck.**

**STS-32 Commander Brandenstein celebrates birthday on OV-102's aft flight deck.**

**S89-48717 1989-11-07 STS-32 Flight Directors in MCC standing in front of the flight director's consoles are (l. to r.) Alan L. Briscoe, Granvil A. Pennington, and Robert E. Castle, Jr.**

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**Continued . . .**
## SPACE SHUTTLE MISSIONS SUMMARY

### PLT ORBITER

**STS-36**
- OV-104 (Flight 6)
- Atlantis

**SEQ FLIGHTS**
- KSC-34

**PAD**
- 39A-26
- MLP-1

**CMO pods**
- LPO1 - 12
- RPO-11
- FPOC - 6

### CREW (5)

**CDR**
- John O. Creighton
  (Flight 2 - STS 51-G)
  P173/R393/60/W08

**FLT**
- John H. Casper
  P174/R111/M99

**MS 1**
- David C. Hilmers
  P177/R77/36/M71

**MS 2**
- Richard M. Mullane
  P186/R112/M100

**MS 3**
- Pierre J. Thuot
  P177/R112/M100

**MCC FCR-2 (19)**

**FLIGHT DIRECTORS**
- AVE - R. D. Dittemore
- LEO 1 - L. S. Bourgeois
- O2 - R. M. Kelso
- C/2 - C. R. Knarr
- MOD - T. W. Holloway

### LAUNCH SITE, LIFTOFF TIME, ABORT TIMES

**KSC 39A**
- 99.07:50:22Z
- 22/9/90 (2)

### LANDING SITE, FLY DURATION, WINDS

**EDW 236, USOS (E) (EDW 27, USOS 17)**
- 63.18:06:44Z
- 106:18:22

**ORBIT PROPERTIES**
- 1. EDW/LAKEBED
- 2. EDW/CONCRETE
- 3. NOR

**X-WIND FIRST PRIORITY**
- MAX O = 743.9
- M = 1.49
- 0.053 MET

**SRB SEP**
- 205.8 MET

**.readFile(1.1236)**

### MISSION HIGHLIGHTS

**NAME**

**DOD**
- KSC WD: OFF 69, VAB 6, PAD 35 = 110

**ORBIT**

**FSW**
- 132 X
- 115 NM

**WEIGHTS**

**INC**
- 1302 M

**HAW**
- 213 K

**PAYLOAD/ EXPERIMENTS**

**LAUNCH DELAYS**

**LAUNCH POSTPONEMENTS:** None.

**LAUNCH DELAYS**

- Delta at T-9 minutes due to predicted rain in RTLS area. Resumed count to T-5 minutes, held for launch pad, RTLS, and TAL weather. TAL WX - Zaragoza 30 (prime) - Some delay waiting for STA go (until STA could see landing strip). Moron - NO GO - ceiling.

**LOADS**

- LSEAT selected yaw positive, alternate H-duct uplink 3.

**POST MISSION**

- Pilgrims first stepped ashore November 1620
- Cape Cod, MA (42.0N, 70.0W) as seen from Shuttle. Geologically, the cape is a deposit of earth and stone called a terminal moraine, left by the great Pleistocene glaciers of about 20,000 years ago.

**NIGHT MISSION**

- Fourth Shuttle night launch.
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<th>CREW</th>
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<th>LANDING SITE/ TIME</th>
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<th>SRB</th>
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**TOP:** S90-32805STS31–Bill Reeves, Lead Orbit Flight Director, briefs media at preflight conference. **BOTTOM:** STS031-76-026 1990-04-29 – HST is grazed by RMS during predeployment checkout.
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<th>FLT NO</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>ORBITER THROTTLE PROFILE ENG. S.L.</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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## SPACE SHUTTLE MISSIONS SUMMARY

**STS-38**

- **Orbiter:** OV-104 (Flight 7)
- **Launch Site:** KSC 39A
- **Landing Site:** KSC 39A
- **Crew:**
  - *CDR:* Richard O. Covey (Flt 3 - STS 51-I)
  - *PLT:* Frank L. Culbertson
  - *MS 1:* Charles J. Meade
  - *MS 2:* Robert C. Springer
  - *MS 3:* Charles D. Gemar

### Mission Highlights

**Launch Postponements:**
- As of Jan 1990, launch date was 7/9/90. On 5/29/90, OV-102/STS-35 launch was scrubbed because of excessive H₂ leak in aft compartment. Special H₂ tanking tests were performed on OV-104/STS-38, 6/19/90 - STS-38 rolled out to Pad A. Scheduled launch 7/9.
- 6/29/90 - LH₂ Tanking Test #1 - Excessive H₂ leak detected in umbilical area.
- 7/13/90 - LH₂ Tanking Test #2 - Excessive H₂ leak detected in umbilical and plate gap areas.
- 7/22/90 - LH₂ Tanking Test #3 - Excessive H₂ leak ET 17” disconnect flange area. Decision made to roll back and fix leak. - 8/9/90 - Rolled stack back to VAB. - 8/15/90 - OV-104 to OPF.  Umbilical removed from ET-37 LH₂ umbilical. - 10/13/90 - Rolled out to Pad A. - 10/24/90 - LH₂ Tanking Test #4 successful.
- 8/9/90 - Rolled stack back to VAB. - 8/15/90 - OV-104 to OPF. - Due to seasonal slip in launch, pitch negative became pitch nominal which LSEAT selected, and was uplinked (Uplink 4). - Extended one rev to land at KSC because of high winds predicted at EDW. - Waved off on fourth day because of excessive head and crosswinds on all three landing opportunities at EDW. - Due to seasonal slip in launch, pitch negative became pitch nominal which LSEAT selected, and was uplinked (Uplink 4).

**Launch Scrubs:** None during second time at pad.

**Launch Delay:**
- Launch delayed because Range Bermuda command link out of service.
- Launch delayed because Range Bermuda command link out of service.
- Night launch. 5/29/90.
- Night launch. 5/29/90.
- Launch scrubbed because of excessive head and crosswinds on all three landing opportunities at EDW.
- Extended one rev to land at KSC because of high winds predicted at EDW.

**Payloads:**
- Performance: A zobow, FPR: 4652 FUEL BIAS: 994 FINAL TDDP: 863 RECON: 474
- Secondary Payloads: APE, VFT-1, RME-III, AMOS, APM
- Entry Range: 4746 NM
- SRPPOs on SRB’s: None during second time at pad.

**Payload Experiments:**
- OI-12: 109%
- SRM 12
- ET-40
- LWT-33
- WAVEOFFS: Waved off on fourth day because of excessive head and crosswinds on all three landing opportunities at EDW.

**Night Launch:** Fifth Shuttle night launch.

### Schedule

- **Launch:** 11/15/90 (7) PLS 129-day slip.
- **Landing:** 11/15/90 (7) PLS 129-day slip.
- **Launch Window:** 11/15/90 (7) PLS 129-day slip.
- **Landing Window:** 11/15/90 (7) PLS 129-day slip.
- **Fuel Savings:** 119,490 lbs
- **Astronauts:** Richard O. Covey, Frank L. Culbertson, Charles J. Meade, Robert C. Springer, Charles D. Gemar

---

**Crew:**
- Richard O. Covey
- Frank L. Culbertson
- Charles J. Meade
- Robert C. Springer
- Charles D. Gemar

**Launch to Landing:**
- **LIFTOFF TIME:** 6:48:15 PM EST Thursday 9/11/90
- **DEORBIT BURN:** 114.9 SECS 228.5 FPS
- **ENTRY:** 114.9 SECS 228.5 FPS
- **impact:** 222K 47:10 MET
- **landing:** 181K 47:56 MET

---

**Payloads:**
- **WEIGHT:** 191091
- **X CG:** 1098.6
### STS-38

**LT**  |  **ORBITER**  |  **CREW (5)**  |  **LAUNCH SITE, LIFTOFF TIME, CROSSRANGE**  |  **LANDING SITE, ABORT TIMES**  |  **LANDING TIMES, FLT DURATION, WINDS**  |  **SSME-TL, NOM-ABORT EMERG THROTTLE PROFILE ENG. S.N.**  |  **SRB RSRM AND ET**  |  **ORBIT**  |  **FSW**  |  **PAYLOAD WEIGHTS, PAYLOADS/ EXPERIMENTS**  |  **MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**
---|---|---|---|---|---|---|---|---|---|---|---|---
STS-38  |  |  |  |  |  |  |  |  |  |  |  |

**LANDING SITE CHANGE:**
- Changed from EDW to KSC landing because of predicted unfavorable winds.

**FIRSTS:**
- First flight with Air Force, Navy, Army, and Marine Corps crewmembers. All 4 hymns were used as wakeup music on one day.
- First flight of GOX FCV's in step 2 position.

**SIGNIFICANT ANOMALIES:**
- WSB 2 not cooling on controller A.
- FES water supply accumulator heater biased low.
- Vacuum cleaner short, CB 29 opened.
- CCTV monitor 2 fault light on - powered down.
- APU 2 EGT and APU 2 and 3 injector tube temps interacting.
- Right vent door 1 and 2 purge position dropped to closed position instead of purge position.
- RU-PC low.
- Continuous 'Press' FDA messages post landing.
- Several smoke detectors had event indicators go high but not high enough to trigger alarm.
- GPC mode switch found in STDBY and power switch in off.

**STS-38: LAUNCH -------- A VARIETY OF EARTH VIEWS -------- LANDING**
(Captions Not Available)
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSRANGE</th>
<th>SSME-TL ORM-ABORT EMERG</th>
<th>SRB &amp; ET</th>
<th>ORBIT</th>
<th>FSW</th>
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<td>STS-35</td>
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<td>Vance D. Brand (CDR)</td>
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<td>EDW22 CONC (EDW30, CONC 13)</td>
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</tbody>
</table>

STS035-503-007 1990-12-11 Crew in Columbia's middeck, clockwise from bottom center. CDR Brand, Parker/MS, Parise/PS, Hoffman/MS, PLT Gardner, Lounge/MS, & Durrance/PS.
STS-35

Continued...

**LAUNCH DELAYS:**
- 21M1S delay while Range Safety had helicopter verify 8000 foot minimum optical coverage.

**TAL WX:**
- Weather good at Banjul and Ben Guerir.

**I-LOADS:**
- Launch delayed to new season and pitch negative became pitch nominal which LSEAT selected and was uplinked (uplink 5).

**NIGHT LAUNCH:**
- Space Shuttle #6.

**NIGHT LANDING:**
- Space Shuttle #4.

**EVENTS:**
- Most people in Earth orbit at the same time - 12 (7 Americans and 5 Soviets).
- FCL-1 degraded flowrate noticed before first launch attempt. Did not affect mission and performed as predicted.
- S/L DDS 1 (DDU) failed on FD1. Crew smelled smoke.
- S/L DDS 2 failed after 4 days. Crew smelled smoke. (Crew did IPS pointing and ground sent commands to operate experiments.)
- S/L subsystem computer failed due to a command problem caused by error in workstation program, recovered by IPL.
- Degraded waste water flow, virtual blockage at 152 hours. Filled CWC with 92 lbs, wastewater transferred to 15 female UCD’s and 18 male UCD’s.
- TAGS jam, TAGS tool broke.
- OPS 1 ... computer failure.
- APU 2 lube oil pressure high during ascent & entry (wax formation caused by hydrazine contamination).
- No blackout during entry.

**SIGNIFICANT ANOMALIES:**
- FCL-1 degraded flowrate noticed before first launch attempt. Did not affect mission and performed as predicted.
- S/L DDS 1 (DDU) failed on FD1. Crew smelled smoke.
- S/L DDS 2 failed after 4 days. Crew smelled smoke. (Crew did IPS pointing and ground sent commands to operate experiments.)
- S/L subsystem computer failed due to a command problem caused by error in workstation program, recovered by IPL.
- Degraded waste water flow, virtual blockage at 152 hours. Filled CWC with 92 lbs, wastewater transferred to 15 female UCD’s and 18 male UCD’s.
- TAGS jam, TAGS tool broke.
- OPS 1 track 2 and OPS 2 track 5 problems.
- P/L recorder poor data quality.
- HEDR failed after 2 days of operations.
- Cameras B, C, & D problems.
- Several software patches were required to correct experiment/IPS target tracking.
- S-band UL and LR antenna problems.
- Several payload experiment problems.
- VISGT control computer failure.
- APU 2 lube oil pressure high during ascent & entry (wax formation caused by hydrazine contamination).
- No blackout during entry.

---

**STT035-28-022 1990-12-10** Astronomy Laboratory 1 (ASTRO-1) telescopes in the PL/Bay. At right is the Orion nebula. The three ultraviolet telescopes are mounted and coaligned on a common structure and attached to the Instrument Pointing System (IPS).

**STS035-05-036 1990-12-11** Commander Brand talks to family using SAREX on Columbia’s middeck.

---

s35-13-008 -- Wisconsin Ultraviolet photo-Polarrimeter Experiment (WUPPE) on Spacelab pallet. The Broad Band X-Ray Telescope (BBXRT) is behind this pallet and is not visible.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-37

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABDOR TIMES, WINDS</th>
<th>SSME/TL NOM/ABORT EMERG, CROSSRANGE</th>
<th>SRB BSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

Crew on Atlantis' middeck: Back row: CDR Nagel and PLT Cameron. Front row, left to right: Ross/MS, Godwin/MS, and Apt/MS. Cards refer to astronauts’ “ACE Moving Company”.

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*Two EVA times are provided: (1) Old definition - started when EMU went to bat power and ended when switched to orbiter power. (2) New definition - starts when EMU goes to bat power and ends when airlock depressurization starts.*
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>FLIGHT DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SSME-RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, ING, ENG S/N</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
</table>

STS-37 continued…

**SIGNIFICANT ANOMALIES**:
- Thruster RTU failed off 32 seconds after MECO.
- WSB 2A temporary spray bar freeze up during ascent.
- WSB 2A and 3A lube oil overcooling during entry.
- PRSD O2 manifold valve failed to close.
- EVA glove palm bar penetrated restraint and glove bladder.
- Prelaunch BFS navigation anomaly.
- Ku-band antenna erratic in ant mode.
- EMU-1 failed to charge battery post EVA-1.
- Abnormal O2 concentration in aft compartment (220 PPM)
- Unscheduled EVA required to deploy GRO high gain antenna.
- Scheduled EVA.

**TOP: STS037-52-013 1991-04-11 Apt/MS, suited in Extravehicular Mobility Unit (EMU), tests Crew and Equipment Translation Aid (CETA) electrical hand pedal cart during EVA in P/L Bay.**

**At Right: STS037-55-012 1991-04-11 Ross/MS drifts outside P/L Bay as he attaches a tether to a port side guidewire during EVA.**
<table>
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<tr>
<th>FLT</th>
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<th>LAUNCH SITE/ RUNWAY, LANDINGSITES/ ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE ENG.S/N</th>
<th>SRB</th>
<th>ORBIT</th>
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<th>MISSION HIGHLIGHTS (LAUNCH SCREWS/DAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<td>LF-02 - R. D. Dittermore</td>
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<td>O 3 - R. K. Kett</td>
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<td>MOD - T. R. Holloway</td>
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STS039-17-017 1991-05-06: Shuttle Pallet Satellite II (SPAS-II)/Infrared Background Signature Survey (IBSS) released by RMS.
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<th>LANDING SITE/ LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY/ CROSSRANGE</th>
<th>LANDING TIMES</th>
<th>THROTTLE PROFILE (ENG. S.N.)</th>
<th>SRB RSRRM</th>
<th>SSB EMERG</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD W/ EXPERIMENTS</th>
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<td>STS-40</td>
<td>OV-102 Columbia (Flight 11)</td>
<td>Bryan D. O'Connor (FLT 2 - STS 61-B)</td>
<td>156:13:24/51Z 08:00:00 AM EDT (P) 9:51:51 AM EDT (A)</td>
<td>Wednesday 5 6/5/91</td>
<td>104/104/ 100%</td>
<td>DIRECT INSERTION</td>
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<td>ARMED</td>
<td>218:14:20 S/T</td>
<td>OWN 16 ENG</td>
<td>10.4H</td>
<td>6 L KTS</td>
<td>3,290,226 sm</td>
<td>156 X 149.84 NM</td>
<td>120156 X 149.84 NM</td>
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<td>1 = 2015 (6) 2 = 2022 (6) 3 = 2027 (6)</td>
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<td>STS040-610-010 1991-06-14</td>
<td>SpaceLab Life Sciences-1 (SLS-1) in P/L Bay</td>
<td>Gutierrez, Seddon, MS, &amp; Bagian, MS. Back row (lt to rt) CDR O'Connor, Jernigan, MS, &amp; Hughes-Fulford, MS.</td>
<td>2202 FT</td>
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**Flight Postponements:**
- 8/21/90 launch date as of 8/21/90. Launch order was STS-35, STS-41, STS-38, STS-40, STS-39, and STS-37. Launch postponed due to STS-35 and STS-38 H2 leak.
- Program manifest in March set tentative schedule of 5/22/91 with STS-37 and STS-38 moved ahead of STS-40.
- 120-day slip.

**Launch Scrubs:**
- 5/22/91 launch scrubbed at approximately L-1 day due to (1) MDM FA2 problem, (2) GPS failure, and (3) SSME cryo temp probes analysis stating probes could break and enter HP turbopumps. Launch rescheduled for 6/1/91. 10-day turnaround.
- 6/1/91 launch scrubbed at T-20 minute hold due to IMU 2 failing calibration. 96-hour turnaround.

**Launch Delays:**
- 14H/0/5/15 delay at T-9 minute hold due to RSO no-go for ceiling at 12K. (Moisture in middle clouds and greater than 4500 feet thick.) TAL WX - Ben Guerir (P) go throughout (selected). - Moron go throughout - Zaragoza go. RTLS - Ben Guerir (P) go throughout (selected).
<table>
<thead>
<tr>
<th>FLT. NO.</th>
<th>CREW (5)</th>
<th>LANDLAUNCH SITE/</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-43</td>
<td>CDR John E. Blaha (Flight 9) Atlantis</td>
<td>OV-104 (Flt 3 - STS-29 &amp; STS-33)</td>
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<td>90/104/ 100%</td>
<td>28.46°</td>
<td>CI-20 (1)</td>
<td>KSC-WD Off 60, VAB 6, PAD 35 = 101 days</td>
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<td>SEQ FLT #42</td>
<td>PLT Michael A. Baker</td>
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<td>LAUNCH POSTPONEMENT</td>
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<td>LAUNCH SCRAMBLE</td>
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<td>28.46°</td>
<td>CI-20 (1)</td>
<td>LAUNCH DELAYS</td>
<td></td>
</tr>
<tr>
<td>TAL - Ben Guerir &amp; Moron go, Banjul late go after T-shower and ceiling no go. Selected BEN 36, 10 days total slip.</td>
<td>OMEC STG</td>
<td>204.3</td>
<td>20.29</td>
<td></td>
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</tr>
</tbody>
</table>

**S90-41340 1990-06-22**

**Artist concept TDRS Comm Network**

**STS043-601-033 1991-08-11 TDRS-E/IUS deploy over Pacific Ocean.**

**STSO43-40-029,1991-08-11 --- Crew on Middeck: (Lt to Rt) Low/MS, Lucid/MS, Adamson/MS, CDR Blaha, & PLT Baker.**
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-48

<table>
<thead>
<tr>
<th>NO.</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES FTL DURATION, LANDINGS</th>
<th>SSME/TL NOM-ABORT EMERG</th>
<th>ORBIT</th>
<th>PAYLOAD/WEIGHS,</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, Etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-48</td>
<td>OV-103 (Flight 13) Discovery</td>
<td>CDR: John O. Creighton (Flight 3 - STS 11-G, &amp; STS-36) P224/R63/50/V1/M68</td>
<td>KSC39A 255.23 11:04Z 6:57:00 PM ET (PT)</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
<tr>
<td>SEQ FLT #43</td>
<td>KSC-43</td>
<td>PLT: Kenneth S. Reightler P225/R134/M419</td>
<td>KSC 39A 255:23:11:04Z 6:57:00 PM EDT (P) 7:11:04 PM EDT (A) Thursday 10 9/12/91 (2) LAUNCH WINDOW: 2H57M (UARS RAAN &amp; CTOB)</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
<tr>
<td>PAA</td>
<td>39A-30</td>
<td>MS 1: James W. Buchli FLIGHT DIRECTORS Asc/Ent - J. W. Bantle Ld/O1 - G. A. Pennington</td>
<td>OV-103</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
<tr>
<td>MLP-3</td>
<td></td>
<td>MS 2: Mark N. Brown FLIGHT DIRECTORS Plng - P. L. Engelauf</td>
<td>OV-103</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MS 3: Charles D. (Sam) Gemar FLIGHT DIRECTORS</td>
<td>OV-103</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OV-103</td>
<td>EDW 22 NOM (EDW 33,COCN 15) 109/104/ 104/104/ 100%</td>
<td>DIRECT INSERTION</td>
<td>RSRM 18W</td>
<td>288 X 36 NM</td>
<td>CARGO: 21564 LBS</td>
<td>LAUNCH ADVANCEMENT: - Launch advanced 9 days from 9/21/91 to 9/12/91, which was the earliest date to complete crew training</td>
</tr>
</tbody>
</table>

**STS048-21-004 1991-09-18 Crew on middeck: (front It to rt) PLT Reightler, CDR Creighton, Buchli/MS and (back It to rt) Brown/MS & Gemar/MS.**
## SPACE SHUTTLE MISSIONS SUMMARY

**STS-44**

**ORBITER:** OV-104 (Flight 10) Atlantis

**CREW:**
- Frederick D. Gregory (CDR)
- Thomas J. Hennen (PLT)
- F. Story Musgrave (MS)
- Mario Runco, Jr (MS)
- Terence (Tom) Henricks (PLT)
- Frederick D. Gregory (P229/R59/V47/M54)
- Thomas J. Hennen (P233/R136/V19/M15)
- F. Story Musgrave (P231/R136/M121)
- Mario Runco, Jr (P233/R136/M122)

**LANDING SITE:** KSC, Pad A

**LANDING TIME:** 3:28:13 PM EST (P) 6:44:00 PM EST (A)

**LIFTOFF TIME:** 104/104/104/70/104/67 100/104/104/73/104/67

**PAYLOADS:**
- **67:** MSS-1 AMOS CREAM SAM RME-III VFT-1 TERRA-SCOUT UVPI 4 CRYO TK SETS NO TOP

**MISSION HIGHLIGHTS**

**FIRSTS, SIGNIFICANT ANOMALIES, ETC.**
- **67:** Loss of one IMU caused MDF and landed on 195:45’W.
- **67:** Shuttle night launch #7.
- **67:** First flight with DOLILU capability. Nominal selected. No uplink required.
- **67:** Scrubbed 11/19/91 launch at T-9 hours because one IMU in IUS RIMU experienced BIT indications. Rescheduled launch for 11/24/91 to replace IUS RIMU. 5-day slip. 142 days total slip.

**PAYLOADS/EXPERIMENTS:**
- **67:** DEPLOY 37588 LBS DEPLOYED 5809 LBS MIDDECK 639991 LBS NON-DEPLOYED
- **67:** PAYLOAD 44637 LBS DEPLOYED 1240 LBS SHUTTLE 501412 LBS CARGO TOTAL 639691 LBS NON-DEPLOYED 581412 LBS CARGO TOTAL 1239864 LBS PERFORMANCE
- **67:** VELOCITY 25968 FSS FINAL TDDP: 565 RECON: 1025
- **67:** ENTR Y 4156 NM

**CARGO:**
- **67:** 47235 LBS

**LAUNCH POSTPONEMENTS:**
- As of 8/21/90, launch date was 7/5/91.
- Postponed launch date to 11/15/91 caused by STS-38 and STS-35 H-1, due to STS-43 delays impacted MLP availability and VAF tee splice replacement.

**ORBIT:** 109%/104%/104/67 100/104/104/73/104/67

**WEIGHTS:**
- **67:** ACTUAL 104/104/104/70/104/67 1 = 2015 (7) 2 = 2030 (6) 3 = 2029 (5) M 3 EOM

**LAP LS:** 335:22:34:43Z VEL: 182 KGS HDOT: -1 FPS TD NORM 195:

**RCS:**
- **2:** 207K 1:19:55 MET
- **3:** 235K 1:20:38 MET
- **4:** 207K 1:20:38 MET

**IGHTS:**
- **2:** 25934 25928
- **3:** 41934 41928

**MCC FCR:**
- **1:** 154.05°W

**M/C:**
- **1:** 267.23:47.36

**PLT:**
- **1:** STS044-17-030 1991-12-01 Crew: featuring "Trash Man" Hennen/PS (front ctr) star of onboard video on disposal of trash. Others (front row) CDR Gregory (left) & Voss/MS and (back row lt to rt) Runco/MS, Musgrave/MS, & PLT Henricks.

**SPACE SHUTTLE MISSIONS SUMMARY**

**Page 2-51 - STS-44**
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE/LIFTOFF, ET</th>
<th>LANDING SITE/ABORT TIMES</th>
<th>RR (4)</th>
<th>SRB</th>
<th>SSME-TL</th>
<th>COLUMBIA</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DAYS, WEATHER, ASCENT LOADS, FIRSTS, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEQ FLT #45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>POST ORBS-2</td>
<td>162 NM X 160 NM</td>
</tr>
<tr>
<td></td>
<td>KSC-45</td>
<td>PLT: Steven S. Oswald (Flt 4 - STS-7, STS-61-B, STS-30)</td>
<td>EDW/22 (REV 3)</td>
<td>100/100</td>
<td>RSRM</td>
<td>20W</td>
<td></td>
<td>PAYLOAD: CHARGABLE</td>
<td>39883 LBS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAD</td>
<td>MS 1 (FLT CNTR), Norman E. Thagard (Flt 5 - STS-8, STS-51-I, STS-41-B)</td>
<td>EDW/22 (REV 4)</td>
<td>100/70</td>
<td>ET</td>
<td>52T</td>
<td></td>
<td>DEPLOYED</td>
<td>0 LBS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MLP-3</td>
<td>MS 2: William F. Readdy (Flt 6 - STS-13, STS-80, STS-141)</td>
<td>EDW/22 (EDW/35, CONC 16)</td>
<td>100/47</td>
<td>ET</td>
<td>30K</td>
<td></td>
<td>NON-DEPLOYED</td>
<td>0 LBS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39A-32</td>
<td>MS 3: David C. Hilmers (Flt 7 - STS-4, STS-61-D, STS-61-C)</td>
<td>X-33: 363 NM</td>
<td>100/35</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>TAL WEATHER, ASCENT LOADS, FIRSTS, ETC.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39B-14</td>
<td>MS 5: UIF D. Merbold (Germany) (Flt 8 - STS-9, STS-80)</td>
<td>ORBIT DIR: 22/59M (TAL LIGHTING)</td>
<td>X-RANGE 109%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39A-31</td>
<td>MS 6: Roberta L. Bondar (Canada) (Flt 9 - STS-12, STS-110)</td>
<td>COLUMBIA EOM/THROTTLE: 160 X 157 NM</td>
<td>100/100</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P237/R15/V14/M19</td>
<td>MS 7: Robert L. Boncar (Mod - T. W. Holloway (Flt 10 - STS-1, STS-90)</td>
<td>CONSOLIDATED: 157.9°W</td>
<td>100/47</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P236/R139/M124</td>
<td>MS 1: (FLT CNTR), Norman E. Thagard (Flt 5 - STS-8, STS-51-I, STS-41-B)</td>
<td>CONSOLIDATED: 44.7°S</td>
<td>100/35</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P235/R76/V41/M70</td>
<td>MS 2: William F. Readdy (Flt 6 - STS-13, STS-80, STS-141)</td>
<td>CONSOLIDATED: 157.9°W</td>
<td>100/47</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P239/R77/V36/M71</td>
<td>MS 3: David C. Hilmers (Flt 7 - STS-4, STS-61-D, STS-61-C)</td>
<td>CONSOLIDATED: 44.7°S</td>
<td>100/35</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P240/R141/F16</td>
<td>MS 4: UIF D. Merbold (Germany) (Flt 8 - STS-9, STS-80)</td>
<td>CONSOLIDATED: 157.9°W</td>
<td>100/47</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P241/R29/V68/M28</td>
<td>MS 5: Roberta L. Bondar (Canada) (Flt 9 - STS-12, STS-110)</td>
<td>CONSOLIDATED: 44.7°S</td>
<td>100/47</td>
<td>ET</td>
<td></td>
<td></td>
<td></td>
<td>3 days total launch slip.</td>
<td></td>
</tr>
<tr>
<td>STS042-201-009, 1992-01-3 At work in IML-1: Bondar (left) &amp; Oswald.</td>
<td></td>
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<td></td>
<td></td>
<td>None.</td>
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</tr>
</tbody>
</table>

**FLIGHT DIRECTORS**

Asst: N. W. Hale

Lm: R. E. Castle

O 1: J. W. Bantle

O 3: C. W. Shaw

MOD: T. W. Holloway

**STANDARD MISSION HIGHLIGHTS**

- DIRECT INSERTION
- POST ORBS-2
- 162 NM X 160 NM
- DEPLOYED: 0 LBS
- NON-DEPLOYED: 0 LBS
- Accumulated Weights: 63069 LBS
- CARGO: 32/64 LBS
- Payloads/Experiments: 39883 LBS
- Mission Highlights: 132632 LBS
- Flight Director: C. W. Shaw
- Payloads: 39075 LBS
- Performance: 4339 x 1394
- Flight duration change: 2716 SECONDS
- Flight duration: 193:14:44
- Flight distance: 3,349,830 sm

- SIGNIFICANT ANOMALIES:
  - MVI CB trip during pitch operations.
  - Waste water dump rate degraded.
  - White Sands central computer failure. Also, RMS battery shortened life.
  - RCS jet L3A fail leak (oxidizer).
  - Crew reported plume from right pod, powered up MDM FPR and confirmed R4U oxidizer leak.
  - SRB - Gas path in RH & LH nozzle-to-case joint polysulfide with eroded wiper O-ring.
  - RCS jet L3A fail leak (oxidizer).

- Launch Postponements:
  - 12/29 launch was delayed 59/53S at T-9 minutes caused by: (1) Paper closure of FC2 H Pump/AC Bus anomaly, (2) KSC field mills read >1 KVOLT/meter (determined to be caused by salt fog), (3) Excessive O2 in mid-body, (4) "BLAST" program violation, and (5) KSC field mills read >1 KVOLT/meter (STA confirmed moisture in cloud passing over field mills).

- Launch Scram:
  - None.

- Launch Delays:
  - 1/22/92 launch was delayed 59M33S at T-9 minutes caused by: (1) Paper closure of FC2 H Pump/AC Bus anomaly, (2) KSC field mills read >1 KVOLT/meter (determined to be caused by salt fog), (3) Excessive O2 in mid-body, (4) "BLAST" program violation, and (5) KSC field mills read >1 KVOLT/meter (STA confirmed moisture in cloud passing over field mills).

- TAL WEATHER:
  - 1/22/92 launch was delayed 59M33S at T-9 minutes caused by: (1) Paper closure of FC2 H Pump/AC Bus anomaly, (2) KSC field mills read >1 KVOLT/meter (determined to be caused by salt fog), (3) Excessive O2 in mid-body, (4) "BLAST" program violation, and (5) KSC field mills read >1 KVOLT/meter (STA confirmed moisture in cloud passing over field mills).
### Space Shuttle Missions Summary

#### STS-45

**Orbiter**: OV-104 (Flight 11) Atlantis

**Flight Director**: Brian Duffy

**Launch Time**: 8:23:06 AM EST (Thursday)

**Launch Site**: KSC 39, Pad A

**Landing Site**: KSC-9

**Payload**: ATLAS-1

**Astronauts**: Charles F. Bolden, Jr., Kathryn D. Sullivan

**Mission Highlights**:
- **Firsts**: First flight of an improved APU (APU 2 only).
- **Significant Anomalies**: Fuel Cell 3 cell performance monitor D volts remained at self test value.

#### STS-45 ATLAS-1 in P/L Bay

**STS045-15-003 1992-04-02** Crew on Forward Flight Deck: In front are Sullivan/MS/PLC (left) & CDR Bolden. In rear are (lt to rt) Leestma/MS, PLT Duffy, Lichtenberg/PS, Frimout/MS, & Foale/MS. The "headpieces" worn by Sullivan and Bolden are actually shadows.

---

### Table: STS-45

| FLT NO. | ORBITER | CREW TITLE NAMES & EVAS | CREW | LAUNCH SITE/ ORBITER | LANDING SITE/ ORBITER | TIME | TIME DIFFERENCE | TIME DELAY |.getDeclared_value| |---|---|---|---|---|---|---|---|---|
| STS-45 | OV-104 | CDR: Charles F. Bolden, Jr. (Flight 11) Atlantis | Atlantic | KSC 39, Pad A | KSC-9 | 8:23:06 AM EST | +3 min 47 sec | 0 min 42 sec | |
| | | | | | | | | | |
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### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT.</th>
<th>NO.</th>
<th>CREW</th>
<th>ORBITER</th>
<th>LAUNCH SITE/</th>
<th>LANDING SITE/</th>
<th>PAYLOADS/</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(7)</td>
<td></td>
<td>RUNWAY</td>
<td>ORBITAL</td>
<td>EXPERIEMENTS</td>
<td>(LAUNCH SCRUNS/DAYS)</td>
</tr>
<tr>
<td>STS-49</td>
<td>STS049-21-005</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
<td>1992-05-16 Middeck crew portrait - front row, left to right,</td>
</tr>
</tbody>
</table>

Below: Replicas of Christopher Columbus’ sailing ships Santa Maria, Nina, and Pinta sail by Pad 39B in honor of Endeavour’s maiden voyage.

**STS-49**

**EDW 22 CONC**

**EDW 36, CONC 17**

**EDW 36, CONC 17**

**DIRECT INSERTION**

**POST OMS-2**

**22K**

**182.5 X 139.8 NM**

**195 X 194 NM**

**INTELSAT RNDZ**

**104/104/100%**

**PREDICTED**

**TRUETIME**

**104/104/99%**

**ACTUAL**

**104/99/104%**

**1 = 2030 (7)**

**2 = 2015 (8)**

**3 = 2017 (7)**

**DEOBIT**

**195 X 194 NM**

**VELOCITY**

**25614 FPS**

**ENTRY RANGE**

**4162 NM**

**CARGO**

**3744 LBS**

**PAYLOAD**

**CHARGEABLE**

**56237 LBS**

**CARGO TOTAL**

**136113 LBS**

**PERFORMANCE**

**INTEGRATIONS**

**34567LBS**

**FUEL BIAS**

**903**

**FINAL TPP/351**

**RECON 3206**

**PAYLOADS**

**FLIGHT DIRECTORS**

**REINDEED**

**INTEGRAL**

**REBOOT**

**INTEGRATE & PERIGEE STAGE**

**PERIGEE STAGE**

**ATTACHED TO INTEGRAL**

**1-12 CM**

**1800 FPS**

**137.20/37.70**

**194 KEAS**

**137.20/57.70**

**209 KG**

**-1.0 FPS**

**-4.5 FPS**

**-3.5 FPS**

**194 IN**

**205 KEAS**

**-1086.2**

**-1084.4**

**163.6°W**

**-4671**

**-439**

**-5.3**

**-5.3**

**-8.29**

**-8.29**

**137.20/57.70**

**2156 X 198 XM**

**184 NM**

**INTEGRAL**

**INTEGRATE**

**REBOOT**

**PERIGEE STAGE**

**ATTACHED TO**

**INTEGRAL**

**WHICH WAS**

**REDEPLOYED**

**MIDDECK**

**CPOG BLOCKII AMOS**

**LVP**

**4 CRYO TK SETS**

**RMS 26 (S/N 303)**

**Used to berth, repair, & deploy INTELSAT & monitor simultaneus waste and supply water dump**

**137.20/57.70**

**2156 X 198 XM**

**184 NM**

**INTEGRAL**

**INTEGRATE**

**REBOOT**

**PERIGEE STAGE**

**ATTACHED TO**

**INTEGRAL**

**WHICH WAS**

**REDEPLOYED**

**MIDDECK**

**CPOG BLOCKII AMOS**

**LVP**

**4 CRYO TK SETS**

**RMS 26 (S/N 303)**

**Used to berth, repair, & deploy INTELSAT & monitor simultaneus waste and supply water dump**
### STS-49

**Continued**

**EMU/Tethered EVA’s**

- **EVA 1 - 5/10/92**
  - SS EVA #16
  - BY EV1 & EV2
  - INTELSAT Capture Bar - NO GO
  - 3H43M

- **EVA 2 - 5/11/92**
  - SS EVA #17
  - Unscheduled EVA #3
  - BY EV1 & EV2
  - INTELSAT Capture Bar - NO GO
  - 5H30M

- **EVA 3 - 5/13/92**
  - SS EVA #18
  - Unscheduled EVA #4
  - BY EV1, EV2 & EV4
  - INTELSAT Hand Capture, Replaced Upper Stage and Released 8H29M

- **EVA 4 - 5/14/92**
  - SS EVA #19
  - BY EV3 AND EV4
  - ASIM - 7H45M

---

**CONTINUED. . .**

**RECORDS:**

- Longest ever EVA (8H29M), second longest EVA (7H45M).
- Longest EVA by female astronaut (7H45M).
- Four EVAs on one flight.

**SIGNIFICANT ANOMALIES:**

- Av Bay 3 high delta pressure.
- O2 manifold valve 1 failed open (failed to close).
- TDRSS state vector propagation errors in MCC.
- Orbit Target Terminal Initiation Computation failure on third rendezvous (used DL state vectors in Ground Computations).
- WCS fan sep 1 failure.
- Four floodlights failed.
- RCS jet L/L, fail leak.
- Ku-band beta gimbal failure - IFM/IMA tow of antenna similar to STS 41-G.
- PLBD port aft bulkhead latch failed to reach latch position.
- SSME 2 HPFT TD latch failed to reach latch position.
- SSME 2 HPFT TD temp sensor failed offscale high.
- GPC AP101S microcode error.

---

**STS049-91-020 1992-05-16**

STS-49 crewmembers complete successful capture of the International Telecommunications Organization Satellite (INTELSAT VI) during EVA3. Left to right, Hieb/MS, Akers/MS, & Thuot/MS, on RMS, have handholds on the satellite and prepare to attach capture bar (tethered to Hieb). Two earlier grapple attempts on two-person EVA’s were unsuccessful.
### Space Shuttle Missions Summary

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSING</th>
<th>LANDING TIMES, FUTURE TIMES, WINDS</th>
<th>ISSM/TTL, NOMABORT, EMERG</th>
<th>SRB</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHS,</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>EORT 5:00:104/72104/104</td>
<td>DELETION</td>
<td>100/104/104</td>
<td>28447 LBS</td>
<td>LAUNCH DELAYS: - 5MP/2 delay during T-9 hold due to a concern about a cirrus layer at 28K-34K with a detached anvil (potential lightning in launch area). WX STA PLT reported it was not a problem because they could see through it.</td>
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<td>EONT R/20: 104/104</td>
<td>X-RANGE</td>
<td>389 NM</td>
<td>28447 LBS</td>
<td>TAL WX: - Barium forecast and observed NO GO - ceiling. Ben Guerin forecast and observed GO (selected). Rota forecast NO GO - Vis (Haze), observed GO.</td>
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<td>EORT T/ T-20: 2322 FT</td>
<td>EORT D/</td>
<td>1041/41/40</td>
<td>28447 LBS</td>
<td>FLIGHT DURATION/LANDING SITE CHANGE: - Extended 1 day because of forecasted rain at EDW. - Changed landing site to KSC and landed one rev early because EDW had forecast of rain in clouds.</td>
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<td>DT NORM/20: 2212 FT</td>
<td>M3 ECOM</td>
<td>22565 lbs</td>
<td>28447 LBS</td>
<td>FIRSTS: - First flight of OV-12 after CFD (Major Mods at Padlakete). - First EDO flight and EDO pallet. - First flight of RCRS (Regenerative C2). Remove System). - First flight of OV-12 with drag chute, IMVS, etc. (Second flight of drag chute - deployed after NLGTDI). - First flight to exceed GEMINI VII flight duration (54:33). Only 3 SKYLAB flights exceed STS-50 duration.</td>
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<td>RD NORM/20: 2212 FT</td>
<td>M3 ECOM</td>
<td>22565 lbs</td>
<td>28447 LBS</td>
<td>DRAG CHUTE STRATEGY: Second drag chute deployed with NLG on ground.</td>
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<td>RD NORM/20: 2212 FT</td>
<td>M3 ECOM</td>
<td>22565 lbs</td>
<td>28447 LBS</td>
<td>Continued . . .</td>
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</tbody>
</table>

### STS-50

**Continued.**

**STS050-291-027 1992-07-09**

Dunbar/MS/PYLD CDR (rt) and DeLucas/PS in SL with Lower Body Negative Pressure Study.

**EARTH VIEWS**

Top Ltr to Rt: Canary Islands & ocean wakes (STS050-82-002) and Dust Storm, Red Sea, & Saudi Arabia (STS050-85-037). Bottom Ltr to Rt: Mt. Pinatubo Volcano - Post Eruption, Luzon, Philippines (STS050-52-026) and Andes Mountains, Chile and Argentina (STS50-112-060).

**STS050-81-027**

STS050-81-027 First U.S. Microgravity Laboratory (USML-1) module is pictured in the P/L Bay in this scene over the southern two-thirds of the Florida peninsula. KSC is just above Columbia’s starboard wing.

**STS050-S-106**

First flight of OV-102 with drag chute, INWS, etc. (Second flight of drag chute - deployed after NLGTD).

**STS50-s-084**

Unidentified Flight Controller hangs mission plaque in FCR.
# SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH DATE</th>
<th>LANDING SITE</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-46</td>
<td>OV-104</td>
<td>Llorencio J. Shriver</td>
<td>1992-08-08</td>
<td>KSC 46</td>
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<tr>
<td></td>
<td>(Flight 12)</td>
<td>PLT Allen &amp; Chang-Diaz</td>
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<td>M. L. Hoffman</td>
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<td>F. Malerba</td>
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</tbody>
</table>

## LAUNCH SITE

- **LAUNCH SITE:** KSC 39, Pad B
- **LIFTOFF TIME:** 213:13:47 AM EDT
- **LANDING SITE:** KSC 46
- **LANDING TIME:** 213:13:56:48 AM EDT
- **ABORT TIMES:**
  - TAL WX 7:16:19 AM EDT
  - TDEL 7:16:19 AM EDT

## MISSION HIGHLIGHTS

- **DIRECT INSERTION:**
  - POST OMS-2
  - POST OMS-3
- **PAYLOAD EXPERIMENTS:**
  - EURECA DEPLOY
- **PAYLOADS/WEIGHTS:**
  - 209,851 LBS X CG: 1078.2
- **PERFORMANCE MARGINS (LBS):**
  - 4 CRYO TK SETS

## EVENTS

- **FIRSTS:**
  - First flight of deployment and retrieval of a tethered satellite.
- **NOTE:** TSS deployed weight of 1040 lbs plus 90 lbs prop is not included in 9901 lbs deployed.

## LASTS

- Last flight of fleet without drag chute, INWS, and other improvements first used on STS-49. These modifications will be made before the next flight of OV-104.

## FLIGHT DURATION/LANDING SITE CHANGE

- **DIRECT INSERTION:**
  - POST OMS-2
  - POST OMS-3
- **PAYLOAD EXPERIMENTS:**
  - EURECA DEPLOY
- **PAYLOADS/WEIGHTS:**
  - 209,851 LBS X CG: 1078.2
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- **PAYLOADS/WEIGHTS:**
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  - 4 CRYO TK SETS

## EVENTS

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  - First flight of deployment and retrieval of a tethered satellite.
- **NOTE:** TSS deployed weight of 1040 lbs plus 90 lbs prop is not included in 9901 lbs deployed.

## MISSION HIGHLIGHTS

- **DIRECT INSERTION:**
  - POST OMS-2
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- **PAYLOAD EXPERIMENTS:**
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## EVENTS

- **FIRSTS:**
  - First flight of deployment and retrieval of a tethered satellite.
- **NOTE:** TSS deployed weight of 1040 lbs plus 90 lbs prop is not included in 9901 lbs deployed.

## LASTS

- Last flight of fleet without drag chute, INWS, and other improvements first used on STS-49. These modifications will be made before the next flight of OV-104.

## FLIGHT DURATION/LANDING SITE CHANGE

- **DIRECT INSERTION:**
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  - POST OMS-3
- **PAYLOAD EXPERIMENTS:**
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- **PAYLOADS/WEIGHTS:**
  - 209,851 LBS X CG: 1078.2
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<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, PAYLOADS/EXPERIMENTS</th>
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</tbody>
</table>

STS-46

Continued

At left: STS046-17-017 1992-08-08 Ivins/MS (left) and Hoffman/MS and PLC are conducting the Tether Optical Phenomena (TOP) experiment.

STS-46 Tethered Satellite System 1 (TSS-1) satellite is reeled out via its thin Kevlar tether into the blackness of space during deployment operations from Atlantis payload bay (PLB).

**SIGNIFICANT ANOMALIES:**
- MPS GH2 FCV erratic pressure. - Fan Sep 1 flooded, indicated stall currents and CB opened. Fan Sep 2 temporarily flooded. - PRL EURECA RF data handling problem (PSL lost lock due to excessive zeros in payload bit stream). - Flight deck speaker failed. - TSS U2 umbilical retractions failed when commanded by crew. - TSS deployer reel stalling at 179 and 251 meters. - TSS upper tether control mechanism jam at 224 meters. - Postflight investigation found the TSS level wind mechanism was jammed by a structural reinforcement bolt which was added based on late loads analysis.

STS046-102-021 1992-08-08 OV-104’s RMS grapples EURECA-1L and holds it in deployment position above PLB.

At left: STS046-17-017 1992-08-08 OV-104’s RMS grapples EURECA-1L and holds it in deployment position above PLB.
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<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITES, LANDING TIMES</th>
<th>LANDING TIMES FLT DURATION, WANDS</th>
<th>SSME/TL NOMABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>PAYLOAD, EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-47</td>
<td>OV-105 (Flight 2) Endeavour</td>
<td>CDR: Robert L. Gibson (Flight 4 - STS-41B)</td>
<td>KSC-39</td>
<td>Pad B</td>
<td>256:14:23Z</td>
<td>9/22/92</td>
<td>100/100/100/100</td>
<td>158.8°W</td>
<td>25803 FPS</td>
<td>114 KGS</td>
<td>1805 FT</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>KSC</td>
<td>33</td>
<td>0.9, L 1.8 KTS</td>
<td>4:04</td>
<td>28527</td>
<td>MECOM:</td>
<td>8.34</td>
<td>26059</td>
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<td></td>
<td>CHUTE JETTISON:</td>
<td>323:13:44:53</td>
<td>MECOM:</td>
<td>8.31</td>
<td>25839</td>
<td>55 KGS</td>
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<td>ROLL OUT:</td>
<td>7:22:30:22</td>
<td>OV-105</td>
<td>8.31</td>
<td>675:9:00:001</td>
<td>9.9 KTS</td>
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<td>MECOM:</td>
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<td>0.9 FMT/SYS</td>
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</table>

STS047-09-009 1992-09-20 Crew in Spacelab Japan (SLJ) science module Endeavour PLB: Lt to Rt, back row CDR Gibson & PLT Brown; middle row, Davis/MS, Apt/MS, & Jemison/MS; and front row, Lee/MS PLC & Mohri/PS (Japan) NASA.
**SPACE SHUTTLE MISSIONS SUMMARY**

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<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
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<th>LAUNCH SITE, LIFTOFF TIME, LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, HANDS</th>
<th>PAYLOAD/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>SSM/TL (6)</td>
<td>LAUNCH POSTPONEMENTS</td>
<td>ET-55</td>
<td>DIRECT INSERTION</td>
<td>POST OMS-2</td>
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<td>TAL, WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.</td>
<td>DIRECT INSERTION</td>
<td>ET-55</td>
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**LAUNCH SITE, LIFTOFF TIME, LANDING SITES, ABORT TIMES**

- **STS-52**
  - OV-102 (Flight 13) Columbia
  - Launch Site: KSC 39, Pad B
  - Liftoff Time: 206:17:09:36.97Z
  - Landing Sites: KSC 33
  - Abort Times: 11:16:00 AM EDT (P), 01:09:39 PM EDT (A)

**LAUNCH SITES, RUNWAY, CROSSRANGE**

- **LAUNCH WINDOW**
  - 2H 30M CTOB

**Landing Times,FLT Duration, Hands**

- **LANDING TIMES**
  - 10/22/92 (6) 2H 30M CTOB

**PAYLOAD/EXPERIMENTS**

- **LASER GEODYNAMICS SATELLITE (LAGEOS-II) (DEPLOYED)**
- **CTA DEPLOYED (CANADIAN TARGET ASSY)**
- **CANEX-2/TPCE, USMP-01 ASP**
- **MIDDECK**
- **SHUTTLE ACCUMULATED WEIGHTS**
- **PERFORMANCE MARGINS (LBS)**
- **FUEL BIAS, FUEL TOTALS**
- **FINAL TDP-11107 RECON 9901**
- **PAYLOADS**
- **LASER GEODYNAMICS SATELLITE (LAGEOS-II) (DEPLOYED)**
- **CTA DEPLOYED (CANADIAN TARGET ASSY)**

**SIGNIFICANT ANOMALIES**

- **WCS fan separator 1 failed to operate FD 10.**
- **FUEL cell 1 performance monitor hangup.**
- **F3L failed off (oxidizer leak).**
- **O2 tank 2 heater A2 erratic.**
- **Window 3 internal "void" or "bruise" (R&R).**

**FLIGHT DURATION CHANGE**

- **None.**

**FLIGHT SITES, ORBITER**

- **P/S 1**
  - Steven MacLean (Canada)
  - Launch Site: KSC 33
  - Liftoff Time: 206:17:09:36.97Z

**PAYLOAD/WEIGHTS**

- **CARGO**
  - 26962 LBS

**MISSION HIGHLIGHTS**

- **POST OMS-2**
  - 162.7 X 160.2 NM

**LAUNCH POSTPONEMENTS**

- Delayed due to engine 3 steerhorn weld anomaly.
- Launch postponed to 10/22/92 on 10/10/92 due to engine 3 steerhorn weld anomaly.

**LAUNCH DELAYS**

- Delayed for 1H53M39S because of RTLS crosswind exceedance (15-knot limit).
- Range safety warning (BLAST) existed for part of launch hold.
- MMT waived crosswind exceedance (0613G21 on center tower).

**TAL WX**

- Moron was forecast and observed NO GO because of low ceiling.
- Ben Guerir was NO GO during most of prelaunch period.
- DOLILU/I-LOADS: EDW 04/CI/N: None.

**ENTRY RANGE**

- 11788 FT

**COLUMBIA**

- (Flight 2 - STS-32)
- James D. Wetherbee
- Liftoff Time: 11:16:00 AM EDT (P) 01:09:39 PM EDT (A) Thursday 13 10/22/92
- Landing Sites: KSC 33
- Abort Times: 11:16:00 AM EDT (P), 01:09:39 PM EDT (A)
- Throttle Profile ENG, SUN: DIRECT INSERTION
- Inc: ET-55
- HAHP: POST OMS-2

**VESSEL**

- 215 FPS

**ITALIAN**

- Research Interim Stage (IRIS), a spinning solid fuel rocket, lifts the Laser Geodynamic Satellite II (LAGEOS II) out of its support cradle for deployment.
### STS-53

**Flight**
- **Orbiter:** OV-103 (Discovery)
- **Launch Site:** KSC-52
- **Launch Time:** 6:59:00 AM EST (P) 8:24:00 AM EST (A) Wednesday 7/12/92
- **Launch Window:** 6:59:00 AM EST (P) 8:24:00 AM EST (A) Wednesday 7/12/92 (3)
- **Liftoff Time:** 337:13:24:00Z
- **Crossrange:** 791 NM ORBIT DIR
- **Tal WX:** MRN, BEN SELECTED
- **Tal Wind:** H9, R11

**Crew**
- **Commander:** David M. Walker
- **Pilot:** Robert D. Cabana
- **Mission Specialist:** James S. Voss
- **Mission Specialist:** Guion S. Bluford
- **Mission Specialist:** Michael R. Clifford
- **Mission Specialist:** James S. Voss

**Payloads**
- **ODM-Pods:** LPOA-02, RBPO-16, PRSC-03
- **Chargeable:** 1030 LBS SHUTTLE
- **Performance:** 25813 FPS ENTRY
- **Payload Weights:** 699604 LBS NON-DEPLOYED

**Mission Highlights**
- **Firsts:**
  - Nominal and DOLILU Heads were GO on L-4.25 balloon.
  - DOLILU was selected and uplinked.
- **Significant Anomalies:**
  - HPOT secondary seal transducer failure.
  - Water spray boiler 1 steam vent heater anomalous cycles.
  - Lowered orbit to 176 nm for ODERACS deployment.
- **Significant Events:**
  - Fluid Acquisition & Resupply Equipment (FARE) middeck experiment.

**Payloads/Experiments**
- **Payloads/Experiments:**
  - Shuttle Accumulated Weights
  - Unloaded Weights
  - Performance Margins
  - FPR, 3934
  - Fuel Bias, 1035
  - CODERACS, Total 1533278 LBS
  - Final TDOP, 1996
  - RECON, 2844

**Mission Notes**
- **Flight Duration:** 4:04 4:06
- **Range:** 4237 NM
- **Payloads:**
  - PRR-6, 696504 LBS
  - FPR, 3934
  - Fuel Bias, 1035
  - CODERACS, Total 1533278 LBS
  - Final TDOP, 1996
  - RECON, 2844

**Flight Durations Changes**
- **Lengthened:** 25885 25885 OMS-2
- **Flight Times:** 5:48 5:41 5:48 5:41

**Flight Status**
- **Status:**
  - Successful launch on 11/5/92 when decision was made to fly STS-52 instead of STS-53.
  - Postponed launch to 12/2/92 due to LP04 replacing LP01, engine steerhorn X-rays, and NWS anomaly.
- **Launch Scrub:** None.

**Launch Delays**
- **Delay Reason:**
  - Acreage ice
  - Wing ice team confirmed melted approx. 30 minutes after sunrise.
  - Additional delay caused by wing ice team and NWS.

**Landing Site Changes**
- **Change:**
  - Changed landing site to EDW after waving off first opportunity at KSC and forecast NO GO (ceiling on second landing opportunity at KSC).

**Significant Anomalies**
- **Anomaly:**
  - HPOT secondary seal transducer failure.
  - Water spray boiler 1 steam vent heater anomalous cycles.

**Significant Events**
- **Event:**
  - Fluid Acquisition & Resupply Equipment (FARE) middeck experiment.
  - Photo shows the fluid mixture and transfer process in transparent sphere.

---

**Caption:**
In orbit crew group portrait in the aft flight deck (Caption unavailable, see names above).
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLIGHT</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE/ CROSSRANGE</th>
<th>LANDING SITE</th>
<th>LANDING TIMES</th>
<th>Throttle Profile ENG. S/N</th>
<th>SSME-TL NOMABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/ DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tbody>
<tr>
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</table>

**STS054-02-008** In orbit crew portrait (caption not available) Susam Helms, 1st Military Woman in space, at top.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>CREW (5)</th>
<th>LAUNCH SITE/LIFTOFF SITE</th>
<th>LANDINGSITES</th>
<th>ABORT TIMES</th>
<th>LAUNCH TIMES</th>
<th>FUEL BIAS</th>
<th>FINAL TDDP</th>
<th>RECON</th>
<th>ORBIT</th>
<th>PAYLOAD</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
<th>LAUNCH POSTCONDITIONS</th>
<th>DOLLU H-LOADS</th>
<th>NIGHT LAUNCH</th>
<th>FLIGHT DURATION CHANGES</th>
<th>SIGNIFICANT ANOMALIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-56</td>
<td>OV-103  (Flight 16) Discovery</td>
<td>CDR: Kenneth D. Cameron (Flight 2 - STS-37) &amp; flight engineer</td>
<td></td>
<td>KSC 38, PAD B</td>
<td>KSC 33, KSC-15</td>
<td>107-11:37:19</td>
<td>104/104</td>
<td>57° (13)</td>
<td>DIRECT INSERTION</td>
<td>POST OMS-2</td>
<td>159.8 X 159.1 NM</td>
<td>1843.9 LBS</td>
<td>159.8 LBS</td>
<td>737/101 LBS</td>
<td>693/342 LBS CARGO TOTAL: 1608317 LBS</td>
<td>KSC WD: OFF 63, VAB 10, PAD 22 = 95 days</td>
<td>159.8 LBS</td>
<td>- Waved off two landing opportunities at KSC because of forecast low ceiling at KSC.</td>
<td>First flight with 90% reefed drag chute (same deploy strategy), 50% more stable than baseline.</td>
</tr>
<tr>
<td>SED FLT #54</td>
<td>P-565-19 MLP-1</td>
<td>FLIGHT DIRECTORS: Escoit - J. W. Bantle</td>
<td></td>
<td>LAUNCH WINDOW</td>
<td>DEPLOYMENT ET 100/100/100</td>
<td>LAUNCH Window Closes on ATMOS Tangent Ray Constraint - 24:01M</td>
<td>X RANGE: 6 NM</td>
<td>X RANGE: ET DIR: CL 27</td>
<td>AIMPT CLOSE IN: M3 EOM</td>
<td>DEORET: 160 X</td>
<td>159.8 LBS</td>
<td>160.5 X</td>
<td>159.9 LBS</td>
<td>25797 FPS</td>
<td>NIGHT LAUNCH: Shuttle night launch #8.</td>
<td>159.8 LBS</td>
<td>- Extended 1 day because WX forecast NO GO at KSC.</td>
<td>- Loose thermal blanket on aft (1307) bulkhead.</td>
<td>- FCI C3 reactor valve falsely indicated closed.</td>
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<tr>
<td>KSC-54</td>
<td>COD: C. Michael Foale</td>
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<td></td>
<td>LANDINGSITE CROSSRANGE</td>
<td>LANDINGSITE CROSSRANGE</td>
<td>ET THROTTLE PROFILER OPTpq ING X/HN/SUN</td>
<td>RSRM: 104/104</td>
<td>57° (13)</td>
<td>DIRECT INSERTION</td>
<td>POST OMS-2</td>
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### SPACE SHUTTLE MISSIONS SUMMARY

**STS-55**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LANDINGSITES, ABORT TIMES</th>
<th>LANDINGSITE/ RUNWAY, CROSSWINDS</th>
<th>SSME-TL NAMER/ EMERGS</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHS, EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-55</td>
<td>OV-102</td>
<td>Steven R. Nagel</td>
<td>KSC 39, Pad A</td>
<td>KSC 39, Pad A 116:44:59.98z</td>
<td>EDW 22 COCC (EDW 38, CONC 19)</td>
<td>EDW 22 COCC</td>
<td>EDW 22 COCC</td>
<td>101/104/100%</td>
<td>126:14:29.59z</td>
<td>28.45&quot; (32)</td>
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<td></td>
<td>(Flight 14)</td>
<td>Terence T. Henricks</td>
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<td>10:50:00 AM EDT (F)</td>
<td>P301/R161/M144</td>
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<td>100/100/100%</td>
<td>126:14:29.59z</td>
<td>126:14:31.20z</td>
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<td>Columbia</td>
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<td>Wednesday 8 4:26/93 (10)</td>
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<td></td>
<td>STS-55-106-056</td>
<td>German payload specialists Walter and Schlegel at work in SL-2.</td>
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<td></td>
<td>STS-55-203-009</td>
<td>Inflight crew portrait in SL- Deutsche 2 science module. Front (lt to rt) PLT Henricks, CDR Nagel, Walter/PS1 (Germany) &amp; Precourt/MS2. Rear (lt to rt) Harris/MS3, Schlegel/PS2 (Germany), &amp; Ross/MS1/ PLC.</td>
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**MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAIL WEATHER, ASCENT ILOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

- STS-55 launch date was postponed to 3/21/93 because of SSME HPOT tip seal retention problem, SSME 3 LH2 umbilical hydraulic supply flexible hose break and range conflicts with Delta and Atlas launches.
- LAUNCH SCRUBS AND PAD ABORT #3: - Replaced all 3 engines at pad. - 4/24/93 launch scrubbed after tanking at L-6.5 hours due to an IMU-2 failed BITE test. - LAUNCH DELAYS: None.
- DOLLU LOADS: - Both nominal and DOLLU were go. DOLLU selected because of increased Q-plane margin at Mach 1.55. DOLLU uplink #7, total I-load uplink #14.
- FLIGHT DURATION CHANGES: - Extended 1 day for additional science. Extended one rev because of forecast variable broken ceiling and changing landing site to EDW concrete.
- LANDING SITE CHANG: KSC to EDW.
- FIRSTS: First flight of operational TIPS.
- DRAG CHUTE: - Baseline chute used with strategy to deploy at derotation similar to STS-56.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>CREW (6)</th>
<th>LAUNCH SITE/LIFTOFF TIME</th>
<th>LANDING SITE/AERTimes</th>
<th>ORBIT TIME/DURATION, CROSSWINDS</th>
<th>THROTTLE PROFILE, ENG/SUN</th>
<th>AND ET</th>
<th>INC</th>
<th>HAMP</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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</table>

**SPACE SHUTTLE MISSIONS SUMMARY**

**STS057-94-017 1993-07-01 Front row left to right: Wisoff/MS3, PLT Duffy, Voss/MS4. In rear (left to right): CDR Grabe, Sherlock/MS2 and Low/MS1/PLC.**
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ABORT TIMES</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
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</tr>
</thead>
</table>

Above: STS057-97-056 1993-07-01 -- Low and Wisoff perform DTO 1210 EVA in OV-105's payload bay.

Earth Observations


STS057-93-052 1993-07-01 EURECA is retrieved by RMS to be stowed in PLB for return to earth.

sts057-s-089 -- Post mission in the MCC are Greg Smith/FAO (Flight Activities Officer), holding mission plaque, and CAPCOM Curt Brown (right).
### Space Shuttle Missions Summary

<table>
<thead>
<tr>
<th>NO.</th>
<th>Title, Names &amp; EVAs</th>
<th>Crew</th>
<th>Launch Site, Aborted Times</th>
<th>Landing Site/Runway</th>
<th>SSME/TL</th>
<th>Nom/Abort Emerg.</th>
<th>Throttle Profile</th>
<th>Orbit</th>
<th>Payload Experiments</th>
<th>PayLoad Weights</th>
<th>Mission Highlights</th>
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<tbody>
<tr>
<td>STS-51</td>
<td>OV-103 (Flight 17) Discovery</td>
<td>CDR: Frank L. Culbertson (FLT 2 - STS-36)</td>
<td>KSC 38B</td>
<td>KSC 15 (KSC 17)</td>
<td>104/104</td>
<td>100%</td>
<td>8-00</td>
<td>28.45°</td>
<td>42 IMS-3</td>
<td>265:07:56:06Z</td>
<td>POST OMS-2 (33)</td>
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<td>OV-103</td>
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<td>7:05:28</td>
<td>9/16/93</td>
<td>109/13/02</td>
<td>640498 LBS</td>
<td>Space Shuttle #6, first night landing at KSC.</td>
<td>25873</td>
<td>25873</td>
<td>106/119.9 NM</td>
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<td>106/119.9 NM</td>
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**Top:** STS051-06-037 Newman & Walz evaluate tools for HST servicing mission. Bottom: STS051(S)158 First night landing at KSC.

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**Space Shuttle EVA #22**
- SCHEDULED EVA #18
- PROCEDURES/TRAINING
- FOR FUTURE EVAS
- EVA 1: Carl Walz
- EVA 2: Jim Newman
- EMU/TETHERED EVA
- EV 1: Carl Walz
- EV 2: Jim Newman
- MCC FCR-1 (36)
- FLIGHT DIRECTORS
  - A/E: R. D. Jackson
  - LDO: R. E. Caste
t
  - O/02: L. D. Kelso
  - PLG: N. W. Hale
  - MOD: B. R. Stone

---

**Flight Duration Changes**
- Tacked off rev 142 landing at KSC because of rain within 30 nm. Extended flight 1 day minus 1 rev. (Total extension 15 revs.)

---

**Significant Anomalies**
- Right SRB bit HPU underspeed problem. (Scrub #2.)
- 25873: 2 fuel flow sensor A2 failed low. (Scrub #3.)
- FAZ MDM BITE.
- ECCE-01: Loose thermal blanket on aft bulkhead.
- PSA slider door stuck open.
- Thruster L3L failed off.
- Thruster RTR chamber pressure transducer failure (post-flight found fuel/oxydizer reaction products (FORP) in tube.)
- TCS SuperZip damage, both detonation cords fired simultaneously damaging 1307 bulkhead and PLB blankets.
- Humidity separator B water carryover.

---

**Launch Postponements**
- Launch date was 2/22/93 of 62/69/93 but was postponed to 6/30/93 on 3/22/92 to reflect changes in manifest.
- 6/30/93 launch was postponed to 7/13/93 on 3/31/93 based on STS-55, and STS-57 launch delays.
- 7/13/93 launch was postponed to 7/17/93 because of STS-57 launch delays. (See 7/17/93 and 7/24/93 scrubs.)
- 8/4/93 launch date was postponed to 7/20/93 to avoid Pensei Meteoroid (Comet Swift-Tuttle) event on 8/11/93. Launch rescheduled for 9/12/93. (See 9/12/93 scrub below.)
- 9/10/93 launch postponed to 9/12/93 on 9/3/93 to allow ACST/TOS to complete a review/analysis of transistor alert (suspected as potential cause of NOAA-I and IAPS Observer failures).

---

**Launch Scrub/Pad Abort #4**
- 7/17/93 launch was scrubbed at L-3 min. At approximately L-2 hours, nine "B" systems PIs indicated they were charged (four on each SRB holddown post and one on ET vent arm). - 7/24/93 launch was scrubbed at T-19 seconds with fuel flow sensor A2 miscompared with sensor A1. (Pad abort #4.) Launch reset to 9/10/93. Replaced all 3 engines at pad.

---

**Events**
- Waved off rev 142 landing at KSC because of rain within 30 nm. Extended flight 1 day minus 1 rev. (Total extension 15 revs.)
- First flight of drag chute with five ribbons removed.
- First flight with right landing at KSC.
- First flight with wake up music (used Heartbreak Hotel by Carl Walz) sung by a crewmember.
- First flight with two U.S. and two Russian EVAs at same time.
- Events: Fuel cell 1 shut down for 24 hours for DTO 412.

---

**Rendezvous #15**
- EVENTS: Fuel cell 1 shut down for 24 hours for DTO 412.
- Night Landing: Space Shuttle #6, first night landing at KSC.

---

**Significant Anomalies**
- Right SRB bit HPU underspeed problem. (Scrub #2.)
- 25873: 2 fuel flow sensor A2 failed low. (Scrub #3.)
- FAZ MDM BITE.
- ECCE-01: Loose thermal blanket on aft bulkhead.
- PSA slider door stuck open.
- Thruster L3L failed off.
- Thruster RTR chamber pressure transducer failure (post-flight found fuel/oxydizer reaction products (FORP) in tube.)
- TCS SuperZip damage, both detonation cords fired simultaneously damaging 1307 bulkhead and PLB blankets.
- Humidity separator B water carryover.
<table>
<thead>
<tr>
<th>FLT NO</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAND aerer SITE, LIFTOFF TIME,</th>
<th>LANDING SITE/ RUNWAY, CROSSTRA</th>
<th>SRB LANDER</th>
<th>ORBIT</th>
<th>FSF</th>
<th>PAYLOAD WEIGHS, EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/ DELAYS, TAIL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-58</td>
<td>OV-102</td>
<td>CDR</td>
<td>KSC 39, PAD B 29:14:53:06:97z</td>
<td>EDW22 CONC (EDW39, CONC 20)</td>
<td>104/104/100%</td>
<td>BI-061</td>
<td>36.0°</td>
<td>DIRECT INSERTION</td>
<td>KSC WID: OFF 82, VA17, PAD 28 = 127 days total.</td>
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<tr>
<td>SEQ FLT #58</td>
<td></td>
<td>John E. Blaha</td>
<td>10:53:00 AM EDT (F)</td>
<td>10:53:00 AM EDT (E)</td>
<td>10:53:10 AM EDT (A)</td>
<td>Monday 10</td>
<td>10/18/93 (7)</td>
<td>104/104/100%</td>
<td>BI-061</td>
</tr>
<tr>
<td>KSC-58</td>
<td>SLS-2LM</td>
<td>P316/R97/V48/M18</td>
<td>Monday 10</td>
<td>10/18/93 (7)</td>
<td>104/104/100%</td>
<td>BI-061</td>
<td>36.0°</td>
<td>DIRECT INSERTION</td>
<td>KSC WID: OFF 82, VA17, PAD 28 = 127 days total.</td>
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<tr>
<td>PAD 36B-22</td>
<td>MPL-1</td>
<td>Richard A. Searfoss</td>
<td>Monday 10</td>
<td>10/18/93 (7)</td>
<td>104/104/100%</td>
<td>BI-061</td>
<td>36.0°</td>
<td>DIRECT INSERTION</td>
<td>KSC WID: OFF 82, VA17, PAD 28 = 127 days total.</td>
</tr>
<tr>
<td>EDO 2</td>
<td>CDR</td>
<td>KSC 39, PAD B 29:14:53:06:97z</td>
<td>EDW22 CONC (EDW39, CONC 20)</td>
<td>104/104/100%</td>
<td>BI-061</td>
<td>36.0°</td>
<td>DIRECT INSERTION</td>
<td>KSC WID: OFF 82, VA17, PAD 28 = 127 days total.</td>
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</tr>
<tr>
<td>CMO-2</td>
<td>CDR</td>
<td>John E. Blaha</td>
<td>10:53:00 AM EDT (F)</td>
<td>10:53:00 AM EDT (E)</td>
<td>10:53:10 AM EDT (A)</td>
<td>Monday 10</td>
<td>10/18/93 (7)</td>
<td>104/104/100%</td>
<td>BI-061</td>
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<tr>
<td>25867</td>
<td>P316/R97/V48/M18</td>
<td>Richard A. Searfoss</td>
<td>Monday 10</td>
<td>10/18/93 (7)</td>
<td>104/104/100%</td>
<td>BI-061</td>
<td>36.0°</td>
<td>DIRECT INSERTION</td>
<td>KSC WID: OFF 82, VA17, PAD 28 = 127 days total.</td>
</tr>
</tbody>
</table>

**STS058-16-008**
Clockwise from top: Seddon/PLC, Lucid/MS, McArthur/MS, Fettman/PS, Wolf/MS, PLT Searfoss, & CDR Blaha.

---

**STS058-92-064**
1993-10-30 SPACELAB-2 in PLB flies over northeast Egypt.
<table>
<thead>
<tr>
<th><strong>FLT NO.</strong></th>
<th><strong>CRS</strong></th>
<th><strong>CREW (7)</strong></th>
<th><strong>LAUNCH SITE, LIFTOFF TIME</strong></th>
<th><strong>LANDING SITE, ABORT TIMES</strong></th>
<th><strong>SSTM/TL ORBIT, CROSSRANGE, LANDING TIMES</strong></th>
<th><strong>SRB RSRM, ORBIT, ET</strong></th>
<th><strong>ORBIT</strong></th>
<th><strong>FSW</strong></th>
<th><strong>PAYLOAD W/WEIGHTS, EXPERIMENTS</strong></th>
<th><strong>MISSION HIGHLIGHTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-61</td>
<td>OV-105</td>
<td>CDR Covey, Nicolette, Hoffman, Bowersox, Thornton, Akers</td>
<td>KSC 36, P&amp;D B 336:09:59:65.62 12/13/93 3:18:26:00 EST</td>
<td>KSC 33, P&amp;D B 336:09:25:32:32 1:05:25:33 AM EST</td>
<td>104/104/100% 100/100/100/100% 100/100/100/100% 100/100/100/100% 100/100/100/100% 100/100/100/100% 100/100/100/100% 100/100/100/100%</td>
<td>Bi-035 48.5° 75° 100° 175° 350°</td>
<td>CI-22</td>
<td>48333 LBS</td>
<td>CARGO: 3981 FUEL BIAS: 30.4 X 214.4 3:18:26:00 EST</td>
<td>STS-61 - Space Shuttle #12 launch was scrubbed while holding at T-5 minutes when 67-minute window expired. Primary causes of delay were RTLS crosswind exceedence and rain within 20 nm. Other factors were BLAST, COLA, ceiling violation (6.5K broken), and intruder ship in SRB recovery area.</td>
</tr>
</tbody>
</table>

**STANDARD MISSION SUMMARY**

**CREW**

Richard O. Covey, Kenneth D. Bowersox, Kathryn C. Thornton, Jeffrey A. Hoffman, F. Story Musgrave, Thomas D. Akers

**LAUNCH SITE, RUNWAY, CROSSRANGE**

KSC 36, Runway 33, Planar Runway

**LANDING TIMES, ORBIT PROFILE**

2:07:39, 2:08:39 ET

**FUEL WEIGHTS, NO. MARGINS (LBS)**

761280 LBS NON-DEPLOYED, 761280 LBS CARGO TOTAL

**ENG. S.N.**

ET-60, ET-53, ET-53

**WEIGHTS & WEATHER**

- Banjul, Ben Guerir, and Moron all forecast and observed GO.
- DOLILU uplink #9, I-load uplink #15.
- Rendezvous with HST for grapple, berth, repair, and deploy.
- Minimum shuttle crossrange (3 nm).

**FIRSTS**

- First flight with four EVA crewmembers.
- First flight with five EVAs (alternating crew on alternating days).
- Minimum shuttle crossrange (3 nm).

**MISSION HIGHLIGHTS**

- Shuttle night launch.
- Significant landing at KSC.
- In-suit drink bags leaked.
- Large in-suit drink bags not stored.
- EMU 3 intermittent loss of 298.6 receive and all hardline comm.
- SRM 3 used for grapple, service, and deploy.
### STS-61

#### Continued

**EMU/TETHERED EVAs:**

- **EVA #1** - 12/4/93
  - SPACE SHUTTLE EVA #19
  - BY EV 1 & EV 2
  - REPLACED RSU'S 2 & 3, ESU'S 1 & 3 AND RELATED GYR'D Fuse Plugs.
  - THROTTLE PROFILE: SSME-TL NOM-ABORT EMERG

- **EVA #2** - 12/5/93
  - SPACE SHUTTLE EVA #20
  - BY EV 3 & EV 4
  - REPLACED BOTH SOLAR ARRAYS, OLD +V2 ARRAY JETTISONED

- **EVA #3** - 12/6/93
  - SPACE SHUTTLE EVA #21
  - REPLACED WIDE FIELD/PLANETARY CAMERA AND INSTALLED TWO MSS'S

- **EVA #4** - 12/7/93
  - SPACE SHUTTLE EVA #22
  - REPLACED HIGH SPEED PHOTOMETER WITH COSTAR AND INSTALLED NEW COPROCESSOR

- **EVA #5** - 12/8/93
  - SPACE SHUTTLE EVA #23
  - REPLACED SOLAR ARRAY DRIVE ELECTRONICS, GHRS REDUNDANCY KIT, MLI CONTAMINATION KITS FOR MSS'S, AND MANUALLY OPERATED BOTH SOLAR ARRAY PRIMARY DEPLOYMENT MECHANISMS

**FLT DURATION:**

- 10:19:58:33

**DISTANCE:**

- 4,433,772 sm

**STS061-86-030** 1993-12-04 Hubble Space Telescope is berthed in Endeavour's payload bay after capture.

**STS061-94-050** Thornton on end of RMS (foreground) and Akers install COSTAR during EVA for HST repair.

At right: **STS061-90-028** 1993-12-09 After servicing, HST flies away on new “Solar Wings”.

Bottom left: **m100_wfpcHSTBefore**

Bottom right: **m100_smallHSTAfter**

**STS061-74-046** Hoffman on RMS and Musgrave installing Wide Field/Planetary Camera (WFPC II).
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-60</td>
<td>OV-103</td>
<td>CDR: Charles F. Bolden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Flight 18)</td>
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<tr>
<td></td>
<td></td>
<td>Discovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spacelab 2</td>
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<tr>
<td></td>
<td></td>
<td>CMS PODS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LP01-21</td>
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<tr>
<td></td>
<td></td>
<td>RP03-19</td>
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<td>PLR3-18</td>
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<tr>
<td></td>
<td></td>
<td>PLT: Kenneth S. Reightler</td>
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<tr>
<td></td>
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<td>(Flight 2 - STS-48)</td>
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<tr>
<td></td>
<td></td>
<td>P331/R134V56M19</td>
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<tr>
<td></td>
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<td>MS 1: N. Jan Davis</td>
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<td>(Flight 2- STS-47)</td>
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<td>P332/R135V100P17</td>
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<td>MS 2: Ronald M. Sega</td>
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<td></td>
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<td>P333/R175M153</td>
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<td>MS 3: Franklin R. Chang-Diaz</td>
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<td></td>
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<td>(Flight 4 - STS 61-C, STS-34 &amp; STS-46)</td>
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<tr>
<td></td>
<td></td>
<td>P334/R89V46M1</td>
</tr>
<tr>
<td></td>
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<td>MS 4: Sergei Krikalev</td>
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<td>(Flight 4 - STS 61-C, STS-34 &amp; STS-46)</td>
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<tr>
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<td></td>
<td>P335/R176M154</td>
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<tr>
<td></td>
<td></td>
<td>MCC FCR-1 (39)</td>
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<tr>
<td></td>
<td></td>
<td>FLIGHT DIRECTORS:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A/E - J. W. Bantle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LD/02C: W. Shaw</td>
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<tr>
<td></td>
<td></td>
<td>O 1 - G. A. Pennington</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PLN/G - R. E. Castle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MOD - G. E. Coon</td>
</tr>
</tbody>
</table>

**LANDING MISSIONS SUMMARY**

STS-60 15-003 SPACEHAB-2 in Payload Bay

**FLIGHT DIRECTORS:**
- A/E - J. W. Bantle
- LD/02C: W. Shaw
- O 1 - G. A. Pennington
- PLN/G - R. E. Castle
- MOD - G. E. Coon

**CREW Squeezes through tunnel to SPACEHAB** in PLB. CDR Bolden is at upper right. Others, clockwise from him are: Sega/MS; Davis/MS, Chang-Diaz/PLC, Krikalev/MS & first Russian on U.S. spacecraft, and PLT.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME T/L NO</th>
<th>SB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS</th>
<th>EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-62</td>
<td>OV-102</td>
<td>CDR</td>
<td>KSC 39, PAD B 63:13:52:59.97</td>
<td>KSC 33:00:00:11.42</td>
<td>KSC 33:00:00:11.44</td>
<td>104/104/104</td>
<td>36 KM</td>
<td>BI-064</td>
<td>B-2</td>
<td>CARGO</td>
<td>30016 LBS</td>
<td>KSC WD: OFF 62, VA35. PAD 19 = 86 days total.</td>
</tr>
<tr>
<td></td>
<td>(Flight 16)</td>
<td>John H. Casper</td>
<td>Columbus</td>
<td>77:13:00:41.2</td>
<td>3/8/94 AM EST</td>
<td>POST CSM-2</td>
<td>183 X 161 X 90</td>
<td>ET-62</td>
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<tr>
<td></td>
<td>EDO 3</td>
<td>CREW</td>
<td>Friday 7</td>
<td>3/1894 (4)</td>
<td>104/104/104/67</td>
<td>enus, &amp; EVAS</td>
<td>DUST-2</td>
<td>RDF</td>
<td>277K</td>
<td>CHARGABLE</td>
<td>79752 LBS</td>
<td>KSC 33/CI/N</td>
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<tr>
<td></td>
<td>CMS PODS</td>
<td>LPO5-5</td>
<td>LAUNCH WINDOW</td>
<td>9:1000 CTOB</td>
<td>Orbit DIR: 116 NM</td>
<td>9:36/104</td>
<td>IMPACT</td>
<td>214K</td>
<td>ET</td>
<td>DEPLOYED</td>
<td>0 LBS</td>
<td>EDO 3</td>
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<tr>
<td></td>
<td>RPO5-5</td>
<td>P337</td>
<td>EORMLS, KSC</td>
<td>77:13:15:02</td>
<td>06:28:00 AM ET</td>
<td>1:12/104</td>
<td>6762</td>
<td>1:27:04 M</td>
<td>NON-DEPLOYED</td>
<td>1612 LBS</td>
<td>100/104/104/67</td>
<td>1 = 2031 (9)</td>
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<td>PSC2-16</td>
<td>M/S 1</td>
<td>KSC, TAL, BEN</td>
<td>77:13:15:02</td>
<td>KSC 33/CI/N</td>
<td>104/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<tr>
<td></td>
<td>M/S 2</td>
<td>Charles D. (Sam) Gemar</td>
<td>Ben Guerir, Moron, and Zaragoza were forecast and observed</td>
<td>132.9°W</td>
<td>M/5</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<td>M/S 3</td>
<td>Marina S. Ivins</td>
<td>39B-24</td>
<td>709 ~708</td>
<td>M/5</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
<td></td>
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<tr>
<td></td>
<td>MCC FCR-1</td>
<td>Pierre J. Thuot</td>
<td>TV Cameras A, B, and end effector problems.</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<tr>
<td></td>
<td>FLIGHT DIRECTORS</td>
<td>M/S 1</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<td>AET 1 - N. W. Miller</td>
<td>M/S 2</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<tr>
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<td>LD 2 - P. L. Engelke</td>
<td>M/S 3</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<tr>
<td></td>
<td>T 3 - C. W. Shaw</td>
<td>M/S 1</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
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<tr>
<td></td>
<td>T 4 - J. M. Huffin</td>
<td>M/S 2</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>MOD - A. L. Bristow</td>
<td>M/S 3</td>
<td>132.9°W</td>
<td>1905P08 T4, L3</td>
<td>364/104/104/67</td>
<td>IMPACT</td>
<td>214K</td>
<td>6762</td>
<td>MIDSLE</td>
<td>1 = 2031 (9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STSO62-81-024 Features activity with Dexterous End Effector (DEE) on RMS. Also seen are U.S. Microgravity Payload 2 (USMP) and OAST-2.**

**STSO62-17-025 Crew in aft flight deck:**
Front: CDR Casper (left), & Thuot/MS.
Rear: (left to right) are PLT Allen, Ivins/MS (and hair) & Gemar/MS.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE &amp; NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>ORBITER LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING TIMES ORBIT DURATION, WINDS</th>
<th>SSME/SSC T/L/NOMABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS WEIGHS</th>
<th>MISSION HIGHLIGHTS</th>
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</thead>
<tbody>
<tr>
<td>STS-59</td>
<td>OV-105</td>
<td>CDR: Sidney M. Gutierrez</td>
<td>KSC 39, PAD A 99:11:04:59:99.9Z 7:05:00 AM EDT (P) Thursday 4 4/20/94 (11)</td>
<td>EDW 22, CONC EDW 40, CONC 21 9:54:30 AM PDT Wednesday 7 4/20/94 (9)</td>
<td>DEBUT BURN 110:16:00:35Z</td>
<td>X-RANGE: 721 NM</td>
<td>ORBIT DIR: DR 11</td>
<td>104/104 100%</td>
<td>BI-065</td>
<td>57” (15)</td>
<td>DIRECT INSERTION POST OMS-2 121 X 121 NM DEPLOYED</td>
<td>33758 LBS</td>
</tr>
</tbody>
</table>

**SPACE SHUTTLE MISSIONS SUMMARY**

**LANDING SITE**

- OV-105 (Flight 6) Endeavour
- OV-105 (Flight 6) Endeavour
- OV-105 (Flight 6) Endeavour
- OV-105 (Flight 6) Endeavour

**ORBITER**

- CDR: Sidney M. Gutierrez
- PLT: Kevin P. Chilton
- MSS: Jerome (Jay) Apt
- MSS: Michael R. Clifford
- MSS: Thomas D. Jones

**CARGO**

- 33758 LBS
- 33758 LBS
- 33758 LBS
- 33758 LBS
- 33758 LBS

**FLIGHT DURATION CHANGES**

- Changed from 9 to 10 days to acquire more science.
- Waved off landing at KSC on orbits 166 and 167 for forecast and observed ceiling violations and rain within 30 nm. Extended flight a second day.
- Waved off landing on orbit 182 due to observed ceiling violations and forecast rain within 30 nm. Waved off landing at KSC due to observed and forecast rain. Landed at EDW on orbit 183.
- Flight extended 2 days plus one orbit.

**SIGNIFICANT ANOMALIES**

- Flight SSME HPOTP fuel charge temperature A biased low (200 degree delta to CHB).
- Bubbles in water from SRG (caused by venturi effect).
- Defective (split) LiOH can casing, no LiOH spilled.
- FES Feedline A Heater 1 thermostat failure.
- H_2 tank 5 check valve failed to seat.
- Sticky cryo H_2 Tank 2 check valve.
- GPS DTO status bit static.
- MADSS recorder tape broke.
- Ku-band channel 3 interferes with Channel 2.
- Ku-band range telemetry unit digit inoperative.
- Side hatch window impact crew reported.
- OCS vent arm on damaged, caused by shuttle plume effect.
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-65</td>
<td>OV-102 (Flight 17) Columbia</td>
<td>CDR: Robert D. Cabana (Flt 3 - STS-41, STS-45) P347/R113/V94/M101</td>
<td>KSC 39, PAD A 189:16:42:59.972Z 12:43:00 AM EDT (P), 12:43:00 AM EDT (A) Friday 10 7/8/93 (4)</td>
<td>KSC 33 (KSC 21) 204:10:36:00.032 EOM PRESSURE 6:00 AM EDT Saturday 11 7/23/94 (4)</td>
<td>DEOBP BURN 204:10:46:382 X RANGE: 180 NM ORBIT DIR: CL 32 AIM PT: NOMINAL MLGTD: 2989 FT 204:10:36:00.032 VEIL: 207 KGS 190 KEAS HDOT: -2.5 FPS TD NORM 204:10:36:00.032 2501 FT</td>
<td>104/104/100% PREDICTED: 100/104/100% ACTUAL: 100/104/100%</td>
<td>BL-066 RSRM 30 KM ET-64 NEW</td>
<td>CARGO: 3280 LBS PAYLOAD: CHARGEABLE: 24262 LBS DEPLOYED: 0 LBS NON-DEPLOYED: 22521 LBS</td>
<td>None</td>
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<tr>
<td></td>
<td>SEQ FLT #63</td>
<td>PLT: James D. Halsell, Jr. P348/R179/M156</td>
<td>NASA: 1 NO.LABORATORIES 104/104/104/100% 67/104</td>
<td>FSW: SPS PLS EDW 22/N/N</td>
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<td>PAD 39A/39</td>
<td>MS 1 (PAYLOAD CDR): Richard J. Hieb (Flt 3 - STS-39, STS-49) P348/R128/V70/M115</td>
<td>MCC FCR-1 (42)</td>
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<td>MLP-3</td>
<td>MS 2: Carl E. Walz (Flt 2 - STS-51) P390/R170/V106/M148</td>
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<td>MS 5: Leroy Chiao P351/R179/M157</td>
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<td>MS 4: Donald A. Thomas P352/R180/M158</td>
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<td>PSS 1: Chaki Naito-Mukai P353/R181/F23 (Japan - NASA)</td>
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**STOCK ALLOCATIONS:**
- **CARGO:** 3280 LBS
- **PAYLOAD:** 24262 LBS
- **DEPLOYED:** 0 LBS
- **NON-DEPLOYED:** 22521 LBS

**SIGNIFICANT ANOMALIES:**
- Supply water dump nozzle icing occurred on third dump on FD3. FES was used to dump water for the rest of flight.
- WCS problems included commode fault during compaction, commode filter fit and odor problems, and fan sep 1 stall and liquid backflow.
- IMU redundant rate BITE messages.
- RCS vernier thruster R5D failed off, then nominal ops.
- Ops recorder 2 track 2 poor dump quality.
- Galley rehydration station did not dispense cold water.

**LAUNCH POSTPONEMENTS:**
- Baseline launch date of 6/23/94 on 4/2/93.
- Postponed launch date to 7/8/94 on 4/15/93.

**LAUNCH DELAYS:**
- Both DOLILU and NOMINAL I-loads were GO, NOMINAL I-loads were selected, no uplink required.

**FLIGHT DURATION CHANGES:**
- Waved off landing at KSC on orbits 220 and 221 due to forecast and observed rain and potential lightening. Extended flight 1 day.

**MISSON HIGHLIGHTS (LAUNCH SCRIBBS/DEPALS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**
- Supply water dump nozzle icing occurred on third dump on FD3. FES was used to dump water for the rest of flight.
- WCS problems included commode fault during compaction, commode filter fit and odor problems, and fan sep 1 stall and liquid backflow.
- IMU redundant rate BITE messages.
- RCS vernier thruster R5D failed off, then nominal ops.
- Ops recorder 2 track 2 poor dump quality.
- Galley rehydration station did not dispense cold water.
- Altrefix magazine jams, Hasselblad jam and lens stuck.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE NAMES &amp; EVAS</th>
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<th>LANDING SITE/MISSION HIGHLIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
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<tbody>
<tr>
<td></td>
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<td>(F113), (Flight 19), Discovery</td>
<td>FLIGHT DELAYS, SCHEDULED EVA</td>
<td>M3 EOM</td>
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<td>EVA SITE: 117</td>
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**STS-64-114-027** --- Meade & Lee) test the new Simplified Aid for EVA Rescue (SAFER).
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW / (6)</th>
<th>TITLE NAMES &amp; EVAS</th>
<th>LANDING SITE, LIFTOFF TIME</th>
<th>LANDING TIMES FLO DURATION, WINDS</th>
<th>SSME-TL NOMABORT EMERG, THROTTLE PROFILE ENG. S.N.</th>
<th>SRB RSRM AND ET</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD</th>
<th>PAYLOADS EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCOURN DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQ PLT #5</td>
<td>KSC-65</td>
<td>PLT: Terence W. Wilcutt</td>
<td>KSC 39 PAD A 273:15:15:59.982 7:16:00 AM EDT (5) 12 Fri 9/24/94</td>
<td>EDW22, CONC (EDW-42, CONC 23) 10/02:48:12 PM EDT Monday 11</td>
<td>10113/94/486 PREDICTED 100/100/100</td>
<td>67/104 ACTUAL 100/100/100</td>
<td>57° (17)</td>
<td>CARGO (8)</td>
<td>34252 LBS</td>
<td>KSC WD: OFF 59, VAB 20 (2), PAD-41 (2) = 120 days total.</td>
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<td>KSC-65</td>
<td>PLT: Terence W. Wilcutt</td>
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<td>57° (17)</td>
<td>CARGO (8)</td>
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<td>KSC WD: OFF 59, VAB 20 (2), PAD-41 (2) = 120 days total.</td>
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**STS 068-070-023** — The Space Radar Laboratory-2 (SRL-2) in the Space Shuttle Endeavour's cargo bay.

**STS 068-002-016 Crew in middeck:** (clockwise from bottom right) Jones/PLC, CDR Baker, Bursch/MS, PLT Wilcutt, Smith/MS, & Wisoff/MS.
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LANDSITE</th>
<th>LANDING TIMES</th>
<th>LAUNCH TEXTILITIES</th>
<th>PAYLOADS &amp; EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-66</td>
<td>SEI PLT #55</td>
<td>CDR: Donald R. McMonagle (Flt 3 - STS-30, STS-54) P365/R12wV57/M113 PLT: Curtis L. Brown (Flt 2 - STS-47) P367/R152V121/M136 MDL: 368-V-26 MUP-3</td>
<td>Atlantis</td>
<td>KSC 39 PAD B</td>
<td>307.16:59:42.77Z 11:56:03 AM EST (P) 11:59:43 AM EST (A) Tuesday 17 11/39 (9)</td>
<td>EDW22, CONC (EDW-43, CONC 24) 7:33:45 AM PST Monday 13 11/149 (9)</td>
<td>DIRECT INSERTION POST OMS-2 164.8 X 164.2 NM DEPLOY 164.8 X 164.2 NM DEPLOY 766601 LBS 15762210 LBS 912210 LBS 18135 LBS</td>
</tr>
<tr>
<td>STS-66</td>
<td>SEI PLT #55</td>
<td>CDR: Donald R. McMonagle (Flt 3 - STS-30, STS-54) P365/R12wV57/M113 PLT: Curtis L. Brown (Flt 2 - STS-47) P367/R152V121/M136 MDL: 368-V-26 MUP-3</td>
<td>Atlantis</td>
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<td>307.16:59:42.77Z 11:56:03 AM EST (P) 11:59:43 AM EST (A) Tuesday 17 11/39 (9)</td>
<td>EDW22, CONC (EDW-43, CONC 24) 7:33:45 AM PST Monday 13 11/149 (9)</td>
<td>DIRECT INSERTION POST OMS-2 164.8 X 164.2 NM DEPLOY 164.8 X 164.2 NM DEPLOY 766601 LBS 15762210 LBS 912210 LBS 18135 LBS</td>
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**SPACE SHUTTLE MISSIONS SUMMARY**

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<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME, LAUNCH SITE/ RUNWAY, CROSSRANGE</th>
<th>LANDING TIMES, FLY DURATION, WINDS</th>
<th>SSME-TL NAME/ABORT EMERGENGY</th>
<th>SRB ENG/ET INC</th>
<th>ORBIT</th>
<th>FS/ PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAIL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tbody>
<tr>
<td>STS-63</td>
<td>OV-103</td>
<td>CDR</td>
<td>KSC 39 PAD B 34:05:22:03.96Z 00:22:04 AM EST (P) Thursday 13 23/95 (4)</td>
<td>KSC 15 (KSC 22) 42:11:50.162 6:50:19 AM EST Saturday 12 2/15/95 (3)</td>
<td>DEOBIT BURN 42:10:44.04 Z</td>
<td>104/104/ 109%</td>
<td>RSRM 42</td>
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<td>PLT</td>
<td>P373/R188/V114/N114/114/469 NM</td>
<td>25/41/8 NM</td>
<td>103.5 X 102.9 NM 106:08:00 MET 4/10:00:30 Z</td>
<td>104/104/ 109%</td>
<td>RSRM 42</td>
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<td>P373/R188/V114/N114/114/469 NM</td>
<td>25/41/8 NM</td>
<td>103.5 X 102.9 NM 106:08:00 MET 4/10:00:30 Z</td>
<td>104/104/ 109%</td>
<td>RSRM 42</td>
<td>ET-68</td>
<td>51.6°</td>
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<td>25/41/8 NM</td>
<td>103.5 X 102.9 NM 106:08:00 MET 4/10:00:30 Z</td>
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<td>RSRM 42</td>
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<td>RSRM 42</td>
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<td>104/104/ 109%</td>
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<td>103.5 X 102.9 NM 106:08:00 MET 4/10:00:30 Z</td>
<td>104/104/ 109%</td>
<td>RSRM 42</td>
<td>ET-68</td>
<td>51.6°</td>
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</table>

STS063-06-018 Crew on aft flight deck: Front row (lt to rt), Harris/PLC & Feole/MS. Back row (lt to rt), Voss/MS, Titov/MS (Russia), CDR Wetherbee, & PLT Collins (first female pilot).
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLIGHT DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SRB, POST, ORBIT</th>
<th>PAYLOAD WEIGHTS, PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<td>SIGNIFICANT ANOMALIES:</td>
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<td>- Cabin pressure transducer shifted low by 0.23 PSI.</td>
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<td>- Fuel Cell 2 H2 motor status increased between 0.6 volts and 0.83 volts.</td>
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<td>- EV2 crewman experienced burning sensation in his eyes during repressurization at 5 PSI. Funny odor inside suit was reported.</td>
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<td>- During EVA, both EV1 and EV2 electronic cuffs were partially unresponsive.</td>
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<td>- THC hotstick event when aft flight controller power was turned on (ref. STS-66), several thrusters fixed.</td>
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<td>- TCZ Z-axis system failure during MIR back away at 322 feet.</td>
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<td>- Erratic TC3 data sporadically throughout TC3 ops on SPARTAN rendezvous day.</td>
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<td>- Port radiator latch 1-6 “A” latched indication intermittent.</td>
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<td>- Spacehab module pressure decay (air leak into airlock).</td>
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<td>- RCS jet R1U failed off (oxidizer temp dropped below RM limit of 30 degree F), oxidizer leak.</td>
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<td>- RCS jet L2D failed off. Jet had good driver output with low (&lt; 13 PSI) chamber pressure.</td>
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<td></td>
<td>- RCS jet F1F tail leak, indicated oxidizer leak.</td>
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</tbody>
</table>

STS063-86-028  Collins and Titov get TIPS mail from MCC.  
STS063-716-064  Freeflying SPARTAN

STS063-21-011---Harris on RMS foot restraint carries Foale during shared EVA. Harris was first African-American to walk in space.
STS063-712-057  As seen from Discovery: MIR Space Station with docked Soyuz (at bottom of MIR) and Progress at opposite end.

S95-12534 -- Pat Patnesky (left) & unidentified Russian Scientist) with Shuttle mockup in background. Pat was NASA JSC PAO photographer responsible for many, many JSC MCC mission photos. He supported all NASA manned programs from Mercury through Shuttle, retiring in 1997.
### STS-67

- **Mission Highlights:**
  - **Launch Postponements:**
    - No launch.
  - **Launch Delays:**
    - No launch.
  - **Launch Scrubs:**
    - No launch.
  - **Launch Weather:**
    - No launch.
  - **Significant Anomalies:**
    - No significant anomalies.

### Payloads/Experiments
- No payload details.

### Flight Crew
- **Crew:**
  - Stephen S. Oswald (EDW 44, CONC 25)
  - Jeff Grunsfeld/MS.

### Mission Events
- **Launch Postponements:**
  - Postponed from launch at 12:19:20
  - Postponed again at 12:28:08
  - Postponed launch due to weather issues.

### Flight Details
- **Launch Window:**
  - Direct launch.

### Payload Details
- **Payload Weights:**
  - Flight Total: 7,453 kg.
  - Middeck: 1,340 kg.
  - Shuttle Accumulated: 2,872 kg.

### Crew in Aft Flight Deck
- **Crew Members:**
  - B. P. Austin
  - C. W. Shaw
  - J. W. Bantle
  - B. C. Garriot (prime & selected)
  - C. M. Monore

### Additional Details
- **Synchronous Orbit:**
  - Orbit 1: 213.6 km.
  - Orbit 2: 213.6 km.

### Flight Duration
- Total flight duration: 105 days.

---

**STS067-317-002 Crew in aft flight deck:**
- Front (to it): Jernigan/PLC, CDR Oswald, and PLT Gregory. Back (to it): Lawrence/MS, Paris/PS, Durrance/PS, and Grunsfeld/MS.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>TITLE, NAMES &amp; EVA'S</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, LANDING TIMES, ABORT TIMES</th>
<th>LANDING SITE/兰 WAY, CROSSRANGE</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SRB ENG. S.N.</th>
<th>ORBIT</th>
<th>FS&amp;W</th>
<th>PAYLOAD WEIGHTS, PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tr>
<td>STS-67</td>
<td>Continued</td>
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</tbody>
</table>

**STS067-713-072** ASTRO-2 cluster of telescopes and Instrument Pointing System in payload bay.

**STS067-368-008** Oswald (center), Grunsfeld (back), and Gregory (Right) involved in Middeck Experiments.

**STS067-721A-087** Flying over the “Roof of the World”, the Plateau of China. Himalayan (foreground) & Gangdise Mountains.

**sts067-s-046--** Space Shuttle Program Manager (and former Flight Director), Tommy Holloway, presents STS-67 Wall Plaque to Flight Control Team for “Mission Well Done”.

**sts067-s-041 --** Glynn Lunney (left), VP & Program Manager USA (and former NASA Flight Director & Shuttle Program MGR) and Flight Director Randy Stone in MCC.

**SIGNIFICANT ANOMALIES:**
- Spacelab SCOS cache addressing error.
- FES primary A failed to come out of standby.
- Noisy supply water tank D quantity transducer.
- High N2 flow on PCS system 2, 14.7 cabin regulator.
- Middeck audio terminal unit failure (main bus current spike).
- CCPI failure to power portable light or camcorder.
- Handheld mike was inoperative on both middeck and airlock ATU’s. Possible short.
- TEAC 8 mm VCR anomaly (degraded picture quality).
- Unexplained external IPS disturbances. Pointing performance degraded.
- Water spray boiler 2 excessive water usage (most of water was accidentally off-loaded prelaunch.)
- LSD oxidizer injector temperature erratic (GMEM uplinked).
- R4R jet fail leak, jet stopped leaking at 21:53 MET.
**SPACE SHUTTLE MISSIONS SUMMARY**

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<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (10) 7 UP, 8 DOWN</th>
<th>LAUNCH SITE, LIFTOFF TIME, THROTTLE PROFILE ENG. S/N.</th>
<th>LANDINGSITES, FLIGHT TIMES, WINDS</th>
<th>LANDING TIMES FLIGHTLAP, CROSS RANGE</th>
<th>SSME/TL, NOMABORT EMERGENCY</th>
<th>SRB RSRM AND ET</th>
<th>ORBIT</th>
<th>FSW PAYLOAD WEIGHTS,</th>
<th>PAYLOAD/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS), TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.</th>
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**STS-71 KSC-95EC-0913 Liftoff of 100th U.S. human space flight. It featured the 1st docking between the U.S. Space Shuttle and the Russian Space Station Mir.**

Continued...
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD/WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAIL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-71 Continued...</td>
<td>MIR-18 FLIGHT ENGINEER: Gennady Strekalov P393/R196/M171 MIR-18 COSMONAUT/RESEARCHER: Norman E. Thagard (Flt 5 - STS-7, STS-51-B, STS-30, STS-42) P394/R20/V14/M19</td>
<td>Continued... MECO CMD: 8:30.72 8:31.1 VI: 25876.5 25871</td>
<td>Continued... OV-104: 03:03:48:17</td>
<td>DISTANCE: 4,100,000 sm</td>
<td>Continued... Rendezvous #21: Rendezvous and dock with Russian Mir Space Station (first docking). Significant Anomalies: - Postflight disassembly of RSRM nozzle joint 3 revealed RTV gas paths with slight heat effect and erosion to primary O-rings of STS-71 LH RSRM and STS-70 RH RSRM. Technique developed to remove RTV from joint and do a vacuum backfill for STS-69 and STS-73 RSRMs. - GPC 4 annunciation GPC BITE fault message followed by GPC 4 fail. Determined to be single event upset, GPC 4 was assigned string 4 and used successfully during entry. - Slow docking module vestibule depress rate. - H2 manifold valve tank 1 failed open. - Cryo O2 tank 1 leak through flight cap of fill/drain line QD. - H2 manifold valve 1 microswitch failure. - Erratic O2 tank 5 heater temperature. - VHF system transmit failure. - PDIP power fail. - S-band comm string 2 uplink problem. - RCS jettison R2U fail off (low chamber pressure).</td>
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<tr>
<td>KSC-95EC-0544 Spacelab-Mir module and transfer tunnel at KSC. In foreground is Obiter Docking system (ODS) topped with red Russian Androgynous Peripheral Docking System (APDS).</td>
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STS-71 Continued…


Above Right: NM18-309-028 -- As Atlantis approaches Mir docking node, MCC/CSR Rep James Nise reported that MIR Cosmonaut Strekalov happily yelled, "The banana truck is here!" (A reference to the days when Russia imported bananas from Cuba.)

Below: Soyuz photo of Shuttle docked to MIR from link: [http://io.jsc.nasa.gov/photos/10280/hires/sts071-s-072.jpg](http://io.jsc.nasa.gov/photos/10280/hires/sts071-s-072.jpg) Provided by Gregory A. Lange JSC-/DA8


S95-16417.jpg -- MOD FD, Alan Briscoe (left) leads Post-Mission toast in CSR to success of first Shuttle-MIR docking and first permanent transfer of Russian/American crews (Mir-19 up and Mir-18 crew down).
ST-S70 RH RSRM. - Erratic supply water tank C transducer. - Ops recorder 2 track 3 degradation. - Vacuum cleaner power cable pinched (IFM fixed). - Crew reported W6 impact crater. - Lost MOC capability when MOC went to 100% CPU.

ST-S70 RH RSRM. - Erratic supply water tank C transducer. - Ops recorder 2 track 3 degradation. - Vacuum cleaner power cable pinched (IFM fixed). - Crew reported W6 impact crater. - Lost MOC capability when MOC went to 100% CPU.

ST-S70 RH RSRM. - Erratic supply water tank C transducer. - Ops recorder 2 track 3 degradation. - Vacuum cleaner power cable pinched (IFM fixed). - Crew reported W6 impact crater. - Lost MOC capability when MOC went to 100% CPU.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ ORBITARY CROSS RANGE</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-69</td>
<td>OV-105</td>
<td>CDR</td>
<td>KSC 39A 261:10:35:13Z</td>
<td>1315 W 60 SEC</td>
<td>フライトテスト (EDFT) #2 を実施するための空間環境対策モード (EDFT) #2 の実施に伴う寄与</td>
</tr>
<tr>
<td></td>
<td>Endeavour</td>
<td>Flight 9</td>
<td>261:11:37:55Z</td>
<td>1023.3</td>
<td>フライトテスト (EDFT) #2 を実施するための空間環境対策モード (EDFT) #2 の実施に伴う寄与</td>
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<tr>
<td>SEQ</td>
<td>FLT #71</td>
<td>PLT</td>
<td>Pad 39A:4-3</td>
<td>151.9°W</td>
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<tr>
<td>KSC-71</td>
<td>OM-67</td>
<td>M/S 1</td>
<td>M/C 39A</td>
<td>1301</td>
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<tr>
<td>PAD</td>
<td>MLP-1</td>
<td>M/S 2</td>
<td>VAB 7 Pad 47</td>
<td>186 x 181 NM</td>
<td>フライトテスト (EDFT) #2 を実施するための空間環境対策モード (EDFT) #2 の実施に伴う寄与</td>
</tr>
</tbody>
</table>

**STS069-715-050 Crew in middeck:**

- FLT (t) to (r): PLT Cockrell and CDR Walker.
- Backrow (t) to (r): Voss/MS/PLC, Gearhardt/MS, and Newman/MS.

---

**Significant Anomalies:**
- CRT 1 dim display.
- Fuel cell 2 condenser exit temp high (scrubbed launch attempt).
- Waste dump fuel filter was unsuccessful, so off loaded waste tank into CWC.
- PSU (prime and selected), MRN forecast NO GO for ceiling and rain but observed GO 10 mins prior to landing time.
- Middeck speaker ATU failure. - Camera D downlink lost. - Loss of Ku-band forward link.
- Random ops recorder commands issued when panel brightness control adjusted in new MCC. - Hydraulics pump 3 stuck in norm press (cycled switch twice to get response then started APU. - WSB 3 lub oil overcooling during entry.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, FLIGHT DURATION, WINDS</th>
<th>LANDING TIMES FLIGHT DURATION, WINDS</th>
<th>LANDING SITE/ Runway, Crossrange</th>
<th>THROTTLE PROFILE, ENG. S/N</th>
<th>SSME/TL</th>
<th>SRB RSRM</th>
<th>PAYLOAD</th>
<th>ORBIT</th>
<th>PAYLOADS</th>
<th>MISSI</th>
<th>MEASURES HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQ</td>
<td>PRT #72</td>
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<tr>
<td>STS073-736-018</td>
<td>Crew worked in this science module in PLB, shown here flying over Africa.</td>
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</tbody>
</table>
STTS-074}

## STS-74 MISSION HIGHLIGHTS

**Launch Scrubs/Delays:**
- Baseline launch date of 10/26/95
- Postponed launch date to 11/1/95, caused by SRB nozzle joint #5 and 6 repairs to STS-69, STS-73, and STS-74.
- Advanced launch date to 11/15/95 on 10/4/95.
- Postponed date to 11/16/95 on 10/27/95 caused by STS-73 launch scrub.

**Launch Scrubs:**
- Scrubbed 11/1/95 launch at T-4 minutes while holding at T-5 mins, when all 3 TAL sites (BEN, MRN, ZZA) were forecast and observed NO GO for weather.

**Launch Delays:**
- None

**Tal Weather:**
- ZZA (prime & selected) was forecast GO but observed NO GO for 7000' broken ceiling. MRN forecast and observed TO. BBN forecast observed NO GO for ceilings and crosswinds.

**Dooluhi Loads:**
- Selected and uplinked DOLIHI-II I-loads, DOLIHI-II uplink #4, DOLIHI uplink #18, I-load uplink #23. (Last flight with nominal I-load availability.)

**Flight Duration Changes:**
- None

**Rendezvous #3:**
- Rendezvous and dock with Russian Mir space station (second docking).

**Payloads:**
- Docking module unberth 1/18/01, capture 1/18/46.12, hardmote 1/18/53.41.
- Docking module APDS-1 to Mir docking at 2/17/56.57 MET, hardmote at 2/18/05 MET.
- Transferred 9/34 lbm H.O., 59 lbm O₂, and 44 lbm N₂ to Mir.
- Undocking from Mir at 3/19/45.01 MET.

**Radiator Deploy #1:**
- Deployed radiator to make water available for transfer to Mir.
- Port RAD deployed to make water 63323-14 GMT.

**Significant Anomalies:**
- Fuel cell 3 cell performance monitor delta volt measurements for all 3 substacks shifted approximately 5 millivolts.
- Cryo O tank manifold valve 1 valve failed open.
- PLB aft port and aft starboard lights failed.
- H₂ manifold valve 1 microwlack failure.
- TCS 1 lost calibration, TCS 2 self-test failures.
- ODS stowage bag adapter plate jammed.
- Ops-1 recorder track 8 data degradation.
- Mir commander battery low capacity.
- WSB 2 regulator pressure erratic postlanding.

### PAYLOADS/EXPERIMENTS

#### Payloads
- Chargon
- FER
- FUEL BIAS 1136
- FINAL TDOP: 1823
- RECNO: 3689

#### MISSION HIGHLIGHTS
- Launch Postponements:
  - Baseline launch date of 10/26/95 on 5/594.
  - Postponed launch date to 11/1/95 on 9/995, caused by SRB nozzle joints #5 and #4 repairs to STS-69, STS-73, and STS-74.
  - Advanced launch date to 11/15/95 on 10/4/95.
  - Postponed date to 11/16/95 on 10/27/95 caused by STS-73 launch scrub.

#### Flight Duration Changes:
- None

#### Rendezvous #3:
- Rendezvous and dock with Russian Mir space station (second docking).

#### Payloads:
- Docking module unberth 1/18/01, capture 1/18/46.12, hardmote 1/18/53.41.
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#### Significant Anomalies:
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- Cryo O tank manifold valve 1 valve failed open.
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- H₂ manifold valve 1 microwlack failure.
- TCS 1 lost calibration, TCS 2 self-test failures.
- ODS stowage bag adapter plate jammed.
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- Mir commander battery low capacity.
- WSB 2 regulator pressure erratic postlanding.
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<thead>
<tr>
<th>NO.</th>
<th>PLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSRANGE</th>
<th>SSME-TL</th>
<th>SSB</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

**STO072-344-019 --- Crew: Front, It to rt right, Barry/MS, CDR Duffy, & Chiao/MS. Rear: Wakata/MS, PLT Jett, & Scott/MS.**

**TOP: EVA 2 --- Barry, lower left, & Chiao, upper right**

**BOTTOM: EVA 1 --- Scott in P/L bay, Chiao is out of frame. Both EVA’s used to demonstrate ISS assembly techniques.**

**SIGNIFICANT ANOMALIES:**
- RCS shutdown and topping FES case icing.
- EMU helmet light damage.
- EMU glove cut damage.
- Loss of reception in left ear piece of EV 1.
- Several EFDT-03 anomalies.
- OAST-Flyer unexpected trajectory dispersions.
- MCC front end processors operating at 100%.
- RCS jet 1A fail off with maximum chamber pressure of 16 psi.
- RCS jet 2A fail leak. Jet had oxidizer leak.
- Failure of SFRU solar array panels to retract for capture and berthing, faulty solar array.
- SFRU AHU thermal discrepancies. Flight SFRU not wired same as training SFRU.
- RCS vent box vent heat degradation.
- LO, ET umbilical fragile nut detonator did not fire (pyro wiring problem).
### Space Shuttle Missions Summary

#### STS-75

<table>
<thead>
<tr>
<th>No.</th>
<th>Orbiter</th>
<th>Title, Names &amp; EVAS</th>
<th>Launch Site, Liftoff Time, Abort Times</th>
<th>Landing Sites, Abort Times</th>
<th>LANDING TIME, FLIGHT DURATION, WINDS</th>
<th>Throttle Profile, Eng. SN</th>
<th>SRB RSFM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>Payloads/Experiments</th>
<th>Mission Highlights (Launch Scrubs/Delays, Tal Weather, Ascent Loads, Firsts, Significant Anomalies, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PLT: Scott J. Horowitz</td>
<td>12025</td>
<td>160.2 NM</td>
<td>100/104/104</td>
<td>DCRS</td>
<td>93</td>
<td>161.9 x 160.2 NM</td>
<td>POST CWS-2</td>
<td>23353 LBS</td>
<td><strong>LAUNCH DELAYS:</strong></td>
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<tr>
<td></td>
<td></td>
<td>MSP: Jeffrey A. Hoffman</td>
<td>53:20:17:59:20Z</td>
<td></td>
<td></td>
<td>1 = 2029 (13)</td>
<td>2 = 2034 (7)</td>
<td></td>
<td>158.4 x 169.4 NM</td>
<td>NON-DEPLOYED</td>
<td>10:12:25:00 MET</td>
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<td>115:22:55:43Z</td>
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<td></td>
<td>- Decision to not try to land on orbit 235 due to forecast of low ceiling.</td>
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<td>49:13:58:20Z</td>
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<td>- Total flight duration extension of 2 days plus one orbit.</td>
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<td>66:36:47:37</td>
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<td>- Extended flight 1 day for additional USMP science.</td>
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<td>65:36:47:37</td>
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<td>- Decision to not try to land on orbit 235 due to forecast of low ceiling.</td>
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<td>69:13:58:20Z</td>
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<td></td>
<td>- Extended flight 1 day for additional USMP science.</td>
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**Inflight crew portraits:**
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>SSME-TL</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-76</td>
<td>OV-104</td>
<td>Kevin P. Chilton (Flt 3 - STS-49, STS-59) P430R145/V103/M129</td>
<td>KSC PAD 3B</td>
<td>EDW 22, CONC</td>
<td>104/104/109</td>
<td>DECREASE</td>
<td>CARGO</td>
<td>KSC W/D</td>
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<tr>
<td>SEQ</td>
<td>FLT #76</td>
<td>Richard A. Searfoss (Flt 2 - STS-58) P431R175/V127/M153</td>
<td>LAUNCH WINDOW</td>
<td>POST OMS-2</td>
<td>158.5 x 85.1 NM</td>
<td>DIRECT</td>
<td>PAYLOAD</td>
<td>MISSION SCREWS/DEBOARDS</td>
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<tr>
<td>KSC-76</td>
<td>PAD</td>
<td>Ronald M. Sega (Flt 2 - STS-60) P434R122/V105/F13</td>
<td>LANDING TIMES</td>
<td>ACTUAL</td>
<td>100/104/104</td>
<td>EPSM</td>
<td>CHARGEABLE</td>
<td>TAIL WEATHER, ASCENT I-Loads, FIRSTS, SIGNIFICANT ANOMALIES, ETC.</td>
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<tr>
<td>39B-32</td>
<td>MLP-2</td>
<td>Linda M. Godwin (Flt 3 - STS-37, STS-59) P434R185/V45/F6</td>
<td>ORBITER DOCKING SYSTEM (ODS)</td>
<td>FUEL BIAS: 1136</td>
<td>2276332 LBS</td>
<td>SHUTTLE</td>
<td>PERFORMANCE</td>
<td>SPACE SHUTTLE MISSIONS SUMMARY</td>
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<tr>
<td></td>
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<td>M/S 4</td>
<td>SHUTTLE/MIR MISSION 3 SPACEHAB 4</td>
<td>FINAL TDOP: 3140</td>
<td>2276332 LBS</td>
<td>PAYLOADS</td>
<td>MIDS: KIDSAT SAREX-II</td>
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<td>Shannon W. Lucid (Flt 5 - STS-51G, STS-34, STS-43, STS-56, to return on STS-79) P435R195/V45/F6</td>
<td>MIDDECK</td>
<td>NO RMS</td>
<td>2276332 LBS</td>
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<td>5 CRYO TK SETS</td>
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<td>Tethered with SAFER CTGY</td>
<td>Fly-by-Nav</td>
<td>2, 62 lbm O2, 2, 62 lbm N2, 2, 62 lbm H2</td>
<td>2276332 LBS</td>
<td>PAYLOADS</td>
<td>NO RMS</td>
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<tr>
<td></td>
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<td>EV 1 - Linda Godwin EV 2 - Rich Clifford</td>
<td>To install MEEP on Mir DM</td>
<td>evaluates EVA HW, aids &amp; tools</td>
<td>2276332 LBS</td>
<td>PAYLOADS</td>
<td>NO RMS</td>
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<tr>
<td></td>
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<td>EV 1</td>
<td>327/36 - 0.22.28 Duration</td>
<td>To install MEEP on Mir DM</td>
<td>2276332 LBS</td>
<td>PAYLOADS</td>
<td>NO RMS</td>
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<td>EV 2</td>
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<td>To install MEEP on Mir DM</td>
<td>2276332 LBS</td>
<td>PAYLOADS</td>
<td>NO RMS</td>
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</table>

**NM21-727-030 (23 March 1996) -- Atlantis as seen from Mir during rendezvous.**
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>THROTTLE PROFILE</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-76</td>
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<td>WHITE FCR (6)</td>
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<td>ORBIT OPS &amp; ENTRY</td>
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</tbody>
</table>
|        | FLIGHT DIRECTORS: V: J. W. Bantle
LD/O1: P. L. Engelauf
O2: W. D. Reeves
PUNG: P. F. Dyke
MOD: R. E. Castle | Continued…               |                           |               |                 |       |     |                |                   |
|        | VI: 25576 25571          |                           |               |                 |       |     |                |                   |
|        | CMS-2: 42:18.5 42:21.9   |                           | 77.1 FPPS 76.8 FPPS |                 |       |     |                |                   |
|        | FLT DURATION: 9:05:15:53 |                           | 604:12:03:30 |                 |       |     |                |                   |
|        | DENS ALT: 1536 FT        |                           | 3,800,000 sm |                 |       |     |                |                   |

**Significant Anomalies:**

Above: STS076-724-016 -- Clifford works at restraining bar on Mir Docking Module. Clifford and Godwin mark first EVA while MIR & Shuttle are docked.

Below: NM21-399-001 --- Aboard Mir Base Block Module Lucid works out on treadmill.

STS076-371-002 (25 March 1996) --- Inflight crew portrait on mid deck. From left on front row: Godwin/MS, CDR Chilton, and PLT Searfoss. Left to right on back row: Clifford/MS, Lucid/MS and payload commander Sega/PLC. Lucid later joined Mir-21 crew for first leg of her five-month stay.
## SPACE SHUTTLE MISSIONS SUMMARY

### ORBITER, CREW, LAUNCH SITE, LANDING SITE/ランディングサイト, LAND/LAND, PAYLOADS/EXPÉRIMENTS, MISSION HIGHLIGHTS/（ラウンドスクリューディレイズ, タルウィザーパーソヒドラーレックス、ETC.）

<table>
<thead>
<tr>
<th>NO.</th>
<th>ORBITER, CREW, ET</th>
<th>CREW &amp; EVAS</th>
<th>Launch Site, LIFTOFF TIME</th>
<th>Landing Site/ラウンディングサイト, AMBRT TIMES</th>
<th>LAND/LAND, ORBIT/オルビット, PAYLOADS/EXPÉRIMENTS</th>
<th>MISSION HIGHLIGHTS/（ラウンドスクリューディレイズ, タルウィザーパーソヒドラーレックス、ETC.）</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-77</td>
<td>OV-105 (Flight 11) Endeavour</td>
<td>ODM: John H. Casper (Flt 4 - STS-36, STS-54, STS-62)</td>
<td>KSC Pad 39B 140.10:32.99:57:32 6:30:00 AM EDT (P) Sunday 9 5/19/96</td>
<td>104/104/104/109 67/104</td>
<td>1014/104/100% 104/100/100%</td>
<td>32505 LBS 32505 LBS</td>
</tr>
</tbody>
</table>

STS077-314-011 Inflight crew portrait. Left to right, front: Thomas/MS, CDR Casper and Runco/MS. Back row: PLT Brown, Garneau /MS/CSA & Bursc/MS.
### STS-78

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE &amp; TIME</th>
<th>LANDING SITE &amp; TIME</th>
<th>PAYLOADS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PLT: Kevin Kregel (STS-70)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EDO: Susan J. Helms (STS-61D)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EDD: Robert B. Thirsk (Canada)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M/S 1: Richard M. Linnehan (STS-51D)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M/S 2: Jean-Jacques Favier (France)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M/S 3: Charles E. Brady, Jr. (STS-41B)</td>
<td>15:47:44.99Z, 8/27/96</td>
<td>104/104/104</td>
<td>104/104/104</td>
<td>104/104/104</td>
</tr>
</tbody>
</table>

**Columbia**
- **CROSSRANGE:** 39.03°
- **Landing Site:** Pad 19 = 89 days total.
- **Flt Duration:** 153.6 X 146.7 NM
- **Trim 1 Burn:** 146.6 X 146.4 NM
- **Trim 2 Burn:** 142.3 X 129.6 NM
- **Landing Site:** Pad 19 = 89 days total.
- **Flt Duration:** 153.6 X 146.7 NM
- **Trim 1 Burn:** 146.6 X 146.4 NM
- **Trim 2 Burn:** 142.3 X 129.6 NM
- **Landing Site:** Pad 19 = 89 days total.
- **Flt Duration:** 153.6 X 146.7 NM

**Payloads**
- **CARGO:** 43:60:00 MT
- **DEPLOYED:** 1113422 LBS
- **NON-DEPLOYED:** 2066 LBS
- **Depoyed:** 23666 LBS
- **Non-Deployed:** 2066 LBS
- **Depoyed:** 23666 LBS
- **Non-Deployed:** 2066 LBS
- **Depoyed:** 23666 LBS
- **Non-Deployed:** 2066 LBS

**Significant Anomalies**
- **Cryogenic N2 tank leak detected after MECO during deorbit process: 2.3 seconds after MECO during shutdown transient flow (changed mixture ratio for STS-79 to 6.02%).
- **High-cold shock and heat effect (discoloration and charring) observed on insulation interfaces within STS-78 flight deck joints. No heat effects to metal interface or capture feature ring, no gas past OF Orings.**
- **Post flight cooldown and high-load core freeze-up during deorbit prep. High-load core was flushed.**
- **FES topping core freezeup at 2 days 1 hour MET and during deorbit prep. Core flush procedure performed.**

**Mission Highlights**
- **Baseline launch date of 6/27/96 on 3/30/96.
- Advanced launch date to 6/20/96 on 3/21/96.
- LAUNCH DELAYS: None
- LAUNCH SCRUB: None
- LAUNCH POSTMORTEMS/ADVANCESMENTS: None
- Events: Extended flight 1 day to 17 days for additional science (planned 16 + 1).

**Launch Date:** 6/27/96

**Launch Site:** Pad 19

**Launch Complex:** KSC 33

**Launch Time:** 10:49:00 AM EDT (A)

**Mission Highlights:**
- **POST OMS-2:**
  - 153.6 X 146.7 NM
- **Flt Duration:**
  - 153.6 X 146.7 NM
- **Trim 1 Burn:**
  - 146.6 X 146.4 NM
- **Trim 2 Burn:**
  - 142.3 X 129.6 NM
- **Landing Site:**
  - Pad 19 = 89 days total.
- **Flt Duration:**
  - 153.6 X 146.7 NM
- **Trim 1 Burn:**
  - 146.6 X 146.4 NM
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- **Trim 1 Burn:**
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- **Trim 2 Burn:**
  - 142.3 X 129.6 NM
- **Landing Site:**
  - Pad 19 = 89 days total.
- **Flt Duration:**
  - 153.6 X 146.7 NM
- **Trim 1 Burn:**
  - 146.6 X 146.4 NM
- **Trim 2 Burn:**
  - 142.3 X 129.6 NM
- **Landing Site:**
  - Pad 19 = 89 days total.

**Payloads Deployed:**
- **CARGO:** 43:60:00 MT
- **DEPLOYED:** 1113422 LBS
- **NON-DEPLOYED:** 2066 LBS

**Flight Director:**
- **A/E - J. W. Bantle**
- **LDI/O 2 - J. P. Shannon**
- **LDI/O 3 - J. P. Shannon**
- **LDI/O 4 - P. L. Engelauf**
- **LDI/O 5 - B. P. Austin**
- **LDI/O 6 - A. L. Briscoe**

**Crew in PLB:**
- **MCC WHITE FCR (8)**
  - **FLIGHT DIRECTORS:**
    - **LDI/O 1:** Terence T. (Tom) Henricks (France)
    - **LDI/O 2:** Kevin Kregel (KSC 31)
    - **LDI/O 3:** Richard M. Linnehan (KSC 31)
    - **LDI/O 4:** Susan J. Helms (KSC 31)
    - **LDI/O 5:** Robert B. Thirsk (Canada)
    - **LDI/O 6:** Charles E. Brady, Jr. (KSC 31)

**Crew in LMS-1:**
- **SUDDEN DEPLOY:**
  - **DEPLOY CHUTE:** 191 KEAS
- **FPR:** 3080 FUEL BIAS: 900 FINAL TDDP: 3683 RECON: 4245
- **PAYLOADS:**
  - **CARGO TOTAL:** 23666 LBS
  - **NON-DEPLOYED:** 2066 LBS
  - **Depoyed:** 23666 LBS
  - **Non-Deployed:** 2066 LBS

**Cryogenic N2 tank leak detected after MECO during deorbit process: 2.3 seconds after MECO during shutdown transient flow (changed mixture ratio for STS-79 to 6.02%).
- **High-cold shock and heat effect (discoloration and charring) observed on insulation interfaces within STS-78 flight deck joints. No heat effects to metal interface or capture feature ring, no gas past OF Orings.**
- **Post flight cooldown and high-load core freeze-up during deorbit prep. High-load core was flushed.**
- **FES topping core freezeup at 2 days 1 hour MET and during deorbit prep. Core flush procedure performed.**
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSWINDS</th>
<th>LANDING SITE TIMES, DURATION, WINDS</th>
<th>LANDING SITE/ Runway, Crosswind</th>
<th>THROTTLE PROFILE, ENG. S.N.</th>
<th>SRM/TL</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS, EXPERIMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAD 39A-45</td>
<td>MLP-1</td>
<td>PLT:</td>
<td></td>
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</tbody>
</table>

**Payload/Experiments**

<table>
<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
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</table>

**Missile Highlights**

<table>
<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
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<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
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</tbody>
</table>

**Rendezvous/Docking**

<table>
<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
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</tbody>
</table>

**Orbit Ranges**

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<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
</tr>
</tbody>
</table>

**Entry/Parachute/Abort**

<table>
<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
</tr>
</tbody>
</table>

**Recovery/Experiments**

<table>
<thead>
<tr>
<th>BRIEF: 00:08</th>
<th>FUEL: 00:08</th>
<th>PERFORMANCE: 00:08</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.6 LBS</td>
<td>75.6 LBS</td>
<td>-25824 FPS</td>
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</table>

**Conclusion**

- STS-79 Atlantis as seen on approach to MIR.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/CROSSRANGE</th>
<th>SSME-TL ENG. S/N</th>
<th>SRB ENG. S/N</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STS-79</strong></td>
<td><strong>Continued</strong></td>
<td></td>
<td></td>
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<td></td>
<td><strong>SIGNIFICANT ANOMALIES:</strong></td>
</tr>
<tr>
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<td></td>
<td><strong>- RH RSRM nozzle erosion beginning in throat ring and extending aft into forward exit cone (approx 60 longitudinal erosion areas up to 0.4 inch diameter).</strong></td>
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<td></td>
<td></td>
<td><strong>- Supply water tank B quantity transducer dropouts.</strong></td>
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<td></td>
<td><strong>- Fuel cell O(_2) flow transducer degraded.</strong></td>
</tr>
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<td></td>
<td><strong>- Cryo H(_2) tank 3 B heater failure.</strong></td>
</tr>
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<td></td>
<td></td>
<td><strong>- Single string GPS erroneous time reference, loss of lock and runaway. (Firmware problem.)</strong></td>
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<td><strong>- TCS range discrepancy.</strong></td>
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<td></td>
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<td></td>
<td><strong>- APU 2 underspeed shutdown at 13:14 MET. Two-APU entry/landing.</strong></td>
</tr>
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<td></td>
<td></td>
<td><strong>- APU 2 fuel pump seal cavity drain line pressure decay to vacuum.</strong></td>
</tr>
</tbody>
</table>

**STS079-S-097-- Left to right, PLT Wilcutt, Lucid/MS, & CDR Readdy on aft flight deck for undocking. Lucid looking to come home.**


**STS079-810-028 --- Russia's Mir Space Station as seen after undocking.**

**S79e5131 --- Mir Changeout: Lucid (left) comes down after 6 mos visit, Blaha stays up.**

**STS079-S-097**

**STS079-810-028**

**S79e5131**
## SPACE SHUTTLE MISSIONS SUMMARY

**STS-80**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, DEOLTURM, CROSSWINDS</th>
<th>SSME-TL, NON-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-80</td>
<td>OV-102</td>
<td>CoP</td>
<td>KSC-PAD 346 342:15:46:04Z</td>
<td>DIRECT INSERTION  POST OMS-2 100 X 188 NM</td>
<td>BI-084 28.45 (42) DIRECT INSERTION</td>
<td>RSRM 49</td>
<td>ET-80</td>
<td>KSC-25 (2)</td>
<td>CARGO 31111 LBS</td>
<td>LANDING POSTPONEMENTS: - Baseline launch date of 11/7/96 on 7/14/95. - Advanced launch date to 10/31/96 on 4/23/96. - Postponed launch date to 11/8/96 on 9/20/96 to analyze implications of STS-79 RH SRM nozzle erosion. - Postponed launch date to 11/15/96 to allow Thiokol time to complete SRM analysis.</td>
</tr>
<tr>
<td>SEQ</td>
<td>FLT #80</td>
<td></td>
<td>KSC-3000 342:10:48:02Z</td>
<td>DEO 9 190 X 188 NM</td>
<td>DEO 9 190 X 188 NM</td>
<td>ET-80</td>
<td>LWT 73</td>
<td></td>
<td>LANDING CHARGEABLE 21006 LBS</td>
<td>DEEP RETRIEVE 12524 / 12427 LBS</td>
</tr>
<tr>
<td>KSC-80</td>
<td></td>
<td></td>
<td>306791 X 188 NM</td>
<td>LAND DEPLOYMENT</td>
<td>LANDING 7575 LBS</td>
<td></td>
<td>ET</td>
<td></td>
<td>NON-DEPLOYED 12575 LBS</td>
<td>PRID 273K</td>
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<tr>
<td>PAD</td>
<td>36B-36</td>
<td></td>
<td>318241 X 188 NM</td>
<td>SHUTTLE ACCUMULATED WEIGHTS: 652065 LBS</td>
<td>NON-DEPLOYED 12575 LBS</td>
<td></td>
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<td></td>
<td>NON-DEPLOYED 12575 LBS</td>
<td>NON-DEPLOYED 12575 LBS</td>
</tr>
<tr>
<td>MLP-3</td>
<td></td>
<td></td>
<td>414213 X 188 NM</td>
<td>PERFORMANCE MARGINS (LBS) FPR: 3100</td>
<td>PERFORMANCE MARGINS (LBS) FPR: 3100</td>
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<td></td>
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<td>PERFORMANCE MARGINS (LBS) FPR: 3100</td>
<td>PERFORMANCE MARGINS (LBS) FPR: 3100</td>
</tr>
</tbody>
</table>

**STSO80-310-028** -- Musgrave photographs Wake Shield Facility during free flight mode with 600mm camera.

**STSO80-701-004** -- Middeck inflight crew portrait. Back row, left to right, CDR Cockrell, Jernigan/MS, & PLT Rominger. Front row, Jones/MS (left) & Musgrave/MS.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLIGHT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE</th>
<th>LANDING SITE</th>
<th>TIME/WEIGHT</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-81</td>
<td>OV-104</td>
<td>CDG</td>
<td>KSC</td>
<td>KSC</td>
<td>12/09/27:23Z</td>
<td>209.7 X 181.9 NM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spacehab</td>
<td></td>
<td></td>
<td>Pad 6</td>
<td>22:14:22:44Z</td>
<td>159.9 X 84.9 NM</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MLP-2</td>
<td></td>
<td>TC-1; 809 LBS</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>TC-1; 40 LBS</td>
<td></td>
</tr>
</tbody>
</table>

**CREW**

- Michael A. Baker (CDR)
- Cheryl L. Steuart (P1)
- Paul D. melted, 1997)
- John M. Grunsfeld (P4)
- Marsha S. Ivins (P5)

**LAUNCH SITE**

- KSC
- Pad 6
- MLP-2

**LANDING SITE**

- KSC
- Pad 6
- MLP-2

**TIME/WEIGHT**

- 12/09/27:23Z
- 159.9 X 84.9 NM
- 209.7 X 181.9 NM
- 809 LBS
- 40 LBS

**PAYLOADS/EXPERIMENTS**

- TC-1
- 809 LBS
- TC-1
- 40 LBS

**MISSION HIGHLIGHTS**

- STS-81 was the 26th Shuttle mission and the 10th mission to be flown in support of the Space Station Freedom program.
- The crew conducted two spacewalks, one to install a new solar array and the other to replace a damaged solar array.
- The mission also featured the first deployment of a Spacehab module, which was used to carry experiments and equipment.
- The mission was successful, and the crew returned to Earth safely.

**SIGNIFICANT ANOMALIES**

- Fuel Cell 1 voltage erratic below MNA voltage.
- Fuel Cell 2 cell performance monitor self test anomaly.
- OCA video camera failure.
- VIU S.N. 1025 failure.
- IMU3 exhibited large X and Y gyro drift rates.

**EVENTS**

- Mir capture at 15:03:54:49Z, 2:18:27:26 MET.
- Docking at 15:04:02:28Z, 2:18:35:05 MET.
- Blaha transferred to STS-81/Atlantis and Linenger transferred to Mir 22 at 3:00:17:00 MET.
- Hatch closure at 07:03:19 MET and undocking at 20:02:15:23Z, 07:16:48:00 MET.

**FLIGHT DURATION CHANGES**

- Waved off landing at KSC on orbit 161 due to forecast of broken 4000 foot ceiling.
- Flight duration extended one orbit.

**EVENTS**

- Mir capture at 15:03:54:49Z, 2:18:27:26 MET.
- Docking at 15:04:02:28Z, 2:18:35:05 MET.
- Blaha transferred to STS-81/Atlantis and Linenger transferred to Mir 22 at 3:00:17:00 MET.
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**FLIGHT DURATION CHANGES**

- Waved off landing at KSC on orbit 161 due to forecast of broken 4000 foot ceiling.
- Flight duration extended one orbit.

### STS-81 MISSION HIGHLIGHTS


**LANDING SITE**

- KSC
- Pad 6
- MLP-2

**TIME/WEIGHT**

- 12/09/27:23Z
- 159.9 X 84.9 NM
- 209.7 X 181.9 NM
- 809 LBS
- 40 LBS

**PAYLOADS/EXPERIMENTS**

- TC-1
- 809 LBS
- TC-1
- 40 LBS

**MISSION HIGHLIGHTS**

- STS-81 was the 26th Shuttle mission and the 10th mission to be flown in support of the Space Station Freedom program.
- The crew conducted two spacewalks, one to install a new solar array and the other to replace a damaged solar array.
- The mission also featured the first deployment of a Spacehab module, which was used to carry experiments and equipment.
- The mission was successful, and the crew returned to Earth safely.

**SIGNIFICANT ANOMALIES**

- Fuel Cell 1 voltage erratic below MNA voltage.
- Fuel Cell 2 cell performance monitor self test anomaly.
- OCA video camera failure.
- VIU S.N. 1025 failure.
- IMU3 exhibited large X and Y gyro drift rates.

**EVENTS**

- Mir capture at 15:03:54:49Z, 2:18:27:26 MET.
- Docking at 15:04:02:28Z, 2:18:35:05 MET.
- Blaha transferred to STS-81/Atlantis and Linenger transferred to Mir 22 at 3:00:17:00 MET.
- Hatch closure at 07:03:19 MET and undocking at 20:02:15:23Z, 07:16:48:00 MET.
STS-82 Sequence FLT #82

**Title: Space Shuttle Mission Summary**

<table>
<thead>
<tr>
<th>FLT No.</th>
<th>Crew</th>
<th>Orbiter</th>
<th>Launch Site, Lift Off Time</th>
<th>Landing Site, Abort Times</th>
<th>Landing Times, FLT Duration, Winds</th>
<th>Throttle Profile Eng. S.N.</th>
<th>SRB RSRM</th>
<th>Orbit</th>
<th>Payloads/ Experiments</th>
<th>Mission Highlights (Launch scrub/delay, first, significant anomalies, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>LAUNCH ADVANCEMENTS - Baseline 12/22/96 launch date on 10/22/96.</td>
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<td>- Advanced launch date to 2/1/1997 on 1/19/97.</td>
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<td>LAUNCH SCRUBS: None</td>
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<td>LAUNCH DELAYS: None</td>
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<td>TAIL Wx: - Only Ben Guerir was manned; however, Ben Guerir was NO-GO for ceiling and visibility (overcast 500 feet and ground fog). There was no requirement for a TAL site due to a planned 9-second overlap between RTLS and PTA (actual overlap 14 seconds).</td>
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<td>DOUILLI HLDOS: DOUILLI upload #13, HI upload #32</td>
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<td>SHUTTLE NIGHT LAUNCH #16</td>
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<td>FLIGHT DURATION CHANGES: - Waved off landing at KSC on orbit 149 due to clouds forming over runway with chance of 3000 feet broken. Landed on orbit 150. - Extended flight duration 1 rev.</td>
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<td>SHUTTLE NIGHT LANDING #8</td>
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<td>FIRSTLASTS: - First night landing at KSC with centerline lights.</td>
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<td>EVENTS: - HST grapple at 1:23:38 MET. - Space Shuttle attitude record 335.1 NM X 321.0 NM after Reboost 3 maneuver.</td>
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<td></td>
<td>Rendezvous: - Rendezvous, grapple, service, reboost, and release of HST.</td>
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<td>HST REBOOST MANEUVERS: - Reboost 1 was 2041/3 at 04:01:39:28 MET. - Reboost 1A was 10:13/35 at 04:06:07:02 MET with delta V 33 FSP. Maneuver was to avoid a conjunction with Pegasus debris. - Reboost 2 was 193/1375 at 05:01:15:00 MET. - Reboost 3 was 313/1543 at 07:31:52:36 MET.</td>
</tr>
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<td>SIGNIFICANT ANOMALIES: - HST + V2 solar array rapidly deploy during airflow depres. For subsequent airflow depresses, one equalization valve on each hatch was duct-taped to limit airflow. - EMU gloves had yellow smudges from HST handrails. - RES feedline A accumulator heater failure. - Erotic supply water tank D transducer.</td>
</tr>
</tbody>
</table>

**STS-82 Mission Highlights**: - First night landing at NSC with centerline lights. - Events: HST grapple at 1:23:38 MET. - Space Shuttle attitude record 335.1 NM X 321.0 NM after Reboost 3 maneuver. - Rendezvous: Rendezvous, grapple, service, reboost, and release of HST. - HST Reboost Maneuvers: - Reboost 1 was 2041/3 at 04:01:39:28 MET. - Reboost 1A was 10:13/35 at 04:06:07:02 MET with delta V 33 FSP. Maneuver was to avoid a conjunction with Pegasus debris. - Reboost 2 was 193/1375 at 05:01:15:00 MET. - Reboost 3 was 313/1543 at 07:31:52:36 MET. - Significant Anomalies: - HST + V2 solar array rapidly deploy during airflow depres. For subsequent airflow depresses, one equalization valve on each hatch was duct-taped to limit airflow. - EMU gloves had yellow smudges from HST handrails. - RES feedline A accumulator heater failure. - Erotic supply water tank D transducer.
### STS-82

<table>
<thead>
<tr>
<th>FLT NO</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, ORBITER CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDNG TIMES, FLIGHT DURATION, WINDS</th>
<th>SSME-TL, NORMAL-ABORT EMERGENCY</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-82</td>
<td>Continued</td>
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<td>Continued . . .</td>
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<td></td>
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<td></td>
<td>SS EVA #34</td>
<td>EMU/EMU EVA 1</td>
<td>by EV1 and EV2</td>
<td>on 2/13/97</td>
<td>Scheduled EVA #30</td>
<td>6H12M02S duration</td>
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<td>SS EVA #35</td>
<td>EMU/EMU EVA 2</td>
<td>by EV3 and EV4</td>
<td>on 2/14/97</td>
<td>Scheduled EVA #31</td>
<td>7H07M31S duration</td>
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<td>SS EVA #36</td>
<td>EMU/EMU EVA 3</td>
<td>by EV1 and EV2</td>
<td>on 2/15/97</td>
<td>Scheduled EVA #32</td>
<td>7H11M30S duration</td>
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<td>SS EVA #37</td>
<td>EMU/EMU EVA 4</td>
<td>by EV3 and EV4</td>
<td>on 2/16/97</td>
<td>Scheduled EVA #33</td>
<td>6H14M03S duration</td>
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<td>SS EVA #38</td>
<td>EMU/EMU EVA 5</td>
<td>by EV1 and EV2</td>
<td>on 2/17/97</td>
<td>Unscheduled EVA #8</td>
<td>5H17M21S duration</td>
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<td>MCC WHITE FCR (12)</td>
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<td>FLIGHT DIRECTORS:</td>
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<td>AVE - N. W. Hale</td>
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<td>LD/1 - J. W. Bantle</td>
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<td>PLNG - C. W. Shaw</td>
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<td>MOD - A. L. Briscoe</td>
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<tr>
<td>SS82E5307</td>
<td>- Lee/PLC inside HST &amp; Smith/MS on RMS during removal of Goddard High Resolution Spectrometer.</td>
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<tr>
<td>SS82E5407</td>
<td>- Harbaugh/MS (left) &amp; Tanner/MS on RMS accessing Fine Guidance Sensor (FGS) in the F site.</td>
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<tr>
<td>STS081-E-5937</td>
<td>- HST begins its separation from Discovery following release.</td>
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</tbody>
</table>

**SIGNIFICANT ANOMALIES (CONTINUED):**
- Fuel cell 3 water flow through alternate path causing concern that H2 gas would get into EMUs during recharge from tank C.
- Bent pins on SADE-2R P2 harness.
- Three PGSC problems.
- No RSRM erosion found.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>CREW PERIOD</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, FLIGHT TIMES</th>
<th>SUPPLEMENTAL S/S M/T/L</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGTHS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-83</td>
<td>OV-102</td>
<td>CDR</td>
<td>James D. Halsell, Jr. (FLt 3 - STS-65, STS-74)</td>
<td>20th June 1994</td>
<td>KSC, Pad 39A 14:19:20:31.96Z</td>
<td>Pad 39A 14:19:20:31.96Z</td>
<td>200:00:00 PM EST (P)</td>
<td>104/104</td>
<td>109%</td>
<td>34373 LBS</td>
</tr>
<tr>
<td>SEQ</td>
<td>PLT #63</td>
<td>PLT</td>
<td>Susan L. Still (FLt 4 - STS-57, STS-63)</td>
<td>15th June 1994</td>
<td>KSC, Pad 39A 14:19:20:31.96Z</td>
<td>Pad 39A 14:19:20:31.96Z</td>
<td>200:00:00 PM EST (A)</td>
<td>104/104</td>
<td>109%</td>
<td>34373 LBS</td>
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<tr>
<td>KSC - 83</td>
<td>PAD 39A</td>
<td>FLG</td>
<td>Michael L. Gernhardt (FLt 2 - STS-69)</td>
<td>20th June 1994</td>
<td>MLP - 3 14:19:20:31.96Z</td>
<td>MLP - 3 14:19:20:31.96Z</td>
<td>200:00:00 PM EST (P)</td>
<td>104/104</td>
<td>109%</td>
<td>34373 LBS</td>
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<tr>
<td>MLP - 3</td>
<td>EDO 10</td>
<td>EDO</td>
<td>Roger Crouch</td>
<td>20th June 1994</td>
<td>KSC, Pad 39A 14:19:20:31.96Z</td>
<td>Pad 39A 14:19:20:31.96Z</td>
<td>200:00:00 PM EST (A)</td>
<td>104/104</td>
<td>109%</td>
<td>34373 LBS</td>
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<tr>
<td>CDR</td>
<td>JFCC</td>
<td>JFCC</td>
<td>Gregory T. Linteris</td>
<td>20th June 1994</td>
<td>MLP - 3 14:19:20:31.96Z</td>
<td>MLP - 3 14:19:20:31.96Z</td>
<td>200:00:00 PM EST (P)</td>
<td>104/104</td>
<td>109%</td>
<td>34373 LBS</td>
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</tbody>
</table>

**STS083-303-002 --- PLT Still floats into the Spacelab Module during activation.**


**S98-16095--- In JSC MCC: Linda Ham, first female Ascent Flight Director. (Photo is from STS-095)**
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CRW</th>
<th>CREW (8) 7 UP &amp; 7 DOWN</th>
<th>LANDING SITE T/L OFF TIME</th>
<th>LANDING SITE T/L RUNWAY/CROSS RANGE</th>
<th>LANDING TIMES</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-84</td>
<td>OV-104</td>
<td>CDR</td>
<td>Charles J. Precourt (Flt 3 - STS-55, STS-71)</td>
<td>KSC, Pad A 135:08:07:47</td>
<td>144:13:27:42</td>
<td>104/104</td>
<td>60</td>
<td>BI-06/7</td>
<td>C-25</td>
<td>26497 LBS</td>
<td>DIRECT INSERTION</td>
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<tr>
<td>SEQ</td>
<td>FLT #84</td>
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<td>POST OMS-2</td>
<td>160.6 x 85.5 NM</td>
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<tr>
<td>PAD</td>
<td>P485/R189/V140</td>
<td>4 ENG</td>
<td>Elena V. Kondakova (Russia)</td>
<td>MLP-2 144:13:27:47</td>
<td>M3 EOM WEIGHT: 216168 LBS X CG: 1080.95</td>
<td>1080.95</td>
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<td>DEPLOYED</td>
<td>3902 LBS</td>
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<tr>
<td>MCD WHITE FOR (14)</td>
<td>P487/R222/M193</td>
<td>4 ENG</td>
<td>Jerry M. Linenger (Flt 2 - STS-64, ascent on STS-81, and stay on Mir 22 and 23)</td>
<td>KSC 33/N/N 144:13:27:52</td>
<td>M3 EOM WEIGHT: 216168 LBS X CG: 1080.95</td>
<td>1080.95</td>
<td>143</td>
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<td>DEPLOYED</td>
<td>130075 LBS</td>
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</table>

**Russia’s Mir-post Atlantis sep.**

### Space Shuttle Missions Summary

<table>
<thead>
<tr>
<th>FLT No.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/PURPOSE, CROSS RANGE</th>
<th>NOTES</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-94</td>
<td>Columbia</td>
<td>Crouch (front) &amp; Gemhardt at the NASA Large Isothermal Furnace (LIF) facility.</td>
<td>KSC-Pad 39A 198:10:46:33Z</td>
<td>KSC-Crawford Landing Site</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td>STS-94</td>
<td>Columbia</td>
<td>Crouch (front) &amp; Gemhardt at the NASA Large Isothermal Furnace (LIF) facility.</td>
<td>KSC-Pad 39A 198:10:48:05Z</td>
<td>KSC-Crawford Landing Site</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td>STS-94</td>
<td>Columbia</td>
<td>Crouch (front) &amp; Gemhardt at the NASA Large Isothermal Furnace (LIF) facility.</td>
<td>KSC-Pad 39A 198:10:48:05Z</td>
<td>KSC-Crawford Landing Site</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
</tbody>
</table>

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**STS094-344-001** Crouch (front) & Gemhardt at the NASA Large Isothermal Furnace (LIF) facility.
### STS-85

**Title:** Space Shuttle Mission Summary  
**Page:** 2-104 - STS-85

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/TIMELAPSE</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHS, EXPERIMENTS</th>
</tr>
</thead>
</table>
| STS-85  | OV-103  | CDR: Curtis L. Brown, Jr. (Fli-4 - STS-47, STS-66 & STS-77)  
          |                           | KSC - 86  
          | PAD 39A/B  
          | MLP-3  
          |                      |                    |                    |                    |                    |                    |                    |                    |
|         | SEQ FLT #86  
          |                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         | STS-85  | RSRM  
          |                  |                    |                    |                    |                    |                    |                    |                    |                    |
|         | LIFTOFF TIME, EMERG FSW NO. | LANDING SITES, FLT DURATION, WINDS | SRB RSRM & ET | INC | HWHP |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| STS-85  | OV-103  | CDR: Curtis L. Brown, Jr. (Fli-4 - STS-47, STS-66 & STS-77)  
          |                           | KSC - 86  
          | PAD 39A/B  
          | MLP-3  
          |                      |                    |                    |                    |                    |                    |                    |                    |
|         | SEQ FLT #86  
          |                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         | STS-85  | RSRM  
          |                  |                    |                    |                    |                    |                    |                    |                    |                    |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|         |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |

**Additional Information:**  
- Baseline launch date of 7/17/97 revised to 3/28/96.  
- Postponed landing date of 8/17/97 caused by renomination of FMS-1 due to STS-63 early termination.  
- APU 1 fuel pump coolant line pressure decay.  
- Flight control filter updates.  
- Yaw gain enhancement.  
- Payload commanding problems with MCC input set to 3/sec.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-86

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME, LANDINGS, SITES, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>OV-104</td>
<td>Spacehab 8</td>
<td>CDR: James D. Wetherbee</td>
<td>KSC Pad 39A, 269:02:34:19 Z</td>
<td>104/104/104</td>
<td>View of damaged solar panel &amp; radiator on Mir Spekt caused by Progress re-supply ship that collided with Mir June 25, 1997, causing Spekt to repressurize. (Atlantis photo during docking.)</td>
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<tr>
<td>KSC - 87</td>
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<td>PLT: Michael J. Bloomfield</td>
<td>279:21:55:10 Z</td>
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<td>PAD 3A-51</td>
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**CARGO:**
- STS086-720-091 -- View of damaged solar panel & radiator on Mir Spekt caused by Progress re-supply ship that collided with Mir June 25, 1997, causing Spekt to repressurize. (Atlantis photo during docking.)
EVENTS:
- Mir capture at 270:19:57:46Z, 01:17:23:27 MET
- Docking complete at 270:20:06:15Z, 01:17:31:56 MET
- Foale completed a Mir EVA with Anatoly Solovyev with exit from Kvant-2 airlock in Orlan M suits (5.7 psia). Both were double tethered using U.S. tether reel and waist tethers. EVA duration was 5H59M to inspect Specktr module leak, slew solar arrays, and put out dosimeter.
- Scott Parazynski and Vladimir Titov made a Shuttle EVA to retrieve MEEP experiments left on Mir DM on STS-76.
- Jean-Loup Chretien flew on Soyuz T-8/Salyut 7 and Soyuz TM-7/Mir 11.
- Total consumables transferred to Mir: 1717.2 lbm H2O (17 CWC’s), 75.7 lbm O2, 130.7 lbm N2.
- Wendy was to replace Foale; however, concerns of inadequate reach in Orlan EVA spacesuit, Wolf moved to STS-86 from STS-85.

SIGNIFICANT ANOMALIES:
- Fuel Cell 1 substack 1 differential volts transient.
- Primary RCS thruster L3D failed off.
- EVA Safety Tether Reel Failure.
- WBB 3 vent heater failure on B controller.

RENDZVOUS #39:
Rendezvous and dock with Mir Space Station.

SIGNIFICANT ANOMALIES:
- Fuel Cell 2 substack 1 differential volts transient.
- Primary RCS thruster L3D failed off.
- EVA Safety Tether Reel Failure.
- WBB 3 vent heater failure on B controller.
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY/CROSSR.</th>
<th>SRB/LSMM-TEL</th>
<th>SSME-TL</th>
<th>ORBIT</th>
<th>PAYLOADS &amp; EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAIL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tbody>
<tr>
<td>STS-87</td>
<td>Columbia</td>
<td>Kevin R. Kregel (Flt 3 - STS-70, STS-78) P511/R197/V123/M172 PLS Steven W. Lindsey P512/R232/M200 MRS 1 Kajipana Chevala P513/R230/F30 MRS 2</td>
<td>EDO 12</td>
<td>KO5-PAD 386 323-19-45:05:6Z 2:46:00 PM EST (P)</td>
<td>KSC PAD 386 339-12-20:04:02 7:20:04 AM EST</td>
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<td>TAL WEATHER</td>
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<td>ET-89</td>
<td>POST OMS-2 159 X 150 NM</td>
<td>LAUNCH POSTPOSTMENTS: - Baseline 10/97 launch date on 11/19/97. - Postponed launch date to 11/13/97 on 4/17/97. - Postponed launch date to 11/19/97 on 5/22/97.</td>
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<td>STS-87-706-002 On middeck: In front (lt to rt), PLT Lindsey, Doi/MS (NASA) &amp; Scott/MS, In back (lt to rt), CDR Kregel, Chawla/MS, Kadenyuk/PS.</td>
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<td>MARGINS (LBS)</td>
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</table>
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-89

**ORBITER:** Endeavour

**CREW:** Terrence W. Wilcutt (Flt 3 - STS-68, STS-79), Joseph F. Edwards Jr. (Flt 2 - STS-58), Michael Anderson (Flt 4 - STS-61-A, STS-32, STS-50, STS-71), Ascent - Andrew S. Thomas, Descent - David A. Wolf

**LANDING SITE:** KSC 15 (KSC 42)

**LANDING TIMES:**
- LANDING TIMES FLIGHT DURATION: 31:22:35:09Z
- LANDING TIMES FLIGHT DURATION: 31:22:35:20Z

**SRB RSSM AND ET:** Bi-003, 51.65 (9)

**ORBIT:** CN-26 (4)

**PAYLOAD WEIGHTS:** 200K6 LBS

**PAYLOAD/EXPERIMENTS:**
- CARGO: 200K6 LBS
- PERFORMANCE ENHANCEMENTS: - First flight using Block IIA SSME's. (Rocketdyne HPFTP) - First flight with external airlock. - Record number of people in orbit: Mir 3 - 2 Russians, 1 American; Soyuz 3 - 2 Russians, 1 French; Endeavour 7 -  6 Americans, 1 Russian.


**NOTES:**

**RENDZEVOUZ DEPLOY #1:**

**SHIP:** STS089-391-004 Onboard Mir Base Block: In conventional position (from left) are Wolf/MS(former Mir guest), Pavel V. Vinogradov/ Mir-24/FE, CDR Wilcutt, Mir-24 CDR Anatoly Y. Solovyev, & Dunbar/MS/PLC. Above, head-to-head with bottom row (from left) Sharipov/MS (RSA) & Anderson/MS. At 90 deg angle are: Thomas/MS/MirGuest (top) & Anderson/MS.
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; ROLLS</th>
<th>CREW</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING SITE, ORBIT CROSSOVER</th>
<th>LANDING TIMES FLIGHT DURATION, WINDS</th>
<th>SSME/LT, EMERG.</th>
<th>CBP/RSM, LANDING PROFILE ENGL.</th>
<th>INC/ET</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCOUR, DELAYS, TAIL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<td>P529/R239/M208</td>
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<td>10144/104/104</td>
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<td>(7)</td>
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<td>MLP-2</td>
<td>MSC 3</td>
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<td>T123</td>
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<td>100%</td>
<td>100/104/104</td>
<td>10144/104/104</td>
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<td>39</td>
<td>(7)</td>
<td>CARGO</td>
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</table>

STS090-378-022 (17 April - 3 May 1998) – Crew floats as a unit in Spacelab. From left are: Hire/MsU, Buckey/PS (top), CDR Searfoss, Pawelczyk/PS, PLT Altman, Williams/CSA/MS (top); and Linnehan/PL CDR.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
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<th>LANDING SITE</th>
<th>LANDING TIMES</th>
<th>SSME/ET</th>
<th>SRB</th>
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<td>OV-103</td>
<td>OV-103</td>
<td>KSC PA39A</td>
<td>KSC PA39A</td>
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**STS091-707-060 (2-12 June 1998):** MIIR as seen during final flyaround by NASA Shuttles.

**STS091-718-010 98 --- Crew portrait:** Bottom, from left, CDR Precourt, Kavandi/MS, & Chang-Diaz/PLC. At top, from left, PLT Gorie, Lawrence/MS, Thomas/MS & Ryumin/MS(RSA). After 4 months stay Thomas was last American to visit Mir.
<table>
<thead>
<tr>
<th>FLT</th>
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<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABDORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, etc.)</th>
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<tbody>
<tr>
<td>STS-95</td>
<td>OV-103</td>
<td>CDR: Curtis L. Brown (rt d), then clockwise, PLT Lindsey, Robinson/MS, Duque/MS/ESA, Naito-Mukai/PS/NASDA, Parazynski/MS, &amp; Sen. Glenn/PS.</td>
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**KSC-95**

**PFD**

**368-39**

**MLP-2**

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<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
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**STSO95-328-031** (29 Oct.-7 Nov. 1998): CDR Brown (rt d), then clockwise, PLT Lindsey, Robinson/MS, Duque/MS/ESA, Naito-Mukai/PS/NASDA, Parazynski/MS, & Sen. Glenn/PS. Continued...
## STS-95 Continued…

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<th>SRB RSRM</th>
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</table>

**Event:**

- SPARTAN-201 release 305:19:00:12Z, 2:23:40:36 MET.
- Due to drag chute anomaly, drag chute was not armed and deployed.
- Inert weight adjustment -200 lbs included in STS OPR chargeable.
  - Berth 5:01:46 MET.
  - Rendezvous # 43
  - Deployed, separated, rendezvoused with SPARTAN-201.

**Radiators Deploy # 23**
- Both port and starboard panels deployed.

**Significant Anomalies:**
- Low Iodine Residual System (LIRS) large spraying leak. Used backup galley iodine removal system.
- Unpleasant taste (rubber hose) from LIRS.
- During space-to-space comm tests, no data from EMU 1 in primary.
- Drag chute door fell off during ME throttle up at T-5 seconds; hence, not deployed during landing.
- Decision made to disable chute for STS-95.
- WSB 2 overcooled six times during entry.
- SPARTAN ground command problem.
- RCS jet L3L failed off, then failed leak.

---

STS095-E-5077 (11-01-98)- Spartan201-05 departs discovery as a free flyer for several days recording solar wind and sun corona data.
**STTS-88/2A**  
**First Shuttle Flight to ISS**

**CREW:**  
- CDR: Robert D. Cabana  
- FLO: Jerry L. Ross  
- M/S 1/EV 1: Sergei Krikalev  
- M/S 2: Nancy J. Currie  
- M/S 3/EV 2: James H. Newman  
- M/S 4: Jerry L. Ross  
- M/S 5/EV 3: Frederick W. Sturckow

**ORBITER:** Endeavour

**LAUNCH SITE:** KSC 39, Pad A

**LIFTOFF TIME:** 338:08:35:34Z

**LANDING SITE:** Zaragoza (prime) forecast and observed NO GO. Ben Guerir forecast NO GO (ceiling & rain) but observed GO.

**LAUNCH WINDOW:** 482S based on T-0 at PLW opening and 3M42S nominal T-0 at PLT). Opted for use of the Preferred Launch Time of 377:08:58:19 which provided a window of 5M00S. An unexpected master alarm (MA), associated with hydraulic system 1 momentary pressure spike, caused an automatic hold at T-4 minutes. After holding at T-4 minutes ... was called while troubleshooting the MA. Resolution of the MA occurred slightly after the expiration of the 3M42S LO drainback hold time (PLT) 5-minute window (LO2 drainback hold time was 5M19S based on T-0 at PLW opening and 3M42S nominal T-0 at PLT). The Planar Launch Window was 7M48S (opened at 337:08:55:31 and closed at 337:09:03:19). Opted for use of the Preferred Launch Time of 377:08:58:19 which provided a window of 5M00S.

**PAYLOAD ACCOMMODATIONS:**  
- 5 CYRO TK SETS 6 GN2 TANKS
- 134 CYRO TK
- 2.6 GN2 TANKS
- 113.4 LBS
- 134 CYRO TK
- 2.6 GN2 TANKS
- 113.4 LBS

**PAYLOAD/EXPERIMENTS:**  
- Uplink #2, LOXO/LH2 Uplink #43.

**MISSION HIGHLIGHTS:**  
- Scrubbed 12/3/98 launch attempt after LO2 drainback hold time of 3M42S expired based on preferred launch time (FLT) 5-minute window (LO). drainback hold time was 5M19S based on T-0 at PLW opening and 3M42S nominal T-0 at PLT). The Planar Launch Window was 7M48S (opened at 337:08:55:31 and closed at 337:09:03:19). Opted for use of the Preferred Launch Time of 377:08:58:19 which provided a window of 5M00S. An unexpected master alarm (MA), associated with hydraulic system 1 momentary pressure spike, caused an automatic hold at T-4 minutes. After holding at T-4 minutes for 3 minutes, the count was resumed. At T-3 seconds, another hold was called while troubleshooting the MA. Resolution of the MA occurred slightly after the expiration of the 3M42S LO. drainback hold time. The count was resumed; however, the launch window had expired. Post-flight, it was concluded that the most probable cause of the pressure spike was a “Switch Teaser” which momentarily reenergized the systems 1 hydraulic pump pressure solenoid valve.

**TAL WEATHER:**  
- Zaragoza (prime) forecast and observed NO GO. Ben Guerir forecast NO GO (ceiling & rain) but observed GO.

**LAUNCH DELAYS:** None. Launched on-time at 338:08:35:34Z, 3:35:34 AM EST, on Friday, December 4, 1998.

**TAL WX:**  
- Uplink #24, LOX/LH2 Uplink #43.
<table>
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<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

**STS088-370-006** ---Crew in U.S.-built Unity Node: Bottom row (left to right) are PLT Sturckow, CDR Cabana, & Currie/MS. Top row, Krikalev/MS (Russia), Newman/MS, & Ross/MS.

**BELOW:** 98e09779 In MCC on console: Scott Altman, Dominic Gorie, & Scott Horowitz.

**STS088-E-5059 (12-08-98)** --- Newman (left) & Ross mated 40 cables & connectors running 76 ft between Zarya & Unity (foreground).

**SIGNIFICANT ANOMALIES:**
- Galley iodine removal assembly hose QD incompatibility.
- Five PLB floodlights failed.
- Anomalous SAFER S/N 1007 GN2 and tank pressure reading.
- GPS anomalies.
- APU 2 fuel pump drain line pressure decay.
- RCS jet R2D fail leak.
- Right Pad A heater circuit failure.
- Right RCS 1/2 tank isolation valves fail open.
- Right inboard tire pressure indication failed low.
- Failed portable foot restraint attachment device hatch pin came out, then broke.

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- Right Pad A heater circuit failure.
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- Right inboard tire pressure indication failed low.
- Failed portable foot restraint attachment device hatch pin came out, then broke.

**STS088-703-032** --- Blanketing clouds form the backdrop for the connected Zarya and Unity modules after release from Endeavour’s cargo bay.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLIGHT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE</th>
<th>LANDING SITE</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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</thead>
<tbody>
<tr>
<td>STS-96</td>
<td>ISS-2A.1</td>
<td>OVC-103</td>
<td>Discovery</td>
<td>KSC-94</td>
<td>monitors aboard for Russian Service Module to assist in the US position</td>
<td>The launch window was in two phases: Phase 1 opened at 147:10:49:42Z and closed at 147:10:54:42Z. There was a 10-second cutout with pane 2 opening at 147:10:54:52Z and closing at 147:10:57:42Z. The total launch window was 8292s with a 10-second cutout between phases based on the ISS Planar/Phase window. The decision was made to use the Preferred Launch Time (PLT) of 147:10:49:42Z for a launch window of 8 minutes 6 seconds, in two phases with a 10-second gap.</td>
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<tr>
<td>ISS-2A.1</td>
<td>KSC-94</td>
<td>P502</td>
<td>MLP-2</td>
<td>KSC 39B</td>
<td>20.3 x 202.4 NM</td>
<td>LAUNCH WINDOW</td>
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<td>PAD</td>
<td>308-40</td>
<td>Kent Rominger, Rick D. Husband, and Ellen Ochoa</td>
<td>KSC</td>
<td>39B</td>
<td>- Close in MLGTD TAL WX</td>
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### MISSION HIGHLIGHTS

- The mission was to transfer nearly 2 tons of logistical supplies to the ISS. These supplies would be used to continue the outfitting of the Unity and Zarya modules and for later use to set up the Russian Service Module for occupancy by a three-man crew. In addition, a small educational satellite called STARSHINE was deployed for observation by international students.

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STS-96B-5037 (29 May 1999) --- Rookie Pilot, Rick Husband, signals thumbs up during rendezvous with ISS.

---

**First Flight With Logistics and Maintenance Spacehab #13**

**Second Shuttle Flight to ISS**

**FLIGHT DIRECTORS**

AIE - L. H. Hammond
LDOI - W. H. Hale
O2-P. F. Dye
PLMW - C. P. Reeves
MOD - J. W. Barrie
ISS LDOI - P. S. Hill
ISS/M2 - J. Kirsich
ISS/PLMW - J. F. Ferrigno

**STANDARD SET-UP**

(1) PE, High G EVA (2) OMS assist is 4000 lbs, (3) 52 nm MECO, and (4) Del Psi.
STSim-96
ISS-2A.1
Continued

SIGNIFICANT ANOMALIES:
- Humidity separator B water carryover.
- Vestibule leakage during airlock depress.
- SSOR anomalies: choppy EVA comm, EVA comm squelch, SSOR noise malfunctions during EVA, EMU TLM from SSOR static.
- Difficulty attaching SCU 1 to DCM.
- Lost LG/SM retractable tether - came off fish stringer.
- Small equipment hook failed open - tether release from D-ring on miniworkstation.
- SAFER Pyro Valve Fired/Manual Isolation Valve open.
- F4R Thruster declared failed leak by RM.

STSim-96-E-5219 --- ISS as seen from Discovery after separation.

STSim-096-(S)-010 --- First flight of Functional Drag Chute with strengthened door pins after STS-95 problem (door fell off at SSME throttle-up). Inconel replaced aluminum pins.

STSim-096-E-5168--inflight crew portrait: At bottom center: CDR Rominger, flanked by Barry/MS & Ochoa/MS. Above Barry (left) Tokaer/MS(RSA), Jernigan/MS & Payette/MS (CSA). PLT Husband is between Payette & Ochoa.

STSim-096-357-003 (30 May 1999) --- MS1 Jernigan totes part of a Russian-built crane, Strela (a Russian word meaning "arrow").
**STARS-93**

**OV-102**

**Columbia**

**STS-93**

**SEQ**

**FLT # 95**

**KSC-95**

**PAD 36B/L**

**MP-1L**

**Crew**

**Eileen M. Collins**

**Jeffrey S. Ashby**

**M/S 1**

**Cady G. Coleman**

**M/S 2**

**Michel Tognini**

**Landing Site**

**LANDING SITES, TIMES**

**CROSSRANGE**

**RSRM**

**FUEL BIAS**

**FINAL TDDP**

**PAYLOADS**

**EXPERIMENTS**

**Payloads**

**AXAF-I/IUS (CHANDRA deployed)**

**MSX, SIMPLEX, SWUIS, GOSMAR, STL-B, LFSAH, CCM, SAREX-II, EARTHKAM, PGIM, CGBA, MEMS, BRIC**

**Performance**

**FUEL BIAS**

**720 LBS**

**AXAF**

**IUS delays.**

**Launch Scrubs**

**- 7/20/99 (12:36 AM EDT.)**

**Launch attempt was halted with a manual GLS cutoff at T-7 seconds (approximately 200 milliseconds prior to Main Engine Start) due to a (false) spike indication of 640 ppm H2 concentration in the aft. Insufficient time to wait for the confirmation sample at T-8 seconds and allow time to issue a manual GLS cutoff before Main Engine Start at T-6.33 seconds. The manual cutoff call was made at T-10 seconds. A 48-hour scrub turnaround was required to replace the Hydrogen Long-Throw Igniters. KSC, BYD, and BEN were forecast and observed GO. Launch reset for 7/22/99.**

**- 7/23/99 (12:28 AM EDT.)**

**Launch attempt was scrubbed at T+47:30 due to Range and RTLS weather. During count, rain and lightning hits within 20 NM, and thunderstorms within 20 NM. Counted down to T-5 minutes and held awaiting improved weather. Mission Director gave ok to extend window 36 minutes by giving up first day deploy. Scrubbed attempt at 203:05:17:35Z (T+47:30) with no signs of improvement in weather (lightning within 8.6 miles of SLF and thundershowers within 20 NM). Banjul was NO GO for ceiling/rain. Ben Guerir was GO. Launch reset for 7/23/99. Weather Scrub.**

**Launch Window**

**46 minutes planned window. During count, the customer relaxed contingency deploy opportunities and IUS battery eclipse constraints to extend window to 116 minutes; however, launch window was limited to Range availability (60 minutes).**

**MSO93-702-048 --- Chandra X-Ray observatory, back-dropped against a desert in Namibia, just before release from Columbia’s payload bay.**
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME/TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>
| STS-93  |         | Collins, first female Shuttle CDR, and crew are shown on-orbit. In front are CDR Collins and Tognini/MS (France). In rear are (from the left) Hawley/MS, Ashby/PLT, and Coleman/MS. | Continued… | Continued… | WINDS: 41T, 6L KTS OFFICIAL: 245° LO 200 FPS 157° LO | OMS-2: 41:04 200 FPS | SRB A: 2:14 | ORBIT | 1551 FT | FLT DURATION: 4:22:49:35 | S/T: 816:16:28:48 | OMS-2: 273:21:09:17 | DISTANCE: 1,796,000 sm | **LAUNCH DELAY:** - Launch was delayed 7M0S during T-20 minute hold for MILA to change out A Frame Sync Box to restore the forward link. - Launched at 204:04:31:00Z, 12:31:00 AM EDT on July 23, 1999.  **TAL WX:** - Banjul (prime) was forecast NO GO (thunderstorms and anvil clouds) and observed NO GO (thunderstorms and ceiling). Ben Guerir (selected) was forecast and observed GO.  **PERFORMANCE ENHANCEMENTS:** - Standard set. - PE LO Q SUM/JUL  **SHUTTLE NIGHT LAUNCH #21**  **FLIGHT DURATION CHANGES:** None  **FIRSTS/LASTS:** - First space flight with female Commander (Eileen Collins). - First U.S. flight for Michel Tognini (CNES-France). - Michel’s first space flight was to Mir on Soyuz TM-15S. - Last flight of phase 2 engines. - Most aft landing Xcg (1099.36)  **SIGNIFICANT ANOMALIES:** - At approximately Liftoff plus 5 seconds, there was a short circuit on AC1 Phase A for approximately 0.5 seconds. The resultant under voltage caused SSME 1 “A” and SSME 3 “B” controllers to be disqualified. Postflight, it was determined the short was on AC1 Phase A to SSME 1 “A” controller. - At liftoff, the right SRB hydraulic pressure sensor 2 was erratic. - Four ET LO 2 sensors indicated dry resulting in low-level cutoff of main engines and slightly early MECO. - Right SSME multiple performance parameters deviations (Post-flight inspection revealed ruptures in three Engine 2019 nozzle tubes caused by an impact of a loose LO2 post deactivation pin. LH2 leak resulted in controller compensating for fuel loss with additional LOX flow, a 16 fps underspeed, and 8 nm lower altitude). - CRT 3 Critical BITE. - High-load FES excessive water carryover. - Camcorder tape jam. - Primary thruster F2D low fuel injector temperature.

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**STS093-322-017 --- Collins, first female Shuttle CDR, and crew are shown on-orbit. In front are CDR Collins and Tognini/MS (France). In rear are (from the left) Hawley/MS, Ashby/PLT, and Coleman/MS.**

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**STS093-706-039 --- Chandra X-Ray Observatory after release from Columbia’s payload bay.**

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**ABOVE: Hawley/MS shown with Micro-Electromechanical Systems (MEMS) experiment. MEMS monitors a suite of sensors under flight conditions. ABOVE RIGHT: Mark Sowa (PAO photographer) recorded the fly-over of Space Shuttle Columbia above the JSC Rocket Park. The Saturn V is below the streak left by the shuttle Columbia re-entering the atmosphere.**
<table>
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<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>CREW (7)</th>
<th>CREW (7)</th>
<th>LANDING SITE/ ORBITER</th>
<th>LANDING TIME</th>
<th>PAYLOAD</th>
<th>PAYLOAD/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<td>STS-103</td>
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<td>Curtis L. Brown</td>
<td>Scott J. Kelly</td>
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<td>Steven L. Smith</td>
<td>Michael Foale</td>
<td>KSC, Pad 39B</td>
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**STS103-713-048 (19-27 December 1999) --**

- Smith and Grunsfeld replacing gyroscopes, contained in rate sensor units (RSU), inside HST.
# SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREST (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, RUNWAY, CROSSRANGE</th>
<th>SSME-TL</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FS</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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**STS-103-397-035** -- Crew portrait. Front: (lt to rt) Nicollier/MS(ESA), PLT Kelly, & Grunsfeld/MS. Back row: (lt to rt) Smith/MS, Foale/MS, CDR Brown, & Clervoy/MS(ESA).

**STS-371-051** (19-21 December 1999) -- Foale (left) and Nicollier/ESA (on end of RMS) replacing one of HST's Fine Guidance Sensors (FGS).

**STS103-726-081** (19-27 December 1999) -- Repaired HST after release from RMS.

**STS103-731-051** (19-21 December 1999) -- Followed HST after release from RMS.

**S99-15923** -- View of JSC MCC during Flight Day 3 activity. Lead Orbit 1 FD Linda Ham is at rear right.

**S99-15923** -- View of JSC MCC during Flight Day 3 activity. Lead Orbit 1 FD Linda Ham is at rear right.

---

**STS-103**

- **Continuous...**
- **SS EVA #48**
- **EMU/STETHERED EVA #41 ON 12/24/99**
- **SCHEDULED EVA #42 DURATION 6:09**
- **TAL WEATHER ASCENT LOADS**
- **PAYLOADS/EXPERIMENTS**
- **SIGNIFICANT ANOMALIES**
- **Performance Enhancements**
- **Shuttle Night Landing #122**
- **Flight Duration Changes**
- **Launch Window**
- **Launch Delays**
- **TAL Weather**
- **Shuttle Night Landing #13**
- **Events**
- **Rendezvous #46**

---

- **Scrubbed 12/18/99 launch attempt at 8:21 AM EST at ET Tanking MMT while holding at T-6 hours due to observed and forecast bad Range and RTLS weather: Rain, low ceiling, and thick clouds triggered lightning conditions. Decision to evaluate 8 + 2, 3 EVA flight, evaluate landing as late as 12/29/99, and vehicle configuration for holiday standdown. At MMT Meeting at 8:30 AM EST on 12/19/99, decision was made to recommend GO for launch on 12/29/99 at 7:50 PM EST. Weather forecast was good and ET MMT gave a GO to tank. Range and RTLS Weather Scrub.**

---

**LAUNCH WINDOW**
- Launch window 42M16S in one pane.

**LAUNCH DELAYS:** None
- Launched at 354:00:50:00Z (GMT date 12/20/99), 7:50:00 PM EST, on Friday, 12/19/99.

**TAL WX:**
- Banjul (prime) was forecast and observed NO GO with visibility 3 miles (smoke/haze). Ben Guerir (selected) was forecast and observed GO.

**PERFORMANCE ENHANCEMENTS:**
- Standard set. PE LOG QWIN/DEC

**SHUTTLE NIGHT LAUNCH #122**

**FLIGHT DURATION CHANGES:**
- Planned landing at KSC on orbit 119. Extended flight one orbit for weather. Waved off landing at KSC on orbit 119 due to crosswinds of 18 knots, peak 19 knots and STA reported turbulence at 500 feet. Landed on KSC 33 on orbit 120.

---

**SHUTTLE NIGHT LANDING #13**
- Landed on KSC 33 on orbit 120 at 362:00:00:47Z, 7:00:47 PM EST on Monday, December 27, 1999.

**EVENTS:**
- HST grapple at 356:00:34:01Z; HST berth 356:01:42:00Z.
- EVA-1 -- Start at 356:18:41:01Z; MET 02:18:04:40 to 03:02:19 MET; duration 8:15:30.
- EVA-2 -- Start MET 03:18:16 to 04:02:26; duration 8:10.
- EVA-3 -- MET 04:13:27 to 05:02:36; duration 8:09.

**RENDEZVOUS ID 46**
- rendezvous, capture, service, and release HST.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW &amp; EVAS</th>
<th>Launch Site/Liftoff Time</th>
<th>LANDING Site/Runway</th>
<th>SSME-TL Nom-Abort Emerg.</th>
<th>Throttle Profile Eng s/n</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>PAYLOAD Weights</th>
<th>Payloads/Experiments</th>
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<td>KSC 39A</td>
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<td>12:30:00 PM EST (A)</td>
<td>Friday 20 21/1000 (7)</td>
<td>LANDING WINDOW</td>
<td>KSC 39A</td>
<td>104:104</td>
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<tr>
<td>PAD 39A</td>
<td>MLP-3</td>
<td>Kevin R. Kregel</td>
<td>KSC 38A</td>
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</table>

**Space Shuttle Missions Summary**

STS-99 was the first shuttle flight of the new century. The primary payload was a space radar, known as Shuttle Radar Topography Mission (SRTM). The SRTM successfully mapped the Earth in 3-D, 30 times more accurately than current global maps. The system used two radar antennas mounted in the shuttle payload bay and two on a 200-foot-long mast deployed behind the payload bay. The mast was the longest rigid structure deployed in space at this time. The SRTM is an outgrowth of the Spaceborne Imaging Radar flown on STS-59 and STS-68.

**Mission Highlights (Launch Scrubs/Delays)**

- **Baseline launch date of 6/30/99 on 3/5/98 (OV-104); then to 1/22/99 on 6/4/98 (Multi-flight changes ISS SM delay).**
- **Postponed launch date to 1/31/00.**
- **STS-103 flight delays and Y2K testing.**
- **Launch scrub at 1/31/00.**
- **STS-103 flight delays and 12K testing.**

**Launch Postponements**

- **Based on 13:00:00 launch attempt at 13:00:00:52z (T-40M12S) in 29/96z (OV-104), then to 1/22/99 at 1/22/99 (OV-104).**
- **Advanced launch delay to 6/1/99 on 7/23/99. OV-104, on 7/30/99 to achieve additional GPS DTO Flight. Updates to flight dates and baseline STS-101 CV-105 on 10/5/99.**
- **Postponed launch date to 1/13/00, additional work work and STS-103 to fly first.**
- **Postponed launch date to 1/13/00.**
- **STS-103 flight delays and 12K testing.**

**Launch Scrubs**

- **Scrubbed 13:00:00 launch attempt at 13:00:00:52z (T-40M12S) with 58/96z (OV-104) due to preflight IPT test to the MEC's was executed. MEC 2 (an EMEC) first response was anomalous (bad address, bad parity, bad SEV).**

**Performance Margins (LBS)**

- **FRR: 3272**
- **FUEL: 854**
- **FINAL TDOP: 1059**
- **RECON: 365**
- **PAYLOADS: PUB**
- **SRTM/SRTM-3 with radar antennas on 200 ft boom.**

**Earth/Avm**


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**References:**

**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>FLT DURATION</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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**LAUNCH DELAYS:**
- Launch delay was 13M40S. Held at T-9 minutes hold to clear the IPR's: (1) MPS LH2 manifold P, (2) cabin pressure leak check at lower pressure, and (3) Hyd Sys 1 Circ Pump pressure low. Launched at 42:17:43:40Z, 12:43:40 PM EST, on Friday, February 11, 2000.

**TAL WX:**
- Zaragoza (prime and selected); Moron (2-engine TAL Call), and Ben Guerir were all forecast and observed GO.

**PERFORMANCE ENHANCEMENTS:**
- Standard Set plus: (1) Interim generic High Q WIN/FEB, and (2) OMS Assist is 4000 lbs.

**FLIGHT DURATION CHANGES:**
- Extended One Rev due to Crosswind Violations at KSC. Waved off landing on orbit 181.

**FIRSTS/LASTS:**
- First shuttle flight in the year 2000.
- First flight of Shuttle Radar Topography Mission using dual-antenna imaging radar with antennas mounted on 200 foot extended boom.
- Last flight of Lightweight ET.

**EVENTS:**

**SIGNIFICANT ANOMALIES:**
- GPC I/O Errors and EMEC preflight BITE errors.
- LH2 Manifold Pressure Tape Meter Oscillations.
- WSB 2 under cool during ascent.
- CRT 1 BITE.
- ET CH2 Ullage Pressure Low at MECO.
- Forward Mission Timer Display Elements Failed.
- RRCS Fuel Regulator B Primary Stage Leakage.
- Vernier Thruster LSO Oxidizer Temperature Erratic.
- Supply water dump nozzle blockage.
- APU 1 CG injector tuber temperature failure.

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**PILGRIM VIEW OF SAN ANDREAS FAULT**

**JSC2000-E-02781 PIA02733 (Release Date: 21 February 2000) --- Perspective view of San Andreas Fault near Palmdale, CA. The view was created by draping a Landsat satellite image (showing residential and agricultural development) over an SRTM elevation model. Topography is exaggerated 1.5 times vertically.**

**S99-E-5034 (12 February 2000) --- The 200 ft.-long mast supporting the Shuttle Radar Topography Mission juts into space from Endeavour (out of frame at left).**

**STS099-318-015 --- A “star-burst” pose. Top Center: Voss/MS, (clockwise from her) PLT Gorie, Kavandi/MS, Thiele/MS (ESA), Mohri/MS (NASDA), and CDR Kregel.**

**JSC2000-01451 -- SRTM personnel support STS-99 in JSC Payload Operations Control Center (POCC). From left are Mike Kobrick, Ian Joughin and Diane Ainsworth.**

**JSC2000-01454 --- Scott D. Vangen “talks topography” at the Crew Interface Console (CIC) in JSC POCC.**
<table>
<thead>
<tr>
<th>NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ ORBIT, RUNWAY, SRB ORBIT, EMERG. LANDINGS</th>
<th>THROTTLE PROFILE, ENG. SUN</th>
<th>SRB RSIRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, EXPERIMENTS</th>
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**SPACE SHUTTLE MISSIONS SUMMARY**

**Brief Mission Summary:** STS-101, 3rd mission to ISS, was initially designed to outfit the Russian Zvezda crew quarters. However, Zvezda’s launch was delayed and the mission was changed to ISS maintenance and logistics support. Outfitting Zvezda would await STS-106 later in the year. A high priority of this flight was the replacement of four of six 800 amp Zarya batteries. Also, this was first flight of Shuttle “Glass Cockpit” upgrade.

**Mission Highlights:**

- **Launch Scrubs/ Delays:**
  - Scrubbed 3:17:17 PM EDT (115:20:17:17Z) 4/24/00 launch attempt while holding at T-9 minutes due to high RTLS crosswinds.
  - Scrubbed 2:53:17 PM EDT (116:19:53:17Z) 4/25/00 launch attempt at L-1:35:00 by Launch Director when RTLS crosswinds persisted in 29-30 knots range and were forecast to exceed limit.
  - Scrubbed 2:34:16 PM EDT (117:19:34:16Z) 4/26/00 launch attempt at 11:19:21Z (L-OH3M) while holding in T-9 min hold due to no TAL site. All three TAL sites were observed and forecasts NO GO.
  - Scrubbed 2:34:16 PM EDT (117:19:34:16Z) 4/26/00 launch attempt at 11:19:21Z (L-OH3M) while holding in T-9 min hold due to no TAL site. All three TAL sites were observed and forecasts NO GO.

- **Launch Postponements:**
  - Baseline 8/5/99 as launch date on 10/5/98. Postponed to 10/14/99, then 12/2/99. TACAN scars removed for GPS scar correction. - Postponed to 3:17:17 PM EDT (115:20:17:17Z) 4/24/00 launch attempt while holding at T-9 minutes due to high RTLS crosswinds.
  - Scrubbed 4/25/00 launch attempt at L-1:35:00 by Launch Director when RTLS crosswinds persisted in 29-30 knots range and were forecast to exceed limit.
  - Scrubbed 4/24/00 launch attempt at 4/14/00 due to high winds.
  - Scrubbed 4/24/00 launch attempt at 4/14/00 due to high winds.
  - Scrubbed 4/24/00 launch attempt at 4/14/00 due to high winds.
  - Scrubbed 4/24/00 launch attempt at 4/14/00 due to high winds.

- **Shuttle Accumulated Weights:**
  - 3002132 LBS

- **CARGO:**
  - 35604 LBS

- **PAYLOADS/ EXPERIMENTS:**
  - TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.

**S99-01417-- 1st flight MEDS cockpit**

**Launch Window:**

- Window opened at 140:10:09:26Z and closed at 140:10:16:14Z for a total window of 6M45S. Selected Preferred Launch Time (PLT) of 140:10:11:02Z for a launch window of 5M4S.

- **CARGO:** 35604 LBS

- **PAYLOADS/ EXPERIMENTS:**
  - TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.

- **Launch Window:**
  - Window opened at 140:10:09:26Z and closed at 140:10:16:14Z for a total window of 6M45S. Selected Preferred Launch Time (PLT) of 140:10:11:02Z for a launch window of 5M4S.
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<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>SSME-TL, NOM-ABORT EMERG</th>
<th>SRB, RSSRM</th>
<th>ORBIT</th>
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**FLT DURATION:** 9:20:09:09  
**SIT:** 645:17:27:28  
**CM-104:** 160:18:39:34  
**DISTANCE:** 5,076,281 sm

**LAUNCH DELAYS:** None  
**TAL WX:**  
- Zaragoza (Prime and Selected), Moron, and Ben Guerir all forecast and observed GO.  
**PERFORMANCE ENHANCEMENTS:**  
- Standard Set Plus: (1) PE Operational - High Q TRN/APR, (2) OMS Assist is 4000 lbs, (3) 52 NM MECO, and (4) Del psi

**SIGNIFICANT ANOMALIES:**  
- Left OMS Engine Bipropellant Valve 2 indicates open.  
- Left OMS Engine GN2 regulator pressure low during Post-Firing Purges.  
- Ku-band radiating within RF Protect Box.  
- PRSD Oxygen Tank 4 Heater temporarily failed.  
- Collins TACAN BITE faults.  
- Slump tile at wing leading edge with internal flow.  
- APCU 1 converter B failure.  
- ME02 MDU CRT 2 display screen came up blank.  
- Speedbrake Ch 3 secondary Delta Pressure delayed response

**TAL WEATHER, ASCE, DELAYS:**  
- LAUNCH SCRUBS/DELAYS.

**RENDEREZVOUS #47:**  
- Rendezvous with ISS at PMA2, Node 1 Forward Port.

**EVENTS:**  
- ISS ring capture at 142:03:56:10Z.  
- Docked with ISS PMA2 Node 1 Forward Port at 142:04:44:09Z, 1:18:32:59 MET.  
- Reboost #1 - Start at 145:00:02:11Z, 4:13:51:01 MET, 29.06 fps, final orbit 190 by 184 nm, increase approximately 9 nm.  
- Reboost #2 - Start at 146:02:14:01Z, 5:16:02:51 MET, 29 fps, final orbit 196 by 195 nm, increase approximately 9 nm.  
- Undocked at 147:23:02:38Z, 7:12:51:18 MET.  
- STS-101/2A.2a ISS Visitor Time is 5D1H41M25S (Docking to Undocking)  
- Total transfers: To ISS, 3371 lbs consisting of 2657 lbs dry cargo (IVA), 4 OMCs with 367 lbs H2O, and External (EVA) 327 lbs.  
- From ISS, 1391 lbs.  
- Completed air quality work, R&R FGB failed electrical equipment and FGB lifetime equipment.  
- EVA tasks completed include installation of OTD and Strela cranes and ECOM antenna R&R.

**RENDEZVOUS #47:**  
- Rendezvous and dock with ISS at PMA2, Node 1 Forward Port.

**CONTINUED…**

**ST101-717-094 --- Inflight crew portrait on ISS Unity (Node 1). Rear (from left): Weber/MS, CDR Halsell, Williams/MS, & PLT Horowitz. Front: Helms/MS, Usachev/MS, & Voss/MS.**

**STS101-390-025 (19-29 May 2000) ---**  
Helms/MS performs battery maintenance below floor of Zarya.

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<th>SSME/TL</th>
<th>NOM/ABORT EMERG</th>
<th>THROTTLE PROFILE DEG. S.N.</th>
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<td>Atlantis</td>
<td>KSC Pad 36B</td>
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<td>MLP-2</td>
<td>4TH SHUTTLE FLIGHT TO ISS</td>
<td>SPACEHAB #15</td>
<td>MLP-2</td>
<td>4TH SHUTTLE FLIGHT TO ISS</td>
<td>SPACEHAB #15</td>
<td>MLP-2</td>
<td>4TH SHUTTLE FLIGHT TO ISS</td>
<td>SPACEHAB #15</td>
<td>MLP-2</td>
<td>4TH SHUTTLE FLIGHT TO ISS</td>
<td>SPACEHAB #15</td>
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</tbody>
</table>

**STS-106-712-028** -- Atlantis crew found much larger ISS since STS-101 departure with the addition of the Russian Zvezda and a docked Progress resupply ship.

**Brief Mission Summary:** The goal of the STS-106 mission, 46th mission to ISS, was to prepare the Zvezda Service Module for the arrival, later in the year, of the first residents, Expedition 1 crew, to start a permanent human presence on the ISS outpost.
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>THROTTLE PROFILE ENG. S.N.</th>
<th>SSME-TL NO</th>
<th>ABORT EMERG</th>
<th>SRB</th>
<th>SBRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-106/ISS 2A.2b</td>
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<tr>
<td>STS106-349-002 (8-20 September 2000)</td>
<td>--- This unique picture captures the cabin of Atlantis, the RMS arm, and part of the ISS.</td>
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<tr>
<td>STS106-373-019</td>
<td>--- Inflight crew portrait on ISS. Front, from the left, Malenchenko/MS (RSA), CDR Wilcutt, PLT Altman. Back, from left, Burbank/MS, Lu/MS &amp; Mastracchio/MS, &amp; Morukov/MS (RSA).</td>
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<tr>
<td>IN THE JSC MCC</td>
<td>--- LEFT: (l to r) FD’s Leroy Cain, Wayne Hale &amp; Jeff Bantle await launch for “baton” handoff from Florida to Houston. CENTER: FCT Planning with FD Kelly Beck holding flight insignia. RIGHT: FD Orbit 4 Bill Reeves on console.</td>
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<td>FLT</td>
<td>ORBITER</td>
<td>CREW</td>
<td>LANDING SITES, ABORT TIMES</td>
<td>LANDING TIMES, FLT LIFTOFF, VANDOS, ET-104/104 100%</td>
<td>SSME-TL</td>
<td>ORBIT</td>
<td>PAYLOAD WEIGHTS, FSW/EXPERIMENTS</td>
<td>MISSION HIGHLIGHTS</td>
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<tr>
<td>STS-92/ISS 3A</td>
<td>OV-103 (Flight B Discovery)</td>
<td>CDR - Brian Duffy, FLT # 4: STS-45, STS-57, STS-72, P595/R1142/V94/M126 PLT - Pamela A. Meloy, P595/R0281/F34</td>
<td>KSC 3A 285:23:17:00 Z 6:17:00 PM EST Wednesday 10 10/11/00</td>
<td>POST OMS-2-POST OMS-2-76 104.5/104.5/104.5 TIL DEPLOY: 104.5/104.5/104.5</td>
<td>BI-104 51.60</td>
<td>CK-7 5</td>
<td>CARGOQ 35250 LBS</td>
<td>BRIEF MISSION SUMMARY: STS-92, the 5th mission to ISS, delivered the first framework structure, 21 trusses, to house communications and motion control equipment, and delivered the third Pressurized Mating Adapter docking station. This was the 100th mission of America’s Space Shuttle.</td>
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<td>SEQ FLT # 100</td>
<td>KSC-100</td>
<td>MS 3/EV1 - Leroy Chiao, FLT 3: STS-65, STS-72, P593/R1197/V125/M157 - MS 2/EV2 - William S. McArthur, P594/R1729/V124/M150</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
<td>28009 LBS</td>
<td>PAYLOAD CHARGEABLE 28009 LBS</td>
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<td>PAD 39A-57</td>
<td>MLP-3</td>
<td>MS 3/EV3 - Peter J. (Jeff) Wisoff, P595/R6160/V110/M145</td>
<td>KSC 3A 285:23:17:00 Z 6:17:00 PM EST Wednesday 10 10/11/00</td>
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<td>BI-104 51.60</td>
<td>CK-7 5</td>
<td>CARGOQ 35250 LBS</td>
<td>BRIEF MISSION SUMMARY: STS-92, the 5th mission to ISS, delivered the first framework structure, 21 trusses, to house communications and motion control equipment, and delivered the third Pressurized Mating Adapter docking station. This was the 100th mission of America’s Space Shuttle.</td>
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<tr>
<td>FIFTH SHUTTLE FLIGHT TO ISS</td>
<td>OV-103 (Flight B Discovery)</td>
<td>CDR - Brian Duffy, FLT # 4: STS-45, STS-57, STS-72, P595/R1142/V94/M126 PLT - Pamela A. Meloy, P595/R0281/F34</td>
<td>KSC 3A 285:23:17:00 Z 6:17:00 PM EST Wednesday 10 10/11/00</td>
<td>POST OMS-2-POST OMS-2-76 104.5/104.5/104.5</td>
<td>BI-104 51.60</td>
<td>CK-7 5</td>
<td>CARGOQ 35250 LBS</td>
<td>BRIEF MISSION SUMMARY: STS-92, the 5th mission to ISS, delivered the first framework structure, 21 trusses, to house communications and motion control equipment, and delivered the third Pressurized Mating Adapter docking station. This was the 100th mission of America’s Space Shuttle.</td>
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<td>MLP-3</td>
<td>MS 3/EV4 - Michael E. Lopez-Alegria, FLT 2: STS-73, P595/R2029/V183/M175</td>
<td>M/S 1/EV1: P596/R2827/V124/M150</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
<td>28009 LBS</td>
<td>PAYLOAD CHARGEABLE 28009 LBS</td>
<td>BRIEF MISSION SUMMARY: STS-92, the 5th mission to ISS, delivered the first framework structure, 21 trusses, to house communications and motion control equipment, and delivered the third Pressurized Mating Adapter docking station. This was the 100th mission of America’s Space Shuttle.</td>
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<td>MLP-3</td>
<td>MS 3/EV5 - Koichi Wakata (Japan), FLT 2: STS-72, P597/R2080/V164/M181</td>
<td>M/S 2/EV2: P598/R2080/V164/M181</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
<td>28009 LBS</td>
<td>PAYLOAD CHARGEABLE 28009 LBS</td>
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<tr>
<td>MLP-3</td>
<td>MS 3/EV5 - Koichi Wakata (Japan), FLT 2: STS-72, P597/R2080/V164/M181</td>
<td>M/S 3/EV3: P599/R2080/V164/M181</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
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<td>MLP-3</td>
<td>MS 3/EV5 - Koichi Wakata (Japan), FLT 2: STS-72, P597/R2080/V164/M181</td>
<td>M/S 5: P597/R2080/V164/M181</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
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<tr>
<td>MLP-3</td>
<td>MS 3/EV5 - Koichi Wakata (Japan), FLT 2: STS-72, P597/R2080/V164/M181</td>
<td>SS EVA #15 EMJ TETHERED EVA #44</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
<td>28009 LBS</td>
<td>PAYLOAD CHARGEABLE 28009 LBS</td>
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<tr>
<td>MLP-3</td>
<td>MS 3/EV5 - Koichi Wakata (Japan), FLT 2: STS-72, P597/R2080/V164/M181</td>
<td>SS EVA #16 EMJ TETHERED EVA #44</td>
<td>ET-104/104/104 100%</td>
<td>ET-104/104/104 100%</td>
<td>TI BURN 11/4/5 MET ET: 100.1/100.1/100.1</td>
<td>NON-DEPLOYED</td>
<td>28009 LBS</td>
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STS092-S-022 [EC00-0311-3] (24 OCTOBER 2000) --- Successful landing at EAFB of the 100th Shuttle mission — “Still young at 100”, PAO.
SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSS RANGE</th>
<th>LANDING SITE, FLT DURATION, WINDS</th>
<th>SSM/E-TL NOM/ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW PAYLOADS</th>
<th>PAYLOADS/ EXPERIMENTS</th>
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</thead>
<tbody>
<tr>
<td>STS-92/ISS 3A</td>
<td>Continued...</td>
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</tbody>
</table>

**Mission Highlights**

- **TAL Weather, Ascent I-loads, Firsts, Significant Anomalies, Etc.**

- **Performance Enhancements:**
  - Standard Set Plus: (1) PE Operational High Q TRN/OCT, (2) OMS assist is 4000 lbs, (3) 52 nm MECO, and (4) Del Psi.
  - Note: OMS Assist Time reduced from 102 seconds to 41 seconds with DOLLUP uplink (2400 lbs more OMS to orbit).
  - Inert weight adjustment is 199 lbs; was -200 lbs.

**Shuttle Night Launch #24**

- Flight duration extension was 2 days plus 3 orbits.
- EDW was not called up for NEOM.
- Did not close PLBD’s.
- Waved-off landing at KSC on orbits 170 and 171 due to sustained high SLF crosswinds. EOM-1.
- Waved-off landing at KSC on orbits 186 and 187 (Did not close PLBD’s or crew in suits) due to high crosswinds.
- Retargeted to EDW on orbit 187, then waved-off due to broken ceiling and showers within 30 nm.
- Targeted EDW on orbit 188, closed PLBD’s, and put crew in suits. Waved-off landing at EDW on orbit 188 at Tig-16 minutes due to forecast and observed showers and rain within 30 nm.
- Waved-off landing at EDW on orbit 189 at Tig-1 hour for showers and rain within 30 nm. NDME-2. Activated NOR for EOM-2. Did not attempt to land at KSC on orbits 201 and 202 due to forecast and observed high crosswinds, low ceiling, and rain within 30 nm. Landed at EDW runway 22 on orbit 203 at 286:20:59:42Z, 12:59:42 PM PST, Tuesday, October 24, 2000.

**Events:**

- Ring capture at 286:17:45:10Z, 1:18:28:10 MET
- Docked at PMA2 Node 1 Forward Port at 286:17:57:55Z
- Z1 Truss grapple at 286:15:57:14Z, Z1 release 286:19:03:30Z
- EVA 1 Start at 289:14:28Z, duration 9:42M
- PMA grapple at 290:15:43:30Z, PMA release at 290:17:59:35Z
- EVA 2 Start at 290:14:13Z, duration 7:48M
- ISS Reboost maneuver #1 Start at 290:21:03:00Z, 4:21:46:00 MET, Delta-V was 6 fps, 1.5 m, 208 by 202 nm.
- EVA 3 Start at 291:14:29Z, duration 6:44M
- EVA 4 Start at 292:15:03Z, duration 6:45M

---

STS092-342-011 --- In-flight crew portrait. Front, from the left: Wisoff/MS, Wakata/MS (NASDA), CDR Duffy, & McArthur/MS. Rear, from the left: PLT Melroy, Chiao/MS, Lopez-Alegria/MS.
## SPACE SHUTTLE MISSIONS SUMMARY

### MISSON HIGHLIGHTS

<table>
<thead>
<tr>
<th>FLT. NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LANDING SITE/ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>LIFTOFF TIME</th>
<th>CROSSRANGE</th>
<th>SSME-TL NOM/abort/EMERG</th>
<th>SRB PSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD</th>
<th>PAYLOADS/EXPERIMENTS</th>
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<tbody>
<tr>
<td>STS-92/3A</td>
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**EVENTS: (Continued...**

- Undocked at 294:15:08:21 Z, 8:15:51:21 MET
- Total transfers to ISS - 21998 lbs (includes Z1=18351 and PMA3=2549 lbs).
- Delivered Z1 Truss, Mated Z1 to Node 1 zenith port. Installed CMG jumper. Z1 umbilicals connected and powered. Delivered PMA3 and berthed to Node 1 Nadir Port, umbilicals connected, SISANT deployed. Relocated IAPFR and Z1 FRGF. Installed two DDCU's and ETSD on Z1.
- ISS Visitor time 6D21H10M26S

**RENDZVOUS #49:**

- Rendezvous and dock with ISS at PMA2 Node 1 Forward Port.

**SIGNIFICANT ANOMALIES:**

- Airlock Depress Valve Cap came loose from tether and was lost.
- FES Primary B shutdown in Full-Up mode.
- Cabin Payload 3 Bus loss, which powered OIU 1, GSVS, C/L Camera.
- EMU Middeck Battery Charger ready indication failure.
- APFR/IAPFR interference with flush side-mounted WIP’s.
- Modular Mini Workstation anomaly.
- Pistol Grip tool chatter.
- Difficulty mating PMA 3 P603 to Node J609.
- Ku-band lost forward link.
- WSB 2 failed to cool.
- CDS C/L Camera misalignment.
- WSB 2 GN, Relief Valve high cracking P and low reseat P.
- DSC OM2 Card 22 failure.
- WSB 3 Steam Vent Heater erratic.

**LEFT:** JSC2000-E-26675 --- Astronauts Peter J.K. (Jeff) Wisoff and Michael Lopez-Alegria participate in final of four STS-92 space walks, including a run with SAFER backpack.

**BELOW:** JSC2000-06403 --- Wayne Hale (front center), Ascent Flight Director for the STS-92 mission, poses with the 50-odd flight controllers who supported his shift.

**JSC2000-E-26636---** ISS after installation of Z1 Truss. From the top, elements are the Zvezda, the FGB or Zarya, Node 1 or Unity, and Z1.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE/ RUNWAY</th>
<th>LANDING SITE/ FLT. DURATION</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
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<th>PAYLOAD/ EXPERIMENTS</th>
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<td>Endeavour</td>
<td>Brent W. Jett, Michael J. Bloomfield</td>
<td>KSC 30B 336:03:06:01 Z</td>
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<td>KSC-101</td>
<td>F601/R67/V126/M60</td>
<td>Joseph R. Tanner, Carl J. Noriega</td>
<td>ET-105</td>
<td>100/104/104.5/104.5/72</td>
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<td>MLP-6</td>
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### Brief Mission Summary: The STS-97/4A mission, 6th mission to ISS, helped “Station spread its wings”. The 17-ton P6 Integrated Truss Segment (the 1st of four such sets) was delivered and installed on ISS. With the deployment of its 240-foot solar arrays the ISS could now provide more electrical power than on any spacecraft before it. This was also the 1st Shuttle to visit an inhabited ISS.

**Launch Postponements**
- Baseline launch date of 4/8/99 on 11/6/97
- Postponed launch to 8/5/99, 2/3/00, 3/23/00, 7/20/00, 12/2/00, and then 11/30/00 EST (12/1/00 GMT date). The primary cause for postponements was Service Module late delivery to ISS.

**Launch Scrubs**
- None

**Launch Window**
- Total launch window was 7M45S. Window opened at 336:03:02:172 and closed at 336:03:10:022. Selected Preferred Launch Time (FLT) of 336:03:06:012 (In-plane time) resulting in a launch window of 4M01S.

**Launch Delays**
- None

**Flight Duration Changes**
- Standard Set plus: (1) PE Operational High Q WIN/DEC, (2) OMS assist is 4000 lbs, (3) 52 NM MECO, (4) No roll to heads up, and (5) Del Psi

**Flight Duration Changes**
- None

**Mission Highlights**

**Shuttle Night Landing #16**

---

S97-E-5031 (5 December 2000) --- Tanner/MS during EVA & newly deployed ISS solar array panel.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT No.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LAUNCHING SITE, ABORT TIMES</th>
<th>LANDING SITE, LANDING TIME, CROSSRANGE</th>
<th>LANDING TIMES</th>
<th>FUEL TANKS</th>
<th>ORBIT</th>
<th>FUEL WEIGHTS</th>
<th>PAYLOADS</th>
<th>MISSION HIGHLIGHTS</th>
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**EVENTS:**
- Ring capture at 337:19:59:35Z
- Docked with ISS PMA3 Node 1 Nadir Port at 337:20:11:47Z (1:17:03:59 MET)
- Hatch between orbiter and PMA3 was opened at 338:00:22:01Z, 1:21:16 MET
- RMS used to deploy P6 Trusses to Z1 Trusses. P6 Truss 4B SAW deployed.
- Total Transfers from orbiter to ISS 1457 lbs, includes 773 lbs hardware and 7 CWC's with 684 lbs H2O. Transfers from ISS to orbiter 227 lbs.
- ISS Visitor time 6:23:01:13 (docking to undocking).
- Total Transfers from orbiter to ISS 1457 lbs, includes 773 lbs hardware and 7 CWC's with 684 lbs H2O. Transfers from ISS to orbiter 227 lbs.
- ISS Visitor time 6:23:01:13 (docking to undocking).

**RENDZVOUS #50:**
- Pressurized and dock with ISS at PMA2 Node 1 Nadir Port.

**SIGNIFICANT ANOMALIES:**
- Waste water quantity sensor dropouts
- Crew could not remove Cabin Temp Controller Actuator Pin Pin
- APCU 1 converters shutdown and APCU 2 tripped off.
- During EVA 1, EV2 reported equipment hook inadvertently opened.
- EV1’s WVS EMU TV not received
- EV2 reported during helmet light battery charging, battery overheated (bad battery).
- IPS workstation crashed, delaying execute package
- CPS application on IPS crashed
- Sequential Still Video processing anomaly
- ICBC3D Camera stopped filming
- Erratic RCS jet L5D oxidizer injector temp transducer
- ISS EPS reconfigured to power U.S. and Russian Segments. FPP assembled and tested.

**STS097-326-031 (8 December 2000)** — The STS-97 and Expedition 1 crews pose for an historic portrait (1st Shuttle visit to inhabited ISS). Front row are (left to right) STS-97 CDR Jett, EXP 1 CDR William M. Shepherd, & STS-97 MS/Tanner. 2nd row (from the left) EXP 1 FE/Sergei K. Krikalev, STS-97 MS/Norridge, EXP 1 Soyuz CDR/Yuri P. Gidzenko, & STS-97 PLT/Bloomfield. In the rear is STS-97 MS/Garneau representing the Canadian Space Agency (CSA). Krikalev and Gidzenko represent the Russian Aviation and Space Agency.

**STS097-704-074 (9 December 2000)** — New ISS configuration following Endeavour undocking.

**STS097-704-074 (9 December 2000)** — New ISS configuration following Endeavour undocking.
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT/ISS</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>CREW NAMES &amp; EVAS</th>
<th>LANDING SITE/LOC</th>
<th>LANDING TIMES/FLT</th>
<th>SSM/TL NO/ABORT EMERGES</th>
<th>SSM/TL THROTTLE PROFILE</th>
<th>SRB</th>
<th>ORBIT</th>
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**MISSION HIGHLIGHTS**

STS098-331-0017 (July 20, 2001) — RMS lifts Destiny from Atlantis payload bay for installation on ISS.

**Brief Mission Summary:** The STS-98/5A mission, 7th mission to ISS, delivered and installed the U.S. Destiny Laboratory onto the forward port of the Unity Node. Destiny is the centerpiece for research on the ISS. The lab is 28 feet long by 7 feet wide. Atlantis landed at EAFB, CA after two consecutive days of wave offs at KSC, due to high winds, then clouds and rain on the third day.

KSC W/D: OPF 70, VAB 30 (2), PAD 28 (2) = 128 days total (Retrack to inspect SRB cables).

**LAUNCH POSTPONEMENTS:**

- Baseline launch date of 5/20/99 on 11/20/97 - Postponed to 10/28/99, 2/3/00, 3/2/00, 4/20/00, 8/29/00, and 1/18/01
- Postponed launch date to NET 2/6/01 when decision made to roll back to VAB and inspect/make SRB cables (Replaced damaged cables).
- Set 2/7/01 launch date at FRR

**LAUNCH SCRAMBLE:** None

**LAUNCH WINDOW:**

- The total launch window was 3M25, which opened at 38:23:11:16Z and closed at 39:23:15:55Z. The decision was made to use the Preferred Launch Time (PLT) of 38:23:11:16Z (-2 minute window) with a 4M25 launch window.

**PERFORMANCE ENHANCEMENTS:**

- Standard Set Plus: (1) PE Operational High Q WIN/JAN, (2) OMS assist is 4000 lbs, (3) 52 NM MECO, (4) Del Psi FLIGHT DURATION CHANGES

- During T-9 hold, a step function was seen on APU 1 Turbine Speed (OA1 card 6). This proved to be a ground-processing problem, however, coming out of T-9 minute hold was 1m46s
- Determined from T-9 hold, a step function was seen on APU 1 Turbine Speed (OA1 card 6). This proved to be a ground-processing problem, however, coming out of T-9 minute hold was 1m46s

- Standard Set Plus: (1) PE Operational High Q WIN/JAN, (2) OMS assist is 4000 lbs, (3) 52 NM MECO, (4) Del Psi

**FLIGHT DURATION CHANGES:**

- Total extension 2 days plus two orbits and changing landing site to EDW
- EDW was not called up for NEOM. Closed PLDBs, but waved-off landing at KSC on NEOM orbits 170 (249 mins) and 171 (248 mins) due to observed and forecast crosswind violations. Activated EDW for EDW+1. Closed PLDBs for EDW+1 but waved-off landing at KSC on orbit 186 for crosswind violations and orbit 187 due to observed and forecast crosswind violations and precipitation. Waved-off landing at EDW on orbits 188 and 189 due to forecasted ceiling, crosswind, and precipitation violations. EOM+2. Waved-off landing at KSC on orbits 201 and 202 due to forecast of low ceiling and precipitation. Landed at EDW runway 22 on orbit 203 at 12:33:06 PST on Tuesday, February 20, 2001.

**MISSION HIGHLIGHTS**

- During T-9 hold, a step function was seen on APU 1 Turbine Speed (OA1 card 6). This proved to be a ground-processing problem, however, coming out of T-9 minute hold was 1m46s
- Determined from T-9 hold, a step function was seen on APU 1 Turbine Speed (OA1 card 6). This proved to be a ground-processing problem, however, coming out of T-9 minute hold was 1m46s

- Standard Set Plus: (1) PE Operational High Q WIN/JAN, (2) OMS assist is 4000 lbs, (3) 52 NM MECO, (4) Del Psi

**Performance Enhancements:**

- Standard Set Plus: (1) PE Operational High Q WIN/JAN, (2) OMS assist is 4000 lbs, (3) 52 NM MECO, (4) Del Psi

**FLIGHT DURATION CHANGES:**

- Total extension 2 days plus two orbits and changing landing site to EDW
- EDW was not called up for NEOM. Closed PLDBs, but waved-off landing at KSC on NEOM orbits 170 (249 mins) and 171 (248 mins) due to observed and forecast crosswind violations. Activated EDW for EDW+1. Closed PLDBs for EDW+1 but waved-off landing at KSC on orbit 186 for crosswind violations and orbit 187 due to observed and forecast crosswind violations and precipitation. Waved-off landing at EDW on orbits 188 and 189 due to forecasted ceiling, crosswind, and precipitation violations. EOM+2. Waved-off landing at KSC on orbits 201 and 202 due to forecast of low ceiling and precipitation. Landed at EDW runway 22 on orbit 203 at 12:33:06 PST on Tuesday, February 20, 2001.
**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-98/ISS 5A**

**FLT ORBITER CREW**

<table>
<thead>
<tr>
<th>NO.</th>
<th>TITLE, NAMES, &amp; EVAS</th>
<th>LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>ORBIT</th>
<th>PAYLOADS/EXPERIMENTS</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

**FLIGHT DIRECTORS:**
- A/E - L. E. Cain
- LD01 - R. E. Castle
- O2 - K. B. Beck
- PLNOC03 - B. P. Austin
- ISS LD02 - A. F. Algate
- ISS O1 - M. A. Kirasich
- ISS O3 - M. J. Ferrigno
- MOD - J. W. Bantle

**MECO CMD:**
- 8:25.1, 8:24.7, VI: 25928, 25928, OMS-2: 43:46, 43:45, 127.1 FPS, 127.1 FPS

**DENS ALT:**
- 2334 FT

**FLT DURATION:**
- 12:21:20:04 S/T

**DISTANCE:**
- 5,369,576 sm

**CONTINUED...**

**SIGNIFICANT ANOMALIES:**
- CDR and PLT HUD runway misalignment. PLT saw about 600 foot offset to the right of the runway, CDR was about half of this offset.
- PCA vent cover bolts did not fit 5/16-in socket. PCA vent bolts were difficult to start with power tool.
- Broken connector bail linkage, one of rivets on connector bail broke.
- Sticky mini-workstations end effectors, SPC component greased.
- Ku-band radar Alpha gimbal angle error.
- SASA P4 connector O-ring loose.
- Bad video for proshare video conferencing.
- STS-98 Vent Command error for Reboost 5.
- Ku-band radar Alpha airmail angle error.

**RENEDEVELOPMENTS:**
- Rendezvous and dock with ISS at PMA3, Node 1 Nadir Port.

**TRANSFERS:**
- To ISS: Dry cargo IVA 3036 lbs, U.S. Lab 29866 lbs, external EVA 368 lbs = total 33270 lbs. (Included H2O transfer to ISS: 10 CWC's = 993 lbs)
- Transfers from ISS to shuttle 872 lbs.

**CONTINUED...**

**FIFTH SHUTTLE CREWMEMBER REPLACEMENT:**
- Mark Lee was replaced by Curbeam in February 2001. (Fourth Shuttle crewmember replacement occurred on STS-85)

**EVENTS:**
- OMS assist at 2:16 MET, duration 102.2 seconds
- Docked with ISS PMA3 Node 1 Nadir Port at 40:16:50:49Z, 01:17:37:47 MET
- Collision avoidance maneuver for ISS at 41:11:48:02Z, 02:12:36:00 MET Delta V +2.5 ft/sec, 186.5 by 199.4 nm
- RMS grappled PMA2 on Node 1 at 41:14:12Z, 2:14:59 MET.
- PMA2 installed on Z1 Truss at 41:17:00Z, 2:17:47 MET.
- U.S. Laboratory grappled in PUS at 41:17:22Z, 2:18:00 MET.
- U.S. Lab (Destiny) was attached to Node at 41:19:00Z, 2:19:47 MET.
- EVA 1 Start at 41:15:51Z, 2:16:36 MET.
- Second Reboost maneuver Started at 44:15:53:02Z, 5:20:53:00 MET lasted 4 hours.
- Fourth Reboost Started at 44:20:06:02Z, 5:20:53:00 MET.
- Sixth Reboost at 46:15:23Z, Delta V of 4.4 fps, orbit 209.4 by 195.5 nm.
- Seventh Reboost at 46:16:56Z, duration 3h11m, Delta V 11.9 fps, orbit 212 by 193 nm.
- Hatch closed at 47:13:22Z, 8:19:08:58 MET.
- Unlocked at 47:14:06Z, 8:14:53 MET.
- Rotated for MS working.
- Relocated PMA2 from Node 1 to fwd CBM.
- Delivered and installed U.S. Lab on Node 1 and reconnected umbilicals, activated U.S. Lab core systems.
- Activated and C/O CMG's, then handed over attitude control to U.S. GN&C system.
- ISS Visitor Time is 6:21:15:11.

**IN MCC: Orbit 1 FCT in Shuttle FCR. FD Robert Castle, near center, holds crew insignia.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (10)</th>
<th>LANDER SITE, LIFTOFF TIME</th>
<th>LANDING TIMES, ABBREVIATIONS</th>
<th>SSM/E-TL</th>
<th>SRB</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-102/ISS 5A.1</td>
<td>Discovery</td>
<td>OV-103 (Flight 29)</td>
<td>KSC 39B</td>
<td>80:07:31:41Z</td>
<td>KSC 15 (KSC 54)</td>
<td>104/104/100%</td>
<td>BI-106</td>
<td>51.60</td>
<td>DIRECT INSERTION</td>
<td>Brief Mission Summary: STS-102, 8th mission to ISS, provided the first ISS crew changeout and, the first flight of the Italian-built Multipurpose Logistics Module (MPLM) named Leonardo. Among the MPLM cargo was the first scientific rack for U.S. Lab, Destiny, delivered on STS-98. With the ISS crew changeout, three crews participated in the STS-102 mission.</td>
</tr>
<tr>
<td>SEQ</td>
<td>FLT # 103</td>
<td>KSC-103 ISS 5A.1</td>
<td>KSC 39B</td>
<td>80:06:26:06Z</td>
<td>KSC 15 (KSC 54)</td>
<td>100/104/100%</td>
<td>FPR</td>
<td>218094 LBS</td>
<td>218094 LBS</td>
<td>NON-DEPLOYED</td>
</tr>
<tr>
<td>PAD</td>
<td>30B-45</td>
<td>MLP-3</td>
<td>KSC 33 CI/N</td>
<td>80:07:32:31Z</td>
<td>KSC 15 (KSC 54)</td>
<td>3274 LBS</td>
<td>FPR</td>
<td>1039900 LBS</td>
<td>1039900 LBS</td>
<td>NON-DEPLOYED</td>
</tr>
</tbody>
</table>

**STS102-326-034 --- First Shuttle flight to transport EXP crews. ISS is lined up for rendezvous with Shuttle Discovery.**
SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>CMBR.</th>
<th>CREW (10)</th>
<th>LAUNCH SITE, LIFTOFF TIME, LANDING SITE/FLIGHT DURATION, WINDS</th>
<th>LANDING SITE ORI., LANDS AT CROSSRANGE, ABORT TIMES</th>
<th>SSME-TL N0M-ABORT</th>
<th>EMERG. SRB</th>
<th>FSW</th>
<th>PAYLOADS WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-102/ISS 5A.1</td>
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<tr>
<td>M/S 5 DN/EXP1 Soyuz PLT:</td>
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<tr>
<td>Yuri Gidzenko (Russia)</td>
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<td>(Soyuz Up, STS-102 DN)</td>
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<td>P617/265/M231</td>
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<tr>
<td>SS EVA #1</td>
<td>EMJ/THERED EVA #45</td>
<td>SCHEDULED EVA #55</td>
<td>DURATION 8:56</td>
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<tr>
<td>SS EVA #2</td>
<td>EMJ/THERED EVA #55</td>
<td>SCHEDULED EVA #55</td>
<td>DURATION 8:21</td>
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<tr>
<td>MCC WHITE FCR (33)</td>
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<tr>
<td>STS102-319-028 --- STS-102, EXP 1, &amp; EXP 2 crews in Destiny. Front (l to r): Gidzenko/RSA, Krikalev/RSA, Shepherd, Helms, Usachev/RSA &amp; Voss. Rear (l to r): Kelly, Richards, Wetherbee &amp; Thomas.</td>
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<tr>
<td>STS102-324-004 --- During EVA 1 Voss (and Helms – out of frame) prepared for MPLM docking to ISS Unity Node.</td>
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<tr>
<td>JSC2000-E-06202 --- At their MOCR console, Flight Directors Wayne Hale (left) and John Shannon discuss a mission detail.</td>
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<tr>
<td>STS102-712-005 --- Backdropped against the blackness of space, the ISS as viewed after Shuttle separation.</td>
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</table>

**FIRSTS/LASTS:**
- Shepard flight time 80:07:31:41

**EVENTS:**
- EVA 1 Start at 2:17:29 MET and End at 3:02:25 MET, duration 8:56.
- PMA3 grabbed, unberthed, and installed on Node 1 Port ACBM at 70:13:39Z.
- MPLM grapple at 73:12:36Z, 3:15:45 MET, and installed on Node 1 Nadir ACBM at 73:12:02Z, 3:18:46 MET.
- EVA 2 Start at 4:17:45 MET and End 5:00:06 MET, duration 6:21.
- Collision avoidance maneuver/ISS Reboost #1 at 73:12:12:08Z, 3:02:00:00 MET, duration 47M22S, orbit 200.1 by 210.8 nm, Delta V 11.8 fps.
- ISS Reboost #3 at 76:09:17:45Z, 8:22:33:52 MET, 7.4 fps, orbit 204.5 by 213.7 nm.
- MPLM grappled at 9:20:22 MET, reberthed in orbiter, and ungrappled at 10:00:08 MET.
- ODS hatch was closed at 78:02:48Z, 10:05:06 MET.
- Unberthed at 78:04:31:53Z, 10:16:50 MET.
- Transfers: Shuttle to ISS; 8469 lbs cargo plus 980 lbs water in 10 CWC’s. ISS to Shuttle; 1647 lbs cargo.
- Crew rotation (Expedition 1 to Expedition 2). Relocated PMA3 from Node 1 Nadir to Node 1 Port. Berthed MPLM to Node 1 Nadir. Transferred RSP’s, RSR’s, HRF, ISP, etc. to ISS.
- Krikalev flew two long-duration missions to Mir.
- ISS Visitor Time is 8:21:33:30

**RENDZVOUS #52:**
- Rendezvous and dock with ISS at PMA2 Lab Forward Port.

**SIGNIFICANT ANOMALIES:**
- Flash evaporator left topping Evaporator Duct Heater String A failure.
- WCS Fan Sep Rotary Switch 2 position failure.
- Freq” loop flow degradation.
- EV1 burning sensation in eyes during Airlock depress.
- PMA3 J603 loose O-ring EVA.
- Unable to remove PMA3 P608 connector cap.
- TCS failure during rendezvous termination operation.
- CCAC fan failure (running slow at all speed settings).
- Right CMS Vapor Isolation Valve #2 anomaly.
- CSM limits set volts pushbutton rotary switch down position not working on panel R13U.
<table>
<thead>
<tr>
<th>NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH TIME</th>
<th>LANDING TIME</th>
<th>ORBIT</th>
<th>PAYLOAD</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-100/ISS 6A</td>
<td>Endeavour</td>
<td>CM-105 (Flight 16)</td>
<td>109:18:40:42</td>
<td>121:16:10:43</td>
<td>Bi-107</td>
<td>38330 LBS</td>
<td>Brief Mission Summary: STS-100/6A, 9th mission to ISS, delivered and installed the ISS Canadarm2 robotic arm. The first job for the arm was to attach a new airlock on ISS, to be delivered on the next flight, STS-104. In addition, the second MPLM Raffaello, flown on this flight, transferred needed cargo to ISS and returned items from ISS to Earth.</td>
</tr>
<tr>
<td>STS-100/ISS 6A</td>
<td>Iss-6A</td>
<td>38A-59</td>
<td>109:18:40:42</td>
<td>121:16:10:43</td>
<td>Bi-107</td>
<td>38330 LBS</td>
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</tr>
<tr>
<td>NINTH SHUTTLE FLIGHT TO ISS</td>
<td>ISS-6A</td>
<td>38A-59</td>
<td>109:18:40:42</td>
<td>121:16:10:43</td>
<td>Bi-107</td>
<td>38330 LBS</td>
<td></td>
</tr>
<tr>
<td>STS-100/ISS 6A</td>
<td>Endeavour</td>
<td>CD-2: Chris A. Hadfield (Flight 2 - STS-74)</td>
<td>16:10:43</td>
<td>16:10:43</td>
<td>304</td>
<td>6346 LBS</td>
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<tr>
<td>STS-100/ISS 6A</td>
<td>Iss-6A</td>
<td>38A-59</td>
<td>16:10:43</td>
<td>16:10:43</td>
<td>304</td>
<td>6346 LBS</td>
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</tr>
<tr>
<td>STS-100/ISS 6A</td>
<td>MLP-1</td>
<td>38A-59</td>
<td>16:10:43</td>
<td>16:10:43</td>
<td>304</td>
<td>6346 LBS</td>
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<tr>
<td>STS-100/ISS 6A</td>
<td>Iss-6A</td>
<td>38A-59</td>
<td>16:10:43</td>
<td>16:10:43</td>
<td>304</td>
<td>6346 LBS</td>
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</tbody>
</table>

**ISS02-E-5829 (21 April 2001) --- Endeavour, with MPLM Raffaello & Canadarm2 on board, approaching ISS for docking.**
SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT.</th>
<th>ORBITER</th>
<th>CREW (T)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/FLYDOWN</th>
<th>SSME/T-L</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD</th>
<th>PAYLOAD/WEIGHTS</th>
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<tbody>
<tr>
<td>STS-100/ISS 6A</td>
<td>Continued...</td>
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</tr>
<tr>
<td>STS100-341-003</td>
<td>--- STS-100 and EXP 2 crews in-flight portrait in Destiny. Bottom, from left: Hadfield/CSA, Guidoni/ESA-Italy, Rominger, Susan J. Helms/EXP2. Middle row: James S. Voss/EXP2, Yury V. Usachev/EXP2, &amp; Lonchakov/RSA. Top: Parazynski, Phillips, &amp; Ashby.</td>
<td>JSC2001-E-12120 -- Ascent Flight Director LeRoy Cain (left) discusses mission with FD Jeffrey Bantle in the MOCR.</td>
<td>STS100-E-5238 (22 April 2001) --- Hadfield/MS representing CSA, stands on one Canadian-built robot arm (RMS) to work with another one, called Canadarm2, for ISS.</td>
<td>STS100-E-5958 -- ISS, sporting a readily visible new addition in the form of the Canadarm2 robotic arm, as seen from Shuttle post-separation.</td>
<td>Continued...</td>
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</tbody>
</table>

**MISSION HIGHLIGHTS**

**LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**

**EVENTS:**

- MCC (RCS) at 1:18:00:36 MET, orbit 199.1 by 206.1 nm
- Docked at ISS PMA2 Lab Forward Port at 11:14:10:42Z
- EVA 1 Start at 2:17:04:41 MET, duration 7:09:51
- RMS grappled the Spacelab Pallet, unberthed from orbiter, and installed on Lab Cradle Assembly at 2:16:07:18 MET
- ISS hatch opening and crew ingress into ISS at approximately 3:14:40 MET.
- MPLM in PLB at 3:19:45 MET grappled and positioned over Node 1 Nadir C3M and installed at 3:21:04 MET.
- First ISS Reboost maneuver Started at 4:01:09:54 MET, duration 59M/6S, Delta V 7.41 fps, orbit 205.5 by 212.2, raised orbit 2.1 nm.
- EVA 2 Start at 4:17:53:12 MET, duration 7:39M:22S
- Second ISS Reboost maneuver Started at 7:16:40:00 MET (RCS), ended at 1 hour, Delta V was 15.9 fps, orbit 210 by 206.
- RMS berthed MPLM in PLB and powered down at 8:02:43 MET, SSRMS to RMS handoff of SLP berthed at 9:02:02 MET.
- Delivered and installed SSRMS and connected cabs to U.S. Lab. UHF antennas on U.S. Lab, removed starboard ECOMM antenna. Delivered and installed express racks with payloads. Replaced failed CMC MDM #1.
- Undocked at 119:17:34:02Z (Extended flight 1 docked day due to ISS C&C MDM and Node MDM problems).
- Transferred 6346 lbs cargo to ISS and 1608 lbs from ISS to Shuttle. Transferred 1380 lbs water in 14 CWC's.
- ISS Visitor time is 8:03:23:22.

**RENDZVOUS #53:**

- Rendezvous and dock with ISS at PMA2 Lab Forward Port

**SIGNIFICANT ANOMALIES:**

- FES Feedline B Mid 2 Htr 1 failed off
- RMS End Effector Capture Switch sticky
- WSB 3 anomalous temperature response when operating on WSB 3B controller
- Humidity Separator B water carryover
- RCS Jet RSD low chamber pressure
- EV1 eye irritation during EVA 1 and EVA 2 (Disposable in-suit drink bag leaked)
- ISS Early Com Antenna connector fell apart
- Video Signal Converter failed to release from SLP during EVA 2
- SIGI data check bad status indications
- SRB - Unburned propellant (3 percent) in RH Forward Booster Separation Motor (BSM). Conclusion is water intrusion.
- LOMS PCD Inboard Y-web differing from System A Heater
- In preparation of launch, the lower left hand OMS Pod TPS appeared to be flexing during SSME startup. Similar but smaller motion has been seen on the pods in the past.

**MISSILES/WEAPONS/EXPLOSIONS:**
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-104/ISS 7A

<table>
<thead>
<tr>
<th>NO.</th>
<th>ORBITER</th>
<th>CREW (5)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/Runway, CROSSRANGE</th>
<th>SSME/TL NO.</th>
<th>SRB RSRM ORBIT PAYLOAD WEIGHS</th>
<th>PAYLOAD WEIGHS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUB/SKILLS, TAL WEATHER, ASCENT I/LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-104/ISS 7A</td>
<td>Atlantis</td>
<td>Steven W. Lindsey, Charles O. Hobaugh, Charles O. Hobaugh, Michael T. Gernhardt, Michael T. Gernhardt</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
<td>KSC-105: 7M57S USING PLT (IN-PLANE TIME)</td>
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<tr>
<td>SEQ FLT #105</td>
<td>KSC-105</td>
<td>STS-104 (Flight 24)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
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<td>PAD MLP-2</td>
<td>MLP-2</td>
<td>STS-104 (Flight 24)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
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<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
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<tr>
<td>TENTH SHUTTLE FLIGHT TO ISS</td>
<td>Atlantis</td>
<td>STS-104 (Flight 24)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
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<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
<td>193:09:03:59Z 5:03:59 AM EDT (P)</td>
</tr>
</tbody>
</table>

STS104-E-5178 — STS-104 & EXP2 crews pose in new Quest airlock. Front: PLT Hobaugh. 2nd row, from left: Reilly/MS, CDR Lindsey, CREW/EXP2 Yuri V. Usachev & Gernhardt/MS. In rear: Kavandi/MS, James S. Voss/EXP2/FE and Susan J. Helms/EXP2/FE.
### SPACE SHUTTLE MISSIONS SUMMARY

**STT-104/ISS 7A**

#### Continued...

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLES &amp; NAMES &amp; EVAS</th>
</tr>
</thead>
</table>

**MISSION HIGHLIGHTS**

- Flight duration changes:

**FIRSTS/LASTS**

- First flight of SSME with alternate Pratt & Whitney HPFTP (S/N 2051) Block II engine
- First operational use of SSRMS since delivery on STS-100/6A. Used to grapple Airlock and install on Node 1 Starboard Port.
- First use of exercise pre-breathe of pure oxygen to purge nitrogen from EVA crew for EVA 3 (12 minute pre-breathe).
- First use of ISS Joint Airlock for EVA (by Shuttle Crew on EVA 3).

**EVENTS**

- Docked at ISS PMA2 Lab Fwd Port. ISS contact at 1:18:04:02 MET, 196:03:08:01Z; Docking complete at 1:18:19:16 MET, 196:03:23:15Z.
- ISS Hatch open (first) 1:20:24 MET, 196:05:28Z.
- Airlock grapple.
- EVA 1 started at 2:18:07 MET, 196:03:12Z; ended at 3:00:06 MET, 196:09:11Z, duration 5h59m.
- ISS Reboost 1 maneuver started at 196:01:18:06Z, 3:16:14:07 MET, Delta V=6.8 ft/sec, altitude increase 2.3 nm, altitude 206 by 201 nm.
- EVA 2 started at 199:03:05Z; ended at 199:09:34Z, duration 6h29m20s.
- ISS Reboost 2 maneuver started at 199:09:59:12Z, 6:00:55:13 MET, Delta V=6.9 ft/sec, altitude increase 2.0 nm, altitude 207.8 by 203.7 nm.
- ISS Reboost 3 maneuver started at 200:07:35:04Z, 6:22:31:05 MET, Delta V=14.9 ft/sec, altitude increase 4.3 nm, altitude 211.1 by 208.6 nm.
- EVA 3 started by 202:08:35Z, and ended at 202:08:37Z, duration 4h10m30s. EVA from Joint Airlock.
- Delivered and installed ISS Joint Airlock on Node 1 Sbmd port using SSRMS. Delivered and installed four HTG’s (two CG and two H) to Airlock. End of ISS Phase 2.
- ISS Hatch close (Final) at 9:17:51 MET, 203:02:55Z.
- Undocked at 9:19:50:00 MET, 203:04:53:59Z.
- Transfers: Shuttle to ISS 19782 lbs cargo (includes Airlock, 13299 lbs) plus 897 lbm water in 9 CWC’s. ISS to Shuttle 626 lbs.
- ISS Visitor Time is 8:01:45:56.

**SIGNIFICANT ANOMALIES**

- Water Loop 1 floodlight coldplate low temperature
- FES Feedline A heater failure
- EMU 3 battery electrolyte leakage
- EV1 right foot discomfort
- Airlock Handhold GSS5 installation failure
- Non-tending retractable tether
- Proshare video conferencing anomaly
- Failed hand held microphone.
- Sequential Still Video (SSV) not operating
- Ku-Band failed to detect and track Ku forward signal.
- CDS CL Camera misalignment
- Left Vent doors 8 and 9 Open 2 sticky microswitch

Photo at right: STS104-E-5237 --- Astronaut James F. Reilly participates in a bit of space history as he joins astronaut Michael L. Gernhardt (out of frame) in utilizing the new Quest airlock for the first ever space walk to egress from ISS.

---

JSC2001-01944 (June 2001) --- First mission from ISS MCC: Members of Orbit 2 team pose for group portrait in the ISS flight control room (FCCR) in Houston’s MCC. Orbit 2 Flight Director Mark Krasich (blue shirt) stands near front at frame center. Lisa Holmesly, lead operations planner for ISS, is standing in front of Krasich between the two logos.

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<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE</th>
<th>LANDING SITE</th>
<th>LANDING TIMES</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHS</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>SEQ FLT #106</td>
<td>OV-103</td>
<td>OMS PODS: LPO-33</td>
<td>21.2:18.1:45.2</td>
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<td>OV-103</td>
<td>SRB EMERG: 100/104.5/104.5</td>
<td>218.8</td>
<td>5 CRYO TK SETS</td>
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<tr>
<td>PAD 39A/40</td>
<td>OV-103</td>
<td>SSME EMERG: 100/104.5/104.5</td>
<td>219.3</td>
<td>6 GN2 Tanks</td>
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<td></td>
<td></td>
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<tr>
<td>MLP-3</td>
<td>OV-103</td>
<td>EMERG NO Logo: 100/104.5/104.5</td>
<td>220.6</td>
<td>52 nm &amp; 104.5</td>
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<tr>
<td>ELEVENTH SHUTTLE FLIGHT TO ISS</td>
<td>OV-103</td>
<td>EMERG NOT LOGO: 100/104.5/104.5</td>
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<td>52 nm &amp; 104.5</td>
<td>DIRECT INSERTION</td>
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</table>

**PAYLOAD/EXPERIMENTS**

- **CARGO:** 33107 LBS
- **PAYLOAD** CHARGABLE: 23055 LBS
- **DEPLOYED:** 10566 LBS
- **NON-DEPLOYED:** 107580 LBS
- **SHUTTLE ACCUMULATED WEIGHTS DEPLOYED:** 15136 LBS
- **ISS TOTAL:** 328238 LBS
- **PERFORMANCE MARGINS (LBS):** FRR: 3065, FUEL BIAS: 937, FINAL TOOP: 705, RECON: 631
- **PAYLOADS/PLB:** ISS-7A.1 (MPLM, ICC crew rotation), Heat, GAS (2), RWS, CDS
- **MODECK:** 465 LBS
- **None**

**MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

- **Brief Mission Summary:** The STS-105/7A.1 (11th ISS mission) provided a new crew to the ISS, transfer of supplies and equipment via the second flight of the Leonardo MPLM. This flight completed the first round trip for Expedition rotation crews (EXP 2).
- **KSC WD:** OPF 79, VAR 8, PAD 31 = 118 days total.
- **LAUNCH POSTPONEMENTS:**
  - Baseline launch date of 6/21/01 on 6/22/00
  - Postponed launch date to 7/12/01
  - Postponed launch date to NET 8/9/01 on 7/11/01
- **LAUNCH SCRUBS:**
  - Scrubbed the 8/9/01 launch attempt. The launch window was in two planes; however, at the L-2 day MVMT, it was decided not to use Plane 2 for the first launch attempt on Thursday, August 9, 2001. Window opened at 221:21:32:472 and closed at 221:21:42:462 or 5M00S total window. With a Preferred Launch Time (PLT) of 221:21:37:462, the launch window was MDSOS. Launch attempt was scrubbed at L-25 minutes due to thunderstorms within 20nm, lighting strikes at 12 nm, and detached anvil's over the Pad and SLF. All three TAL sites were GO. Weather scrub. Launch set for Friday, August 10.
- **LAUNCH WINDOW:**
  - Launch window opened at 222:21:10:14Z and closed at 222:21:22:12Z, giving a total launch window of 9M36S. The PLT (Preferred Launch Time) of 222:21:15:132 (In Plane Time) was selected, which gave a planned window of 4MVS. During the late count, thunderstorms were moving toward the launch site from the Southwest and forecast to be within 30 nm of the Pad and SLF at launch time. At L-27 minutes, the Ops Manager made the decision to increase the probability of launching by moving the Launch Time to the opening of the launch window (222:21:10:42), giving the ultimate launch window of 9M36S. Weather was observed GO at RLTS landing time for PLT and Window Open Time.
- **LAUNCH DELAYS:**
  - Launch occurred On-Time at 222:21:10:14Z, Friday, August 10, 2001 at 5:10:14 PM EDT.
- **TAL WX:**
  - All three TAL sites were forecast and observed GO (Zaragoza prime), Moron, and Ben Guerin). Moron was selected because it had the best weather (ZZA had potential for winds and rain).
- **PERFORMANCE ENHANCEMENTS:**
  - Standard Set plus PE Operational High Q SUM/AUG, 52 nm MECC, and Del Psi.
- **FIRSTFLIGHTS:**
  - First Shuttle round trip with Expedition rotation crews (Expedition 2 round trip, Expedition 2 crew down).
- **RENEDEWS:**
  - Rendezvous and dock with ISS-FMA, 2 Lab Forward Port

---

**STS105-E-5067 (12 August 2001)**

--- Close-up view of Shuttle/ISS docking.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>NO.</th>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7 UP/7 DOWN)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE ENG. S/N</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS, MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-105/ISS 7A.1</td>
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**Continued…**

- **MS 4 ON/EXP 2 Flt Eng 2:** Susan J. Helms (Flt 5 - STS-54, STS-64, STS-78, STS-101, STS-102 UP; P63/R159/V106/F19)
- **MS 5 ON/EXP 2 COO:** Yuri V. Usachev (Flt 2 - STS-101; Russia; STS-102 UP; P63/R256/V168/M223)
- **SS EVA #68:** EMU/TETHERED EVA #61
- **SCHEDULED EVA #62 DURATION 0:16**
- **SS EVA #69:** EMU/TETHERED EVA #62
- **SCHEDULED EVA #63 DURATION 5:29**
- **MCC WHITE FCR (36)**

**FLIGHT DIRECTORS:**
- A/E/ O1 - J. P. Shannon
- LD/O1 - P. F. Dye
- C2 - K. E. Beck
- FLNCO3 - B. P. Austin

**ISS LD/O1:** M. J. Ferring
**ISS C2:** R. E. La Brooke
**ISS PRO1:** J. M. Curvy
**MOD:** N. W. Hale

**Continued…**

- **SE TAL (ZZA):** 5:04
- **MECO CMD:** 0:24.4
- **OMS-2:** 36:34 96.2
- **DENS ALT:** 1816 FT
- **FLT DURATION:** 11:21:12-45
- **ST:** 943:12:45:47
- **CM-103:** 241:22:40:35
- **DISTANCE:** 4,912,390 sm

**SIGNIFICANT ANOMALIES:**
- Loss of AC2 phase A during MPM stow
- Zero-G connector loose O-rings
- Safety tether hook lock guard inadvertently released on EV2’s safety tether
- GPS ADC-CC-15 anomaly (MAGR tracking difficulty)
- Ku-Band Power Output low
- GPS Recorder 1 degraded tracks
- Nose Wheel Steering switch anomaly
- Left OMS Crossfeed low point drain line heater failure
- TCS power supply under-voltage annunciators

**STS105-E-5326 (17 August 2001)** --- The STS-105 mission involved three crews, shown in U.S. Lab. **EXP 3** crew (white shirts) front to back, Culbertson/RSA, Dezhurov/RSA, & Tyurin/RSA; **STS-105** crew (striped shirts) front row, Forrester & Barry, and back row, Horowitz and Sturckow. **EXP 2** crew (red shirts) front to back, Usachev/RSA, Voss, & Helms.

**STS105-E-5265 --- Barry (left) and Forrester surround Early Ammonia Servicer (EAS), to be installed on P6 during EVA 1.**

**FLIGHT DURATION CHANGES:**
- Total changes—orbit weather extension. NEOM was to land at KSC on orbit 186 at approximately 12:46 PM EDT. EDW was not called up. At T+25 minutes, waved-off landing due to observed and forecast thunderstorms and rain showers within 20 nm of SFL. STA reported there was not-a-cloud-in-the-sky over Florida except for the rain cell that persisted at 1 or 2 miles south of the SFL, which caused the wave-off. Landed at KSC 15 on orbit 187 at 234:15:22:59Z, 2:2:59 PM EDT, on Wednesday, August 22, 2001.

**EVENTS:**
- ISS capture was at 1:21:31:27 MET, 224:18:41:14Z.
- ISS hard dock at PMA2 Lab Forward Port at 1:21:53:36Z.
- First ISS hatch opening at 1:23:30 MET, 224:20:41:14Z.
- RWS grapple of the MPLM at 2:15:41:46 MET, 225:12:52:00Z.
- MPLM installed on Node 1 at 2:18:36:37 MET, 225:15:45:12Z.
- IELK time and Command Handover Time (ISS transfer from Exp 2 crew to Exp 3 crew and Cmd from Usachev to Culbertson) at 225:19:15Z.
- EVA 1 Start time 228:13:58:14Z, 5:16:48:00, duration 6H19M.
- First Reboost maneuver started at 228:17:56:26Z, 3:20:48:12 MET, delta V 6.0 ft/sec, altitude increase 1.7 nm, orbit 218 by 208 nm.
- Second Reboost maneuver started at 228:12:12:27Z, 6:15:02:13 MET, delta V 6.4 ft/sec, altitude increase 1.8 nm, orbit 218.8 by 209.5 nm.
- Total transferred to ISS 10551 lbs, 9657 lbs cargo (MPLM 6314, ICC 1549, MD 1794, HOD 10 CMCs with 983.8 lbs). Total transferred from ISS 3032 lbs (MPLM 2964, ICC 10, MD 101).
- Net transfer from Shuttle to ISS 6849 lbs.
- Undocked at 232:14:51:37Z.
### STS-108/ISS UF-1

**Launch Site:** KSC-15 (KSC 57)

**Orbiter:** Endeavour

**Crew Names & EVAs:**
- Dominic L. Gorie (FLT 3 - STS-91, STS-89), P640/R642/V157/M211
- Mark E. Kelly, P641/R727/M237
- Linda M. Godwin (FLT 4 - STS-37, STS-59, STS-76), P642/R122/V105/F13

**Payload Weights:**
- 31877 LBS payload
- 6 GN2 tanks
- 6 H, 2 L PK: 13H, 2L
- 6461 P13 SS: 6H, 2L PK: 13H, 2L
- 5 CRYO TK SETS
- 6 RMS
- 5 FCM
- 36 tanks

**Payloads/Experiments:**
- Performance/Experiments: FCS-105
- FUEL BIAS: 9.37
- FINAL TDOP: 2981
- RECON: 1152

**Mission Highlights:**
- Crew Transfer
- ISS MPLM deploy and retrieval
- ISS UF-1 (MPLM, LMC)

**Crew:**
- Commander: Daniel W. Bursch (M/S 4 UP/EXP 3 Flt Eng)
- Pilot: Yuri T. Onufrienko (Russia)
- Mission Specialist: Carl E. Walz (M/S 3 DN/EXP 3 SPLT)
- Mission Specialist: Vladimir N. Dezhurov (Russia)
- Mission Specialist: Frank L. Culbertson, Jr. (M/S 4 DN/EXP 3 CDR)
- Flight Engineer: Yuri T. Onufrienko (Russia)
- Flight Engineer: Daniel W. Bursch (M/S 4 DN/EXP 3 CDR)

**Launch:**
- Post OMS-2: 109%
- 1205.3 LBS
- 36.3% LBS

**Landing:**
- 1569 FL
- 1389 FL
- 1295 FL
- 1223 FL

**Payloads:**
- 8941 FT
- 92 KGS
- 2 DRAG CHUTE
- 1 JETTISON
- 1 PK: 13H, 2L

**Launch Window:**
- Postponed launch date to NET 11/1/01

### ISS UF-1 (MPLM, LMC)

**The STS-108/ISS UF-1 mission**

Provided a new crew to the ISS, transfer of supplies and equipment via the Raffaello MPLM, and an EVA to install thermal blankets at the bases of the solar panels. Launch was scrubbed twice; first due to debris in ISS docking port from Progress 6 soft dock, and second due to RLTS and Range weather.

**Launch Postponements:**
- Baseline launch date of 10/4/01 was 9/21/00
- Postponed launch date to NET 11/1/01
- Postponed launch to 11/29/01

**Launch Scrub:**
- Scrubbed Thursday 11/29/01 EDT (11/30/01 GMT) Launch at ET 1569 FT
- Progress 6 had Soft Docked with SM Aft Port; however, did not achieve Hard Dock. Suspect debris within the docking interface. Initial IP Russia was GO. U.S. ISS management wanted to scrub to work problem. Then IP Russia announced at ISS MMT on 11/30/01 that they planned an EVA on 12/3/01 to clear debris in docking mechanism. SSP MMT on 11/30/01 set launch for 12/4/01 to allow review of results of EVA. IP Russia EVA crew removed damaged seal from previous Progress enabling Progress 6 to Hard Dock. ISS Technical Scrub (new category of scrub).

**Launch Window:**
- Preferred Launch Time (PLT) was not visible on radar or by SLF Observer. Counted down to T-5 minutes and held while evaluating the observed weather and forecast weather.

**Launch Times:**
- 5:19:28 PM EST (P) 5:19:28 PM EST (A)
- 11:55:12 AM EST
- XRANGE: 26 NM
- TD NORM 1 = 2049 (6) 2 = 2043 (7) 3 = 2050 (2)
- ENGINE 2050 IS BLOCK IIA ENGINE.
- OTHER TWO BLOCK IIA ENGINES.
- ENGINE 2050 IS BLOCK II ENGINE.
- ISS UF-1 (MPLM, LMC) MACH-1, SEM (1), GAS (5), RMS, ODS, Crew Transfer

**Crew Rotation:**
- Mark E. Kelly, P641/R727/M237
- Linda M. Godwin (FLT 4 - STS-37, STS-59, STS-76), P642/R122/V105/F13
- Daniel W. Bursch (M/S 4 UP/EXP 3 Flt Eng)
- Yuri T. Onufrienko (Russia)
- Carl E. Walz (M/S 3 DN/EXP 3 SPLT)
- Vladimir N. Dezhurov (Russia)
- Frank L. Culbertson, Jr. (M/S 4 DN/EXP 3 CDR)

**ISS MPLM deploy and retrieval and EVA support**

**Crew Rotation:**
- Mark E. Kelly, P641/R727/M237
- Linda M. Godwin (FLT 4 - STS-37, STS-59, STS-76), P642/R122/V105/F13
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- Vladimir N. Dezhurov (Russia)
- Frank L. Culbertson, Jr. (M/S 4 DN/EXP 3 CDR)
Continued... 

ST S-108/ISS UF-1

Continued...

Significant Anomalies:
- LEIE Gaseous Hydrogen (GH2) Vent Arm did not latch-back and the GUCP rebounded beyond FSS. GH2 Vent Arm contacted side of support structure (Constraint to Fast flight)
- RCS Thruster R4U Failed-Off and was auto deselected
- Loud white noise was heard on A/G 2 after SSOR 1 was tied to Orbiter Audio Bus

Events:
- MCC WHITE FCR (37)
- Flight Directors: A/E - L. E. Cain
- Shuttle LD/O 1 - N. W. Hale
- Shuttle O 2 - P. S. Hill
- SHuttle Png - C. A. Kissinger
- ISS LD/O 1 - S. P. Davis
- ISS O 2 - R. E. Castle
- ISS PLNG - J. A. McCullough
- MOD - J. M. Heflin

Aboard STS108-E-5390
- Expedition 4 Crew Up, Expedition 3 Crew Down.

Below STS108-E-5390 (10 December 2001)
- Godwin & Tani install insulation blankets on ISS solar array rotation mechanisms.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, LANDING TIMES</th>
<th>LANDING SITE/ RUNWAY, CROSSRANGE</th>
<th>SSME/TL</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSW</th>
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<td>SLW-17</td>
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<td>335900 LBS</td>
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**Intro_im2_smACS.jpg --- in the Clean Room at GSFC two men in "bunny suits" stand near the new ACS to be installed on HST.**

**Brief Mission Summary:** The STS-109 mission was the 4th Servicing Mission to the Hubble Space Telescope to rejuvenate the World's Greatest Observatory. During five EVA's the crew replaced the Reaction Wheel Assembly, the solar arrays, the Power Control Unit (down since 1999) and installed a new scientific instrument, the Advanced Camera for Surveys (ACS). The ACS is able to survey a field of the cosmos twice as large as previous instruments, with ten times the resolution and four times the speed.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-109

**Flight Number:** STS-109  
**Orbiter:** Continued…  
**Crew Titles:** Continued…  
**Launch Site:** Continued…  
**Liftoff Time:** Continued…  
**Flt Duration:** Continued…  
**Landing Site:** Continued…  
**Landing Time:** Continued…  
**Crossrange:** Continued…  
**SSME-TL:** Continued…  
**NOM-Abort:** Continued…  
**EMERG:** Continued…  
**SRB:** Continued…  
**RSRM:** Continued…  
**ORBIT:** Continued…  
**FSW:** Continued…  
**Payload:** Continued…  
**Payload Weights:** Continued…  
**Pay loads/Experiments:** Continued…

### Crew Assignments

**MCC WHITE FCR (38):**  
LD/O 1 - B. P. Austin  
O 2 - A. J. Cecoacci  
PLNG - J. M. Hanley  
AVE - J. P. Shannon  
MOD - N. W. Hale

### Flight Directors

- LD/O 1 - B. P. Austin  
- O 2 - A. J. Cecoacci  
- PLNG - J. M. Hanley  
- A/E - J. P. Shannon  
- MOD - N. W. Hale

### Mission Highlights

**STS109-E-6032** — Crew on middeck. From left (front row): Currie/MS, CDR Altman, & PLT Carey. From the left (back row): Grunsfeld/PLC, Linnehan/MS, Newman/MS, & Massimino/MS.

**STS109-713-014** (8 March 2002) — Grunsfeld/MS (right) and Linnehan/MS during 5th EVA completing HST upgrades.

**STS109-331-005** (9 March 2002) — Rejuvenated HST flies away.

### Significant Anomalies

- Freon® Loop 1 Aft Coldplate Flow Blockage  
- Loss of EV1 Suit data during EVA  
- Starboard Slidewire Slider Anomaly  
- Inner Aftlock “A” Hatch locking device difficult to actuate  
- APU 3 Drain Line Pressure Decay  
- MPS LH2 4-Inch Recirculation Disconnect Slow to Close  
- Forward THC-X Contact Lost During One Burn  
- FES Accumulator/H-Load Feedline B Heater System 2 Failure  
- Primary RCS Thruster R3R Failed Off  
- Water leaking from EMU 1 PLSS

### Performance Enhancements

- Standard Set Plus PE Operational High Q, WINFEB

### Shuttle Night Landing #19

**KSC Night Landing #14**

**Flight Duration Changes:** None

- Planned landing at KSC on orbit 166. Landed at KSC Runway 33 on orbit 166, MLGTD at 71:09:31.52Z on Tuesday, March 12, 2002.

### Events

- OMS-2 Start at 60:16:43.49Z, 13.8 duration, Delta V 10.3 ft/sec, resultant orbit 105.0 by 310.5 nm.  
- NH maneuver (OMS-4) at 62:04:07.30Z, 207 seconds duration, Delta V 326.6 ft/sec, resultant orbit 302.2 by 309.2 nm. MC-4 at 62:08:23.29Z, resultant orbit 303.4 by 314.9 nm.  
- EVA 2 Start at 64:06:41Z, 3:19:19 MET, End at 64:13:57Z, duration 7H16M. Replaced old SA with +V2 Solar Array 3 and diode box. Preplaced Reaction Wheel Assembly. Installed NOBL in Bay 6 and two doorstop extensions (one on -V2 side and one on +V2 side.)  
- EVA 4 Start at 66:09:00Z, 5:21:38 MET, duration 7H30M. Replaced FOC (Faint Object Camera) with new ACS (Advanced Camera for Surveys), installed Electronics Support Module and PCU clean up tasks.  
- HST Reboost started at 67:17:18:04Z, 7:05:56:02 MET, Delta V 11.8 fps, altitude increase 3.6 nm, orbit of 314.7 by 310.6 nm.  
- HST unberthed from Orbiter at 68:08:34Z, 7:22:42 MET.  
- Orbit Adjust maneuver at 70:10:07:32Z, 48.3 seconds, Delta V 11.2 fps, orbit 325 by 315.5 nm.  
- Last flight of Block IIA Engines.

### TAL Weather, Ascent I-loads, Firsts, Significant Anomalies, etc.

- Standard Set Plus PE Operational High Q, WINFEB
**Brief Mission Summary:** The STS-110/8A (13th mission to ISS) was the most complex ISS assembly flight to date with four EVA’s and extensive use of Shuttle and ISS robotic arms. The EVA included successful beam assemblies, bolting of ISS truss sections, and installing work lights and electrical connections. The ISS Canadarm2 transferred the 13.5-ton, 43-foot long S0 Truss (ISS backbone) from Shuttle payload bay for installation on U.S. Lab, Destiny. Also, the first railcar was operated on the new truss, paving the way for eventual transportation for the Canadarm2 along the length of the ISS.

KSC-WD: OPF 132, VAB 6, PAD 28 = 166 days total.

**LAUNCH POSTPONEMENTS:**
- Baseline launch date of 1/17/02 on 11/15/00.
- Postponed launch date to 2/28/02 on 5/4/01 and Postponed launch date to 3/21/02 on 10/4/01.
- Postponed launch date to 4/4/02 on 1/10/02 due to ground processing delays requiring OMS Pod removal.

**LAUNCH SCRUBS:**
- Scrubbed 4/4/02 Launch at approximately 8 hours later, due to H2 leak in MLP 3 Hydrogen Vent Line which is fed by Orbiter Hi-Point Bleed line. The leak was found to be from a 1/8 in wide crack in a weld location in the 16-inch double walled aluminum line. Weld is more than 20 years old. Decision was made to repair using a clam-shell technique. New launch date was set for Monday, 4/8/02. Line was repaired using a two-piece clam-shell that was welded to the 16-inch outer line.

- Day-of-Launch Delay was 4M48S. LPS system detected consecutive sync errors in all three Stand-by PCM FEP’s (OI, GPC, PLD). The count was held at T-5 Min for 4M48S to execute Front End Processor resynchronization procedure which was successfully completed. Came out of the T-5 Min hold, and picked up the count at 98:20:39:19Z (4:39:19 PM EDT) with 11 seconds remaining in the Launch Window at Liftoff. Only 11 seconds remained in the Launch Window at Liftoff.

**LAUNCH WINDOW:**
- The Launch Window opened at 98:20:34:32Z and closed at 98:20:44:32Z for a total window of 9966S. Using a Preferred Launch Time (In-Plane Time) of 98:20:35:32Z, the Launch Window was 4966S.

**LAUNCH DELAYS:**
- Day-of-Launch Delay was 4966S. LPS system detected consecutive sync errors in all three Stand-by PCM FEP’s (OI, GPC, PLD). The count was held at T-5 Min for 4966S to execute Front End Processor resynchronization procedure which was successfully completed. Came out of the T-5 Min hold, and picked up the count at 98:20:34:19Z (4:34:19 PM EDT) with 591S remaining to Launch Window closure. Launched occurred at 98:20:44:19Z, 4:44:19 PM EDT, on Monday, April 8, 2002.

**STTS110-341-002 (11 April 2002) ---
Canadarm2, operated by Ochoa & Bursch, moves S0 truss from Atlantis to temp location on ISS Destiny Lab.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-110/ISS 8A

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
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<th>FLYTIME ORBIT, CROSSRANGE</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, WEATHER, ASCENT I-LOADS, TAL WEATHER, ASI)</th>
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**Mission Highlights**

- **Pre-Launch Scrub of 4/4/02 Launch due to Hydrogen Leak in MLP-3 16-inch Hydrogen Vent Line.**
  - Sync errors on LPS RF TLM FEP reflash required at L-9M115 (Launched occurred with 11 seconds in window.)
  - MED'S IDP-2 MSU BITE and FCE Buffer Overflow Error
  - Primary RCS Thruster L1A Failed Off and was auto-deslected (Chamber P Max 20 psia)
  - Low Chamber Pressure on Primary RCS Thruster F10 (Ps = 63-65 psia)
  - Lack of Digital Video from PD100 Canmoder to DTV MUX
  - ICCOM Problem with BPSMU
  - CCS Upper Hatch Delta Pressure Gauge Bias
  - Loss of Biomed Data during EV-2
  - Payload Bay Floodlight Failure
  - Problems with Prosharea Audio and Video during PMC
  - Window 2 impact

**Significant Anomalies**

- Sync errors on LPS RF TLM FEP reflash required at L-9M115 (Launched occurred with 11 seconds in window.)
- MED'S IDP-2 MSU BITE and FCE Buffer Overflow Error
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- Problems with Prosharea Audio and Video during PMC
- Window 2 impact

**Events**

- **Abort Times**
  - Launch scrub of 4/4/02 due to hydrogen leak in MLP-3 16-inch hydrogen vent line.
- **Flights and Missions**
  - STS-110/8A
  - ISS 8A

**Payload**

- **Payloads/Experiments**
  - **FSW**
    - OI-39: First flight with all three Block II SSME's.
    - First flight of FSW OI-29.
    - First operation availability of delayed TAL.
  - **Payload Bay**
    - First flight with all three Block II SSME's.
    - First flight of FSW OI-29.
    - First operation availability of delayed TAL.
  - **Payload Bay**
    - First flight with all three Block II SSME's.
    - First flight of FSW OI-29.
    - First operation availability of delayed TAL.

**Miscellaneous**

- **ISS Configuration**
  - **ISS Destiny Lab**
  - **ISS Configuration**
    - **ISS Destiny Lab**
Brief Mission Summary: The STS-111/UF-2 (14th ISS mission) provided a new crew to the ISS, transfer of supplies and equipment via the Leonardo MPLM, and three EVA’s for ISS assembly. The Shuttle RMS was used to successfully install the Mobile Remote Service Base System to the Mobile Transporter on the Destiny Lab. This allows the Canadian RMS to travel the length of the ISS for future construction tasks.

KSC WD: OPF 92, VAB 7, PAD 33 + 132 days total.

LAUNCH POSTPERATIONS:
- Launch was scheduled for 5/2/02.
- Postponed launch to 5/31/02 to the end of a Beta Cutout and allow time to train EVA 6 and low power systems.
- Advanced launch to 5/30/02 after analysis indicated adequate power generation using an ISS Pitch attitude bias.

LAUNCH POSTPERATIONS:
- Scrubbed Thursday 5/30/02 Launch at L-24M53S due to opaque anvils within 30 nm circle while holding at T-9 minutes. PLT was 7:44:26 PM EDT with a window of 4M9S. Lightning was present within 5 nm.
- Launch forecast was for attached SRB STG.
- Decided to hold a tanking MMT on Friday, May 31, where it was decided not to tank. Forecast included thunderstorms, anvil clouds, and/or high winds.
- Continued…

ISS004-E-13246 (7 June 2002) --- Endeavour approaches ISS with Leonardo (MPLM) supplies.
<table>
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<th>FLT</th>
<th>ORBITER</th>
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<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABBORT TIMES</th>
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**FLIGHT DURATION:**
- Total: 13 days (13:20:34:53)
- OMS-2:
  - 38:42 38:45 98 FPS 95 FPS

**NOM-ABORT EMERG:**
- SSME-TL: 38:42 98 FPS 95 FPS
- OMS-2: 38:45 98 FPS 95 FPS

**DURATION:**
- SS EVA 81: 7:14
- DOCKED QUEST EVA 6: 5:00
- DOCKED QUEST EVA 7: 7:17

**FIRSTS:**
- First use of orbiter oxygen for EVA pre-breathe for astronauts in ISS Joint Airlock.

**LAUNCH WINDOW:**

**LAUNCH DELAYS:**
- None

**TAL WX:**
- Zaragoza (Prime) was forecast and observed NO GO for precipitation. Ben Guerir was forecast and observed NO GO for Head Winds of 27 Knots. Moron (Selected) was forecast and observed GO.

**PERFORMANCE ENHANCEMENTS:**
- Standard Set plus: (1) PE Operational High Q TRN/MAY, (2) OMS Assist, (3) 52 NM MECO, (4) Del Psi

**FLIGHT DURATION CHANGES:**
- Total Extensions: 2 Days Plus 2 Revs. Planned landing at KSC on Orbit 186 at 12:59 PM EDT on June 17, 2002. Did not call up EDW. Closed PLBD's but did not fluid load crew. Waved off Orbit 186 due to forecast ceiling, precipitation, crosswinds, and thunderstorms and observed precipitation, thunderstorms within 20 nm, ceiling 2600 broken and visibility violations. Waved off landing at KSC on Orbit 187 with similar forecast and observed at landing time. Extended one day. Brought up EDW for ECM+1. Waved off landing at KSC on Orbit 201 due to forecast ceiling, precipitation, and thunderstorms. Observed ceiling, precipitation, thunderstorms, and visibility violations. Waved off Orbit 202 due to similar forecasts and observations. Extended the second day.

**FIRSTS:**
- First use of orbiter oxygen for EVA pre-breathe for astronauts in ISS Joint Airlock.
**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-111/ISS UF-2**

**EVENTS:**
- MDA Maneuver Start at 158:15:16:16Z, 1:127:53:26 MET, 1.2 ft/sec, altitude 203.3 by 211.9 nm.
- ISS Capture at 158:16:24Z, 1:19:01 MET.
- Expedition 4 ISS Habitant Time is 181:00:43.
- MPLM installed on Node 1 by RMS at 159:14:28Z, 2:17:05 MET.
- Photographed failed ISS CMG-1.
- Reboost Maneuver 1 Start at 161:20:53:24Z, 4:23:30:35 MET, Delta V 3.0 fps, 0.8 nm altitude increase, altitude 212 by 205 nm.
- EVA 2 Start at 162:15:19Z, 5:17:58 MET, duration 5:00, final installation of MBS to MT (Connected video and data cables), attached bag with contingency extension cable to MBS.
- Reboost Maneuver 2 Start at 163:12:08:02Z, 6:15:45:13 MET, Delta V 3.0 fps, altitude increase .81 nm, orbit 212.8 by 206.2 nm.
- Reboost Maneuver 3 Start at 165:11:51:26Z, 6:14:28:37 MET, Delta V 12.5 fps, altitude increase 3.6 nm, orbit 214.4 by 211.1 nm.
- Transfers from shuttle to ISS = 9512 lbs (from MPLM = 8062 lbs and from middeck = 1450 lbs). Transfers from ISS to Shuttle = 6342 lbs (to MPLM = 4668 lbs and to middeck = 1675 lbs). Consumables transfer: Total water = 884.9 lbm (8 CWC’s with 798.9 and 4 PWR’s with 86.0 lbm). Total shuttle O2 transferred = 34 lbm for the 3 EVA prebreathes in JAL, N2 tank transfer of 18.9 lbm.
- Undocked at 166:14:31Z, 9:17:08 MET.
- STS-111/ISS Visitor Time is 7:31:04:28 (Docking to Undocking).
- Expedition 4 ISS Habitant Time is 181:00:43:00 (IELK S/L Xfer to IELK S/L Xfer), Expedition 4 broke U.S. Flight Time record, flight time is 195:19:38:14 (STS-108 LO to STS-111 MLGTD).
- Carl Walz record total flight time is 230:13:02:44. Dan Bursch.
- Sep Burn 166:16:16Z, 9:18:36 MET.
- STS-111/ISS Visitor Time is 7:31:04:28 (Docking to Undocking).
- Expedition 4 ISS Habitant Time is 181:00:43:00 (IELK S/L Xfer to IELK S/L Xfer), Expedition 4 broke U.S. Flight Time record, flight time is 195:19:38:14 (STS-108 LO to STS-111 MLGTD).
- Carl Walz record total flight time is 230:13:02:44. Dan Bursch.
- Sep Burn 166:16:14:27Z, 9:18:36 MET.
- Orbit Adjust Maneuver at 166:17:57:48Z, 9:20:34:59 MET, Delta V 4.65 fps, orbit was 185.1 by 211.9 nm.
- Rendezvous # 59. Rendezvous and Dock with ISS (Dock to PM2 Lab Forward Port).

**SIGNIFICANT ANOMALIES:**
- Right Main Engine High Pressure Fuel Pump Speed Sensor Failure
- FUSE Evaporator Controller Primary B failure
- WIF Adapter Hitch Pin Anomaly
- EV2 Boot Fit Problems during EVA 1
- EVA Communications Anomaly on STS-111 EVA 3
- AVU-Camcorder Failed
- BPSMU/AVU/COM Data causes Video to Flicker
- LL QUAD Reflected Power Spikes
- Loss of BIOMED Data on EVA 1

**MISSON HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

STS111-E-5238 (11 June 2002) --- Perrin/MS1 (France) installs the Mobile Remote Servicer Base System (MBS) on the ISS railcar.

JSC2002-E-23100 --- Flight Directors Steve Stich (right foreground) and John Shannon; along with astronauts William A. Oefelein and Kenneth T. Ham, spacecraft communicators (CAPCOM), watch the large MOCR screens.

JSC2002-E-23106 --- J. Milton (Milt) Heflin (standing), Chief, Flight Director’s Office, along with Dan Carpenter (background), Director, Public Affairs Office, and Rob Navias, lead STS-111 PAO commentator, discuss mission in JSC MCC WFCR.

**FLT** | **ORBITER** | **CREW 7 UP/7 DOWN** | **LAUNCH SITE, LIFTOFF TIME, CROSSRANGE** | **LANDING SITE, ABORT TIMES** | **LANDING TIMES, FLT DURATION, WINDS** | **THROTTLE PROFILE ENG. S.N.** | **SRB** | **RSRM** | **INC** | **HA/HP** | **MISSION HIGHLIGHTS** | **PAYLOADS/PRODUCTS**
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**NO.** | **TITLE, NAMES & EVAS** | **LAUNCH SITE, LIFTOFF TIME, CROSSRANGE** | **LANDING TIMES, FLT DURATION, WINDS** | **THROTTLE PROFILE ENG. S.N.** | **SRB** | **RSRM** | **INC** | **HA/HP** | **MISSION HIGHLIGHTS** | **PAYLOADS/PRODUCTS**
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**STS-111/ISS UF-2**

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<th>FLIGHT</th>
<th>ORBITER</th>
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STS112_ECTAM_Typical — Typical view during ascent from first ET Shuttle Observation Camera. (Courtesy MSFC ET Project Office)
**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-112/ ISS 9A**

---

**FLT DURATION:**
- **10:19:57.50**
- **ST:** 1001:18:46:44
- **OV-104:** 219:21:26:00
- **DISTANCE:** 4,513,015 sm

---

**LAUNCH WINDOW:**
- Launch window opened at 280:19:40:51Z and closed at 280:19:50:50Z for a total launch window of 9m59s. In-plane time was 280:19:45:51Z for a launch window of 4m59s.

**LAUNCH DELAYS:**
- None

**LAUNCH DELAY TIMES:**

**TAL WX:**
- Zaragoza (prime and selected) and Moron (2-Eng TAL Call) were forecast and observed GO. Moron earlier forecast was NO GO for showers and anvils. Ben Guerir was not available.

**PERFORMANCE ENHANCEMENTS:**
- Standard Set plus: (1) PE Operational High Q TRN/OCT, (2) OMS Assist, (3) 52 NM MECO, (4) Del Psi

**FLIGHT DURATION CHANGES:**
- None


**FIRSTS/LASTS:**
- First use of ET Shuttle Observation Camera during ascent.

**EVENTS:**
- **MC4 Start at 282:14:18:46Z, 3.2 fps, orbit 200.4 by 213.6 nm.**
- **ISS Capture at MET 1:19:30:19, 282:15:16:10Z.**
- **Hard dock to PMA2 Lab Fwd Port complete at 1:19:44:06 MET, 282:15:29:57Z.**
- **EVA 1 (JAL) Start at 283:15:21Z, 2:19:35 MET End at 283:22:22Z, duration 7h01m.**
- **Released CETA cart launch locks. Connected Zenith side power umbilicals and deployed S-Band Antenna. Installed S1 nadir ETVCG.**
- **EVA 2 (JAL) Start at 285:14:30Z, 4:18:44 MET, End at 285:20:34Z, 05:00:48 MET, duration 6h04m.**
- **Installed Z1/P6, Z1/Lab and RBVM SPD's. Connected ATA Umbilicals. Installed Lab ETVCG. **
- **ZCG Activation.**

---

**BELOW:**
- **STS112-331-031 -- The EXP 5 & STS-112 crews in Destiny Lab on ISS. From left, front row EXP 5 crew: Peggy A. Whitson/FE, Valery G. Korzun/CDR(RSA), & Sergei Y. Treschev/FE(RSA).**
- **From left, back row STS-112 crew: Wolf/MS, Magnus/MS, Melroy/PLT, Ashby/CDR, Sellers/MS, and Yurchikhin/MS(RSA).**

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**STS112-326-033 --- Wolf (left) & Sellers during 2nd EVA. Wolf is anchored to a foot restraint on ISS’s Canadarm2 while Sellers traverses along the airlock spur.**

---

**ISS005-E-16524 --- Atlantis on approach to ISS for rendezvous and docking operations to deliver the 15 ton S1 Truss.**

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**STS112-709-033 (12 October 2002) --- Newly installed Starboard S1 Truss and Canadarm2.**

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**STT112-326-033 --- Wolf (left) & Sellers during 2nd EVA. Wolf is anchored to a foot restraint on ISS’s Canadarm2 while Sellers traverses along the airlock spur.**

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**Continued...**

**Continued...**

**Continued...**

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**MISSION HIGHLIGHTS (LAUNCH DELAYS/STALLS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**

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**TAL WEATHER, ASCENT LOADS, EVENTS:**
- First use of ET Shuttle Observation Camera during ascent.

---

**EVENTS:**
- MD4 Start at 262:14:18:46Z, 3.2 fps, orbit 200.4 by 213.6 nm.
- ISS Capture at MET 1:19:30:19, 262:15:16:10Z.
- Hard dock to PMA2 Lab Fwd Port complete at 1:19:44:06 MET, 262:15:29:57Z.
- EVA 1 (JAL) Start at 263:15:21Z, 2:19:35 MET End at 263:22:22Z, 3:02:36 MET, duration 7h01m. (Attached S1 to S0 Truss using SSRMS, Released CETA cart launch locks, Connected Zenith side power umbilicals and deployed S-Band Antenna. Installed S1 nadir ETVCG.)
- EVA 2 (JAL) Start at 285:14:30Z, 4:18:44 MET, End at 285:20:34Z, 05:00:48 MET, duration 6h04m. (Installed Z1/P6, Z1/Lab and RBVM SPD’s. Connected ATA Umbilicals. Installed Lab ETVCG. ZCG Activation.)
Continued…

- Second Reboost maneuver (c3) start at 287:11:20:50Z, 6:15:34:59Z MET, delta V = 6.9 fps, altitude increase 1.96 nm, orbit 219.4 by 203.3 nm.

- Total cargo transfers from Orbiter to ISS = 29120 lbm (S1 Segment = 27676 lbm), Total cargo transfers from ISS to Orbiter = 1351 lbm Consumables Transfer:  H₂O Total = 1658.1 lbm (16 CWC's with 1603.7 lbm and 3 PMW's with 54.4 lbm).  Total N₂ (Tank) = 68.2 lbm.
- Total O₂ = 60 lbm (Pre-Breathe: EVA 1 = 10 lbm, EVA 2 = 10 lbm, EVA 3 = 10 lbm, Tank Transfer= 28 lbm).

- Post-undocking initial separation maneuver began at 289:13:13Z.  ISS flyaround terminated at 289:14:30Z, 8:18:44 MET.
- Final Separation at 289:15:00Z, 8:19:14 MET, delta V= 5.5 fps, resulting Orbit = 200.8 nm by 219.9 nm.

- Orbit Adjust Maneuver at 290:20:26:51Z, 10:00:41:00 MET, delta V = 93.9 fps, Orbit 146.6 nm by 219.9 nm - Note:  At 291:08:35Z, using Progress engines, raised the ISS 6.9 miles.

RENDZEVOUS # 6:
- Rendezvous and Dock with ISS (Dock to PMA2 Lab Front Port)

SIGNIFICANT ANOMALIES:
- Piece of debris impacted ETA ring near IEA box on LH SRB at 33 seconds.
- Insulating foam was lost on ET-115 left bipod ramp (approx 4" X 5" X12") exposing bipod housing SLA closeout.
- Primary Thruster L4D failed off due to low chamber pressure (IFA STS-112-V-01).
- Panel F7 SM Alert Light Brightness
- Supply Water Crossover Valve Circuit Breaker did not indicate Open
- System A Pyros for SRB Holddown Posts and ET Vent Arm Systems did not fire at T-0 (IFA STS-112-K-01).
- EVA Glove Wrist Tether Point Torr
- RPOP PGSC (STS-5) Network Problem
- Emergency Egress Net Daisy Wheel Knob broke
- PCS 1 CO Supply Pressure Indication failed OSH
- MADS recorder “stuck” at beginning of tape (tape came off reel)
- Forward RCS Primary Thruster 13F Failed On Heater
- ICOM-A from Shuttle to Station not operating
- Handheld Microphone failed
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, DURATION, LANDINGS</th>
<th>SRB</th>
<th>ORBIT</th>
<th>PAYLOAD/EXPERIMENTS</th>
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<td>STS-113</td>
<td>ISS 11A</td>
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**MISSON HIGHLIGHTS**

- **Brief Mission Summary:** STS-113 was the 16th American assembly mission to the ISS. The primary goals achieved on this mission were to transport the EXP 6 crew to the ISS and return the EXP 5 crew to earth after 5 months in space and to install the Port (P1) Integrated Truss Assembly. The 45-ft long 14-ton P1 truss is the opposite side mate to the Starboard S1 truss delivered on STS-112. It is the 4th of 11 truss structures that ultimately will extend the ISS length to that of a football field. The P1 truss contains the Active Thermal Control System (to be activated later), a second UHF comm system, a second CETA cart, and a Thermal Radiator Rotary Joint (TRJ).

- **Launch Postponements:**
  - Launch was postponed from July after Post-STS-110 visual inspections of OV-104 Inconel 12" NFS L2 Flowliners revealed three cracks to SSME 2. Subsequent inspections found cracks in other orbiter LH2 Flowliners:
    - OV-103 - three cracks (SSME 1)
    - OV-105 - one crack (SSME 1) and one crack (SSME 2)
  - At FRR, STS-113 Launch was postponed 1 day to November 7, 2002 EST at 11:56 PM (311:04:56Z).

- **Gary C. Dillinger**
  - As a result, STS-113 and STS-112 moved ahead of STS-107.
  - Scrubbed Monday, November 18. Inspection/troubleshooting found a blowing leak in PCS 2 O2 and N2 flex hoses. During preparation to get access to PCS 2 O2 line under PLB liner, an Access Platform came in contact with the RMS damaging the TPS, Kevlar honeycomb with minor delamination to composite boom. Tests and analyses proved it is OK to fly-as-is. On November 20, set launch date to 11/22/02. Technical Scrub.

- **Kenneth D. Bowersox**
  - Scrubbed 11/22/02 launch planned for 8:15:30 PM EST at L-8 minutes due to unstable weather at ZZA and MRN. Early forecasts were showers within 20nm at Zaragoza and occasional overcast 1500 feet and showers at MRN. At L-1 hour, Moron weather had improved and FD updated TAL to Moron. However, both TAL sites were forecast and observed NO GO at the L-8 minute scrub time and at TAL landing times. TAL weather Scrub.

- **Valery C. Korzun**
  - Scrubbed Monday, November 7 Launch at approximately L-3 hours due to an O2 leak in PCS 2 between ECLSS Supply Valve and 576 Bulkhead. Leak was first noticed when Haz Gas Detection System indicated an O2 concentration of approximately 150 ppm in the Mid-Body. Troubleshooting procedures isolated the leak to PCS 2 outside the cabin between ECLSS O2 Supply Valve and Crew Module 576 bulkhead. Launch date set to NET Monday, November 18. Inspection/troubleshooting found a blowing leak in PCS 2 O2 flex hose near the 576 bulkhead. Replaced PCS 2 O2 and N2 flex hoses. During preparation to get access to PCS 2 O2 line under PLB liner, an Access Platform came in contact with the RMS damaging the TPS, Keval honeycomb with minor delamination to composite boom. Tests and analyses proved it is OK to fly-as-is. On November 20, set launch date to 11/22/02. Technical Scrub.

- **Ben Gurerir**
  - Scrubbed 11/22/02 launch planned for 8:15:30 PM EST at L-8 minutes due to unstable weather at ZZA and MRN. Early forecasts were showers within 20nm at Zaragoza and occasional overcast 1500 feet and showers at MRN. At L-1 hour, Moron weather had improved and FD updated TAL to Moron. However, both TAL sites were forecast and observed NO GO at the L-8 minute scrub time and at TAL landing times. TAL weather Scrub. Ben Guerir was not available as a TAL site; however, Ben Guerir continued on as a backup TAL site.
--- THREE UP (EXP 6) THREE DOWN (EXP 5) ---

STS113-E-05230 (29 November 2002) --- The STS-113 (red shirts), Expedition Five (right) and Expedition Six crewmembers (left) gathered for a group photo in the Destiny laboratory on the ISS. The STS-113 crew, front to back, are astronauts James D. Wetherbee, Mission Commander; John B. Herrington (left), Michael E. Lopez-Alegria, Mission Specialists; and Paul S. Lockhart, Pilot. The Expedition Six crew, front to back, are astronauts Kenneth D. Bowersox, Commander; Donald R. Pettit, NASA ISS Science Officer; and cosmonaut Nikolai M. Budarin, Flight Engineer. The Expedition Five crew, front to back, are cosmonauts Valery G. Korzun, Commander; astronaut Peggy A. Whitson, NASA ISS Science Officer; and cosmonaut Sergei Y. Treschev, Flight Engineer. Korzun, Treschev, and Budarin represent Rosaviakosmos.
STS-113/ISS 11A

Continued...

RENDZVOUS #61:
- Rendezvous and Dock with ISS (PMA2 Lab Fwd Port).

SHUTTLE NIGHT LAUNCH #28:

EVENTS:
- NC1 maneuver at 328:03:42:05Z (02:52:28 MET) resultant altitude of 170.2 by 186.7 nm.
- MC4 maneuver at 329:20:27Z (01:19:37 MET) resultant altitude 203.3 by 215.5 nm.
- IELK S/L Transfer (Official transfer of ISS from Expedition 5 Crew to Expedition 6 Crew) at 330:02:28Z (02:01:39:13 MET).
- SRMS unberth of P1 ITS at 330:15:19:51Z (02:14:30 MET) and positioned P1 over orbiter Port Wing for handoff to SSRMS. (Thereafter SRMS camera was used only for video support of EVA activities.)
- SSRMS used to mate P1 ITS to S0 truss at 330:18:50:14Z (02:18:00:27 MET).
- EVA 1 Start at 330:19:48Z (02:18:57 MET), EVA 1 End at 331:02:33Z (03:01:43 MET) on November 26, 2002, duration 6H45M.
- All three EVAs used Pre-Breathe Protocol while exercising on Shuttle Ergometer located in mid-deck.
- Made connections between P1 and S0 Trusses. Released launch restraints on CETA Cart, DLA, and TARJ Stinger, installed Node 1 WETA.
- Reboost 1 at 331:17:10:47Z (03:16:21 MET), delta V + 2.4 fps, altitude increase 2.4 nm, altitude 216 by 207 nm.
- EVA 2 Start at 332:18:36Z (04:17:46 MET), EVA 2 End at 333:00:47Z (04:23:57 MET) on November 28, 2002, duration 6H10M.
- Installed fluid jumpers between P1 & S0. Removed P1 Port & Stbd keel pins. Installed WVS TX Assy on P1.
- Relocated CETA Cart from P1 to S1. Released P1/P3 line clamps. Removed & stowed Radiator beam launch locks.
- Reboost 2 at 333:16:50:59Z (05:16:01:12 MET), delta V = 2.56 fps, altitude increase 0.7 nm, altitude 216 by 209 nm.
- EVA 3 Start at 334:19:24Z (06:18:34 MET) and End at 335:02:24Z (07:01:34 MET) on November 30, 2002, duration 7H00M.
- Installed Z1/P6/Lab, Lab HX, and P1 RBVM SPD's. Reconfigured electrical harnesses, route power through Main Bus switching units.
- Reboost 3 at 335:16:36:47Z (07:15:49 MET), delta V = 8.6 fps, altitude increase 2.4 nm, final orbit 216.6 by 211.4 nm.

SIGNIFICANT ANOMALIES:
- Right OMS Engine Bi-Propellant Valve 2 position indicator indicated 95 percent Open at start of OMS Assist Burn and continued to indicate 95 percent Open after burn (IFA STS-113-V-02).
- S-Band Power Amplifier 2 power output low (IFA STS-113-V-03).
- PGSG for RPOP RS 422 cable bad - Film review indicates very small engine 1 coldwall nozzle fuel leak, no performance impact.
- Right OMS Engine Bi-Propellant Valve 2 position indicator indicated 95 percent Open at start of OMS Assist Burn and continued to indicate 95 percent Open after burn (IFA STS-113-V-02).
- S-Band Power Amplifier 2 power output low (IFA STS-113-V-03).
- PGSG for RPOP RS 422 cable bad - Film review indicates very small engine 1 coldwall nozzle fuel leak, no performance impact.

STS113-E-05433 (2 December 2002) --- The ISS post undocking of Endeavour as the two spacecraft flew over northwestern Australia. The newly installed Port One (P1) truss now complements the Starboard One (S1) truss in center frame.

STS113-714-039 --- John B. Herrington (left) and Michael E. Lopez-Alegria, work on the newly installed Port One (P1) truss.

JSC2002-01994 --- The Ascent/Entry FCT pose for group portrait in the shuttle flight control room (WFCR) in Houston’s MCC. Ascent/Entry Flight Director Wayne Hale is in center front row.
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-107

**NO.** | **ORBITER** | **CREW (7)** | **LAUNCH SITE, LIFTOFF TIME** | **LANDING SITES, ABORT TIMES** | **LANDING TIMES** | **SSME-TL ENG. MRR** | **SRB RSMM** | **ORBIT** | **PAYLOADS/EIXPERIMENTS** | **MISSION HIGHLIGHTS**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
STS-107 | OV-102 (Flight 29) | MCC WHITE FCR (43) | KSC 39A | 16:15:39:00Z | 104/104/109% | 103/104:57:22/42:45 | BI-116 | 39.0 | DIRECT INSERTION | Post OMS-2: 195 x 147 NM
SEQ FLT #113 | Columbia | FLIGHT DURATION: 15:22:20:32 | KSC 39A | 10:39:00 AM EST (P) | 2053 (5) 3 = 2049 (7) | TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)
PAD 39A-40 | FPS 1: | 302:05:40 | 756 | 749 | X CG: 1077.87 | 234,616 LBS |
EDO FLT 15 | (Flight 28) | PERF NOMINAL | MAX Q NAV | 103/104:57:22/42:45 | X CG: 1078.53 | Performance: 3047
SH RDM 1 | M/S 4: | 2.07 | 9 CRYO TK SETS | 103/104:57:22/42:45 | 25762 FPS |
MCC WHITE FCR (43) | FPS 4: | 2.50 | 5 GN2 TANKS | 103/104:57:22/42:45 | RECON: 1348 |
Crew: P. L. Engelauf | FPS 2: | 3.52 | NO RMS | 103/104:57:22/42:45 | Payloads: 9 CN2 TK SETS (EDO PALLETS)
LOAD 2 - K. B. Beck | FPS 3: | 5.14 | FREESTAR | 103/104:57:22/42:45 | FUEL: 1112 |
C 3 - B. P. Austin | SE OPS 3: | 5.25 | FREESTAR | 103/104:57:22/42:45 | FUEL: 1112 |
O 4 - J. M. Hanley | PtM (US 242): | 6.05 | FREESTAR | 103/104:57:22/42:45 | FUEL: 1112 |
A/E - L. E. Cain | SE TAL (ZZA): | 6.05 | FREESTAR | 103/104:57:22/42:45 | FUEL: 1112 |
**IN MEMORIAM -- See next page.**

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Brief Mission Summary: The STS-107 crew carried out a 16-day mission dedicated to a mix of life and physical sciences on board the first SPACEHAB Research Double Module (RDM). The crew of seven included the first Israeli astronaut. During descent for landing at KSC at an altitude of 203,000 feet over north central Texas, a breach in the TPS on Columbia's left wing resulted in loss of vehicle and crew. Communications with the crew were lost at 9 AM EST, Saturday, Feb. 1, 2001. Second loss of vehicle and crew in Shuttle program.

**LAUNCH POSTPONEMENTS:**
- Baseline launch date of 1/11/01 on 11/10/98.
- Postponed launch date to 2/22/01 on 3/3/00.
- Postponed launch date to 4/15/01.
- Others(?), then 5/2/03, moved after STS-112 and STS-113 (Priority flights to HST and ISS flights that had been ppd. due to flow-liner cracks.)
- Postponed launch date to 1/16/03.

**LAUNCH DELAYS:**
- First flight of Space Shuttle in CY 2003.
- First flight of Israeli Astronaut - Ilan Ramon

**TAL WX:**
- Mission was on time and selected. Both Moron and Zanagouza were forecast and observed GO.

**PERFORMANCE ENHANCEMENTS:**
- Standard Set plus: PE Operational High Q (WIN/JAN) and OMS Assist.

**FIRSTS/LASTS:**
- First flight of Space Shuttle in CY 2003.
- First flight of Shuttle/RDM (Research Double Module) with more than 80 Experiments. Science: Biological, Physiological & Countermeasures, Physical Sciences, Earth and Space Science, Space & Technology Development.
- First EDO Pallet Flight since STS-90 (April 17, 1998)
- First flight of Israeli Astronaut - Ilan Ramon

**FLIGHT DURATION CHANGES:**
- Planned landing at KSC on orbit 256 (TIG orbit 255) on Saturday, February 1, 2003. Deorbit maneuver was initiated at 32:14:15:02Z, 9:15:02 AM EST.
- Orbiter weight and Xcg at entry interface was 234,495 lbm, Xcg was 1078.53.
- Orbiter weight and Xcg at entry interface plus 15 minutes 234,167 lbm, Xcg was 1077.67.
- Flight controllers reported increased temperatures on some sensors and some failed sensors in left wing area. Off-nominal indications started at approximately 32:13:52:17Z. Columbus contact loss (Loss-of-Signal) occurred at 32:13:59:32Z, 8:59:32 AM EST (15:22:20:32 MET), 16 minutes prior to planned landing

Continued...
CAIB REPORT:
Accident Analysis indicated that the physical cause of the loss of Columbia and its crew was a breach in the Thermal Protection System on the leading edge of the left wing. The breach was initiated by a piece of insulating foam that separated from the left bipod ramp area of the External Tank and struck the wing in the vicinity of the lower half of Reinforced Carbon-Carbon panel 8 at 81.9 seconds after launch. During re-entry, this breach in the Thermal Protection System allowed superheated air to penetrate the leading-edge insulation and progressively melt the aluminum structure of the left wing, resulting in a weakening of the structure until increasing aerodynamic forces caused loss of control, failure of the left wing, and breakup of the Orbiter.

IN MEMORIAM

The STS 107 crew is shown on-orbit in SPACEHAB research module aboard Columbia. From left (bottom row) wearing red shirts to signify their work shift color, are Kalpana Chawla/MS2, CDR Rick D. Husband, Laurel B. Clark/MS4, and Ilan Ramon/PS1 (Israel). From left (top row), wearing blue shirts, are David C. Brown/MS1, PLT William C. McCool, and Michael P. Anderson/PL-CDR.

STT-107 EVENTS:
- Orbital Altitude was 150 nm.
- STS-107 FLIGHT OBJECTIVES/EXPERIMENTS:
  - Primary payload is SPACEHAB Research Double Module (SHRDM) with International, NASA and SPACEHAB commercial payloads including Life Sciences, Materials, and Microgravity Science Research Experiments.
  - Fast Reacting Experiments Enabling Science, Technology, Applications and Research (FREESTAR) is a complex Secondary Payload which is a cross bay carrier with following payloads: MEIDEX (Mediterranean Israeli Dust Experiment), Solar Constant-3 (SOLCON-3), Shuttle Ozone Limb Sounding Experiment-2 (SOLSE-2), Critical Viscosity of Xenon-2 (CVX-2), Low Power Transceiver (LPT), and Space Experiment Module-14 (SEM-14).
  - Ram Burn Observation (RAMBO)

SIGNIFICANT ANOMALIES:
- ET Foam loss during ascent at approximately 81 seconds (likely from Bi-pod area) (IFA). Re-design constraint to flight.
- RSRM Nozzle Flex Boot Separation (IFA). Constraint to flight.
- O2 Tank 7 Heater failed off in Manual Mode (IFA STS-107-V-02)
- Suspected Fuel Cell Monitoring System Data Cable problem.
- SM I/O Errors on IP Bus
- 70 mm Hasselblad Intermittent Motor Drive (Binds or jams)
- Payload No I-COM B Transmission in Spacehab (Not being heard in Spacehab)
- Spacehab water loop Degradation (Flow rates decreasing)
- Payload Ku Channel 2 Data Dropouts (Ku-Band and S-Band)
- AC2 Phase B “Sluggish” Current Signature on Orbiter (IFA STS-107-V-01)
- Forward DAP Auto A Contact Desilled by RM
- Spacehab Rotary Separator flooding short
- Loss of Columbus and crew during Entry - IFA STS-107-V-03

By Mike Leinbach/Launch Director & Amy Simpson/KSC PH-2, May 2010

KSC-2010-4452 (http://mediaarchive.ksc.nasa.gov/index.cfm). This Tribute Display features Columbia, the “first of the fleet”, rising above earth at the dawn of the Space Shuttle Program. Crew-designed patches for each of Columbia’s missions lead from earth toward our remembrance of the STS-107 crew. In the background are images from the Chandra X-Ray Observatory (launched aboard STS-93) representing Columbia’s contributions toward scientific discovery. Other significant accomplishments include the first space shuttle landing at White Sands with STS-3, first deployment of commercial satellites during STS-5, first four-member crew on STS-5, first Spacelab mission and first six-member crew on STS-9, first female mission commander (Eileen Collins) on STS-93, as well as multiple laboratory missions—many with international partnership. (May 2010)
Brief Mission Summary: With STS-114/LF-1 (17th ISS Mission), NASA initiated Return to Flight 2 years after the Columbia accident. The crew was charged with a busy to-do list that included testing new safety techniques and delivering much-needed supplies to ISS.

KSC/WD: OFF 9:44, VAB 25, PAD 85 = 1104 days total

LAUNCH POSTPONEMENT:
- Baseline OV-114 Atlantis as LUF-1 Crew Rotation flight with launch date of 1/16/03 on 1/16/03.
- Postponed launch date to NET 3/1/03 on 9/16/02. Postponement caused by Engine Flowline cracks.
- Subsequent postponements after STS-107 Accident to NET 7/21/03, NET 10/16/03, NET 12/16/03, NET 9/12/04.
- Postponed launch date to NET 9/16/05 on 7/21/05. Changed flight to ISS Logistics Flight L1, canceled crew rotation, and changed orbiters to Discovery OV-113.

- Tanking Test 1 on 4/24/05 experienced two intermittent LH2 ECO anomalies. (ECO sensors #3 & #4 failed WET. Replaced MFS Point Sensor Box (PSB) and all Sensor #3 & #4 wiring to LH2 monoball. Subsequent to completion of this work, the Tanking Test #2 LH Sensor performance was normal.
- Postponed launch date to NET 9/12/05, 5/15/05, 5/22/05, 7/13/05. Rolled back from pad 30B to VAB on 5/22/05 to swap stacks with STS-121, due to a late all-flights requirement for a heater on the ET LO2 Feedline upper bellow, to prevent formation of critical ascent ice debris in that area. Installation of the bellow heater was started on ET-121 (STS-114 was ET-123 in the VAB before the STS-114 stack was rolled-back. Removed and replaced an out-of-spec H2 diffuser. Replaced MFS PSB after a power card failure.
- Rolled out to pad 30B on 06/15/05 and set launch date of 07/13/05 on 05/22/05.

LAUNCH SCHEDULE:
- Scrubbed 07/13/05 launch attempt at 194:17:30Z (-L-14:51 to Window Opening when LH2 ECO Sensor #2 failed WET (failed to transition to DRY with Sim Commands). This violated OMRSD and LCC MPS-2 requirements for four functional LH2 sensors. Extensive tests were conducted that identified a degraded PSB ground and some evidence of EMI as potential causes of the false WET problem. At MMT on 07/20/05, decided to set launch for 07/24/05 (without a special tanking test), allowing sufficient time to clean up the ground and EMI. Decision was made to perform ECO Sensor #2 and #4 pin swap that provides additional troubleshooting results. (Note: ECO sensors operated normally on 7/26/05; further analyses and tests have significantly reduced the concerns about PSB grounding and EMI as causes of the STS-114 anomalies, but this remains a UA as of February 2006).
- Weather: All three TAL sites were forecast and observed GO. RTLs and AOA landing site KSC was forecast NO GO for precipitation and thunderstorms within 20 NM and observed NO GO for thunderstorms within 20 NM (April). 07/13/05 Launch Attempt was a Technical/Weather Scrub.

LAUNCH WINDOW:
Window opened at 207:14:34:33Z and closed at 207:14:43:52Z for a total window of 9M19S. The Preferred Launch Time (In-Plane Time) was 207:14:39:00Z resulting in a Launch Window of 4M26S.

CONTINUED...
**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE/ RUNWAY, CROSSRANGE</th>
<th>LANDING SITE, FLIGHT DURATION, VANDS</th>
<th>SSME-TL NOM, ABORT EMERG</th>
<th>SRB RSRM ENG. S/N</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS, PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

**LAUNCH DELAYS:**
- None. Launch occurred at 207:14:39:00Z, 10:39:00 AM EDT on Tuesday, 07/26/05.
- Early weather forecast was GO except for a chance of showers. Gave crew a GO for PLBD closing at 220:05:15Z. Light rain was observed at SLF for a few minutes. At 220:06:15Z gave crew a GO for fluid loading. Last forecast changed to NO GO at 220:06:42Z.
- Changed Landing site to EDW. Targeted landing at KSC on Orbit 219 at 221:10:43Z. Gave crew a GO to fluid load at 221:09:42Z. At 221:09:42Z, weather forecaster reported two cells developing rapidly northeast of field moving NE with lightning in a northeast cell. At 221:09:42Z, crew reported APU prestart complete. Current observations at SLF had showers within 30 NM with electrified cirrus (anvil) within 30 NM with forecast of thunderstorms within 30 NM moving NE. At 221:09:42Z, Flight Director advised crew to stop fluid loading. Waveoff landing at KSC on Orbit 219, the last opportunity on FD 13. Decision made to change landing sites to EDW concrete runway 22 on Orbit 220. Flight extensions 2 days + two orbits.

**FIRST USE OF ROBOTIC ARM:**
- First use of the 50-foot-long robotic arm known as Orbiter Boom Sensor System (OBSS) equipped with laser imager and cameras to inspect for ascent damage of Wing Leading Edges RCC and Shuttle Bottom Tiles during approach and docking with ISS.

**S114-E-5070 (26 July 2005) --- Photo shows a large piece of foam detached from ET PAL Ramp (light spot centered just below LO2 feedline). The debris was also seen on ET live video camera, in photo below at left, and indicated no impact to Discovery.**

**FIRSTS/LASTS:**
- First flight in Return-To-Flight after Columbia STS-107.
- First launch in 922 days after STS-107 launch.
- First flight with Istres, France as a TAL site.
- First flight with ET bipod redesign to eliminate large insulating foam ramps as a debris source and replace them with electric heaters.
- First use of the 50-foot-long robotic arm extension known as Orbiter Boom Sensor System (OBSS) equipped with Laser Imager and cameras to inspect Wing Leading Edges RCC and the Shuttle Bottom tiles for damage.
- First use of upgraded Ground Camera Ascent Imagery System, two WB-57 aircraft based video, and ship and ground based radar.
- First use of VUL instrumentation behind RCC panels to gather and downlink acceleration and temperature data during ascent phases.
- First use of orbiter back-flip pirouette (R-bar pitch maneuver) to allow ISS based photography of orbiter bottom TPS.
- First EVA crew to make repairs on shuttle bottom. Removed gap fillers protruding approximately 1 inch from black tiles in two areas of orbiter bottom black tiles, each extended approximately 1 inch. Gap fillers were removed during EVA 3.
- First flight with ET design change to use heater in bipod ramp area to prevent ice/frost buildup (in lieu of insulating foam in that area).
- First use of WLE instrumentation behind RCC panels to gather acceleration data during ascent phases.
- First flight with ET LOX Feedline upper bellows heater to prevent formation of critical ascent ice debris in that area.

**EVENTS:**
- ET Separation at 207:14:47:00Z, 8:46 GET
- MC-1 maneuver at 01:17:37:53, delta V 0.44 ft/sec Orbit 199.7 by 213.1 NM
- FD2 SRMS/OBSS survey of Wing Leading Edges and nose cap
- FD2 SRMS survey of orbiter upper surfaces
- ISS capture at 208:11:17:22Z (01:20:38:20 MET)
- Open Lab FedEx Hatch at 209:11:51:03Z (01:21:12 MET)
- Open APAS Hatch at 209:12:35:00Z (01:21:55:00 MET)
- Open CDS Hatch at 209:12:14:00Z (01:22:14 MET) ISS ingress
- FD4 OBSS survey of heat-protection tiles. MPLM docked to Node 1. MPLM and Middeck transfers begin.
- EVA 1 start at 211:09:45:50Z, 3:19:06:50 MET, duration 8:65:00 MET, on 07/30/05. Crew members performed EVA & NOAX TPS sample repair DTO 848 in FUB. Crew used OBSS to scan pre-damaged RCC samples on DTO pallet.
<table>
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<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (T)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE, ENG. S.N.</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM AND ET</th>
<th>INC</th>
<th>HAHP</th>
<th>PAYLOADWEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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<tbody>
<tr>
<td>STS-114/LF-1</td>
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**EVENTS (Continued):**
- EVA 2 start at 213:06:43:00, 5:18:04:00 MET, duration 7H14M, on 08/01/05. EVA crew removed, replaced, and performed checkout of ISS CMG 1. Crew started CMG 1.
- EVA 3 start at 213:06:48:00Z, 7:18:09:00 MET, duration 6H01M, on 08/03/05. Installed External Stowage Platform (ESP-2) on ISS airlock. Removed gap filter material (two) protruding from orbiter bottom tiles.
- Orbiter undocked from ISS at 218:07:23:45Z (10:16:44:45 MET)
- Total Consumables transferred to ISS 1855.2 lbm (18 CWC's & 5 PWR's), N2 = 29 lbm tank-to-tank; Stack-to-stack O2 = 60.85 lbm (27.6 lbm atm & 33.3 metabolic), N2 to ISS cabin transfer = -7.7 lbm.
- Total MPLM transfers to ISS 3695 lbs (2095 Cargo and 1600 HRF), 6600 lbs transferred to MPLM/Discovery for return to earth
- ISS Visitor Time was: 8D19H51M52S (Hard dock to Undock)
- Sep 1 Burn at 218:08:36:26Z Ha 193.5 Hp 189.3, Sep 2 Burn at 218:09:04:26Z Ha 194.1 Hp 168.1 NM
- Orbit Adjust Burn at 221:11:06:18Z

**SIGNIFICANT ANOMALIES:**
- LH2 ECO sensor #2 stayed wet when commanded dry caused launch scrub.
- ET TPS damages and TPS foam losses during ascent constraint to next flight:
  - LH, PAL ramp, Ice/Frost ramp, Acreage, Intertank flange foam losses.
  - +Y thrust strut flange and -Y Bipod spindle closeout foam losses.
- TPS Blanket damage near window 1
- TPS Gap Filler Protuberances (removed during EVA 3)
- Nose Landing Gear TPS tile damage
- APU 2 momentary loss of Press & Temp Indications
- CDS Capture Latch manual release telltale showed “Open” prior to hooks drive
- Airlock AR “B” Hatch Closure difficulties
- Airlock Depress Off-Nominal
- TCS repeated loss of Track
- VRCS Thruster RSR Low Pc. Heater may have failed on.
- MPS/SSME low pressure helium decay rate exceeded
- WEB GIN, Regulator outlet pressure low
- High O2 concentration in aft compartment during ascent
- Loss of several Orbiter tile putty repairs during ascent
- Late release of two FRRS Thruster TYVER rain covers during ascent
- Orbiter forward ET attach point NSI pyro bolt ejection after nominal NSI firing

**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-114-E-6642 ---** Robinson anchored to a foot restraint on ISS Canadarm2, participates in the mission’s third EVA which included removal of two gap fillers protruding from orbiter bottom tiles.

**ISS011-E-11517 (5 August 2005) ---** ISS Canadarm2 grasps the MPLM for transfer from ISS Unity Node back to Discovery’s cargo bay for return to Earth. James Kelly/Pilot, and Wendy Lawrence/MS controlled the transfer.

**S114-E-6642 ---** Robinson anchored to a foot restraint on ISS Canadarm2, participates in the mission’s third EVA which included removal of two gap fillers protruding from orbiter bottom tiles.

**INTEGRATED SIM**

**JSC2004-E-45140 —** Lead Flight Director Paul Hill (foreground) and CAPCOM Stephen N. Frick monitor communications in the Shuttle Flight Control Room (WFCR) in JSC MCC with the STS-114 crewmembers during a fully-integrated simulation - one of many to establish readiness for Return to Flight.

**JSC2005-E-32538 (5 August 2005) —** U.S. Senator Kay Bailey Hutchison (R-Texas) and U.S. Representative Tom DeLay (R-Texas) talk to CDR Eileen M. Collins aboard Discovery. Looking on are NASA Administrator Mike Griffin (left) and Flight Director Jeff Hanley.
<table>
<thead>
<tr>
<th>NO.</th>
<th>FLT #</th>
<th>ORBITER</th>
<th>CREW (7 up, 6 down)</th>
<th>LAUNCH SITE, Lift-off Time</th>
<th>LANDING SITE, Abort Times</th>
<th>LANDING TIMES</th>
<th>SSME-TL Nom Abort Emerg</th>
<th>SRSRV</th>
<th>ORBIT</th>
<th>FSW</th>
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<tbody>
<tr>
<td>STS-121/ULF1.1</td>
<td>OV-103</td>
<td>Discovery</td>
<td>Steven W. Lindsey, (FLT 4 - STS-87, STS-95, STS-104)</td>
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<td>KSC 115</td>
<td>PAD 30B-51</td>
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<td>Michael E. Fossum</td>
<td>(30B) 102354 LBS</td>
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<td>29280 LBS</td>
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<td>Lisa M. Nowak</td>
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<td>189 KEAS</td>
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</table>

**Mission Highlights**

**Brief Mission Summary:** STS-121/ULF1.1 (10th ISS mission) continued the testing of new equipment and procedures for increasing Space Shuttle safety of flight. Specifically, this mission continued the testing of ET design and process changes for minimizing damage to the ET and the crew during launch, ground and flight camera systems for vehicle observations during launch, and techniques for on-orbit inspection and repair of vehicle TPS. The flight also delivered critical supplies and cargo for the repair and future expansion of the ISS.

**Crew:**
- Michael E. Fossum
- Stephanie D. Wilson
- Lisa M. Nowak
- Thomas Reiter
- Piers J. Sellers

**Payloads/Experiments:**

**ISS013-E-48774 --- Discovery approaches ISS for docking with Leonardo Multipurpose Logistics Module (MPLM) in the payload bay.**

**Parameters:**

- **Weight:** 102354 LBS
- **GSN Numbers:** 5046
- **GSN Character:** E
- **GSN Group:** E

**Deployment:**
- **Deployment Date:** 7/4/06
- **Deployment Time:** 185:18:37:55 Z
- **Deployment Site:** KSC 15
- **Deployment Velocity:** 149 KGS
- **Deployment Time to Entry:** 7:31

**Retrieval:**
- **Retrieval Date:** 7/17/06
- **Retrieval Time:** 185:18:37:55 Z
- **Retrieval Site:** KSC 15
- **Retrieval Velocity:** 149 KGS
- **Retrieval Time to Entry:** 7:31

**Data:**

- **GSN Numbers:** 5046
- **GSN Character:** E
- **GSN Group:** E

**Additional Data:**

- **GSN Numbers:** 5046
- **GSN Character:** E
- **GSN Group:** E
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<th>LANDING SITE, ABORT TIMES</th>
<th>THROTTLE PROFILE ENG.SN</th>
<th>PAYLOAD WEIGHS.</th>
<th>MISSION HIGHLIGHTS</th>
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<tr>
<td>STS-121/ULF1.1</td>
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<td>MCC WHITE FCR (45)</td>
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<td>FLIGHT DIRECTORS:</td>
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<td>A/E - Steve Stich</td>
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<td>LD/O 1 - Anthony Crocco</td>
<td>O2 - Norman Knight</td>
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STS121-E-05156 (4July 2006)--- ET was photographed by orbiter umbilical well camera for damage studies by ground experts.


--- S121-E-06058 (8 July 2006) --- Fossum and Sellers test the Shuttle RMS and the OBSS as a platform for making repairs to a damaged orbiter.

--- Continued...
STS-121/ULF1.1

Continued…

First flight of an ET without the Protuberance Air Load ramps as a safety improvement to reduce potential for debris.
- First test of 50-ft robotic arm boom extension as a work platform.
- First flight with hardened tiles on NLG doors.
- First flight with SRMS/OBSS/Laser Dynamic Range Imager (LDRI) to scan Orbiter VLE and Nose Cap (RCC).
- DTO 848 RCC crack repair tasks using caulking guns to dispense the NOAX (non-oxide adhesive experimental) material.
- First flight of Orbiter MLG with four new larger, smoother tires that can withstand higher loads at landing.
- New procedures developed to ensure gap fillers between heat-shielding tiles stay in place (5000 replaced prior to launch).
- First flight to take GPS to NAV (BFS). Incorporated after processing TACAN approx. 140K. Performed well.
- ISS has three crew members for first time since May 2003.

Events:
- ET Separation at 185:18:46:46Z, 000:00:08:51 MET.
- OMS-2 ignition at 185:19:15:55Z, 98.7 fps, resultant orbit 124.4 by 85.1 nm.
- TI ignition 187:12:04:46Z, 16.8 seconds, resulting orbit 190.1 by 177.9 nm.
- SRMS/OBSS/Laser Dynamic Range Imager (LDRI) scanned both VLE and nose cap, no anomalous conditions identified.
- IELK Seat Liner transfer at 187:19:13Z (002:00:35:05 MET which is Reiter’s Shuttle time). This is the official transfer of Thomas Reiter from Space Shuttle STS-121 crew to ISS Expedition 13 crew. ISS crew increased to three persons for first time since May 2003.
- Leonardo MPLM grappled and installed on Unity Module.
- STS-121 crew farewell to ISS crew (Commander Pavel Vinogradov, Flight Engineers Jeffrey Williams & Thomas Reiter).
- STS-121 Undock from ISS at 10/15:29 MET, 196:10:06:55Z. - Total consumables transferred from Orbiter to ISS: Water 1545.8 lbm (1454.9 lbm in 15 CWC’s and 90.9 lbm in 4 PWR’s); N2 74.2 lbm transferred to Joint Air Lock tanks. No oxygen transferred between tanks.
- Cargo transferred from Orbiter to ISS total 10903.35 lbs (7423.99 plus unplanned 241.52 lbs to MPLM and 1820.26 lbs to Middeck).
- No communications blackout during entry.

Significant Anomalies:
- L5L Thruster heater fail off (first launch attempt)
- ET LH2 5% fill-point sensor failed wet when commanded to dry state (during loading attempts)
- FES Full up PRI B Shutdown
- Protuding Cap Filters
- Personal hygiene hose leak
- TPS Blanket Damage
- 85-ft safety tether 624 retraction issue
- Scratch reported on crowlock external hatch sealing surface
- SAFER 5000 (EVT) unlatched during EVA. Refixed by EV2
- APU 1 Fuel Tank Leak
- APU 3 GGFLU Pump Heaters cycling in over temp range
- Two-inch spatula inadvertently released during EVA 3
- Waste Dump Nozzle Temperatures A&B unusual signature during condensate dump
- Right Air Data Probe Initial fail to deploy
- WLEIS Inadvertent Software Shutdown (GFE)
- MCC GCN ISP Server Issue
- DOLU LPLAD Procedure error (LOAD LOK estimate High)
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLIGHT DURATION, WINDS</th>
<th>LANDING TIME, CROSSOVER</th>
<th>LANDING PROFILES, EMERG.</th>
<th>THRUST PROFILE, ENG. S/N</th>
<th>AND ET</th>
<th>DEC/ET</th>
<th>INC/ET</th>
<th>PAYLOAD/EXPERIMENTS</th>
<th>PAYLOAD/WEIGHTS</th>
<th>PAYLOAD/WEIGHTS</th>
<th>FSW</th>
<th>ORBIT</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRIBBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-115/12A</td>
<td>OV-104/103</td>
<td>Brent W. Jett</td>
<td>11/14:55 AM EDT (P)</td>
<td>104/104/109%</td>
<td>104/104/109%</td>
<td>Bi-127</td>
<td>Direct Insertion</td>
<td>51.60</td>
<td>(19)</td>
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<td>Brief Mission Summary: STS-115/12A (19th ISS mission), for the first time since late 2002, resumed assembly of the ISS. Atlantis left ISS with a new, second pair of 240-foot solar wings attached to a new 17.5-ton truss segment P3/P4 with batteries, electronics, and a giant rotating joint for sun tracking. The new solar arrays would double the ISS on-board power when the electrical systems were brought online during the STS-116 mission to follow.</td>
</tr>
<tr>
<td>ISS 12A</td>
<td>OV-104/103</td>
<td>Christopher J. Ferguson</td>
<td>11/14:55 AM EDT (A)</td>
<td>104/104/109%</td>
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<td>Joseph R. Tanner</td>
<td>11/14:55 AM EDT (P)</td>
<td>104/104/109%</td>
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<td>NOM-ABORT EMERGENT</td>
<td>SRB RSRM</td>
<td>ORBIT</td>
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<td>PAYLOAD WEIGHTS</td>
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**Launch Scrubs: (continued)**
- Scrubbed Wednesday, 9/6/06 launch at approximately L-8.5 hours due to a fuel cell 1 coolant pump phase A short. (Pump operated on two phases.) 24-hour scrub turnaround with MMT at 1 PM 9/6 to decide launch date. The MMT decision was to press for a launch attempt on Friday, 9/8. Plan was to keep Phase A cb open during ascent. Technical scrub.
- Scrubbed Friday, 9/8/06 launch attempt at 251:14:53Z while holding at T-9 minutes when ET LH2 ECO Sensor #3 indicated failed wet when actually sensor was dry. 24-hour scrub turnaround. ECO sensor operated normally during drainback and on Saturday launch day. GO for launch. Technical scrub.

**Launch Window**
- The 9/9/06 launch window opened at 252:15:10:39Z and closed at 252:15:19:36Z for a total launch window of 9 minutes 0 seconds. The Preferred Launch Time (In-Plane time) was 252:15:14:55Z giving a launch window of 4m41s.

**Launch Delays:**

**Tal Weather:**
- Zaragoza and Moron were forecast NO-GO for thunderstorms within 20. FMF was forecast with a 1-knot tailwind violation (average tailwind forecast to be 11 knots and peak tailwind forecast to be 16 knots). Zaragoza was observed NO-GO for thunderstorms and attached anvil. MRN and FMF were both observed GO at TAL landing time. Moron was selected as Prime TAL site.

**Performance Enhancements**
- Standard set plus (1) PE Operational High Q SUM/AUG, (2) OMS Assist, (3) 52 NM MECO, (4) Del Psi, (5) Non-standard consumables reduction.

**Flight Duration Changes/Landing**
- EOM landing was planned for 263:13:04Z on 9/20/06 at KSC. However, during INCO survey of the orbiter after FCS checkout, an unidentified piece of debris was observed in Camera A. Tuesday 9/19/06 MMT decided to investigate the significance of the debris. The MMT extended the flight 1 day to allow time to perform RNVS and OBSS surveys. The RNVS and OBSS surveys of the PLB, both WLE and flight control surfaces using the RNVS elbow camera, did not identify the debris. Atlantis was cleared for landing on ECM+1 day. Deorbit burn occurred at 264:06:14:23Z (11/17/59:28 MET) Orbit 185. Main Landing Gear touchdown on KSC Runway 33 was at 264:10:21:23Z (6:21:23 AM EDT) on Thursday, 9/20/06 for a flight duration of 11/19/06:28. Noise Landing Gear touchdown was at 264:10:21:32Z. Landing winds were forecast 0303P05 and observed 0303P04 (2H, 3R). Total flight duration extensions of 1 day (technical extension).

**Mission Highlights (Launch Scrubs/Delays, Tal Weather, Ascent I-loads, Firsts, Significant Anomalies, etc.)**

**Downloaded Image:**
- S115-E-05623 (12 Sept. 2006) --- Piper, releases the restraints on the forward Solar Array Blanket Box (SABB) during EVA with Tanner, partially visible at top edge of frame.

**Downloaded Image:**
- ISS013-E-81630 --- Crews in ISS Destiny Lab: Exp 13 from the left (front row): Thomas Reiter/FE (ESA), CDR Pavel V. Vinogradov (RSA), & Jeffrey N. Williams/FE. STS-115 from the left (second row): Tanner/MS, Stefanyshyn-Piper/MS, & CDR Jett; and from the left (top row): PLT Ferguson, Burbank/MS, & MacLean/MS (CSA).

**Downloaded Image:**
- JSC2006-E-40208 --- Mike Suffredini, ISS Program Manager, responds to a question from media during STS-115 mission update briefing on Sept. 14, 2006, at JSC. Shuttle Flight Director John McCullough is at left.
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<td>RENDEZVOUS # 64: Rendezvous and dock with ISS</td>
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<td>SPACE SHUTTLE NIGHT LANDING 21 (landed on runway KSC 33)</td>
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<td>- Used Airlock Campout Prebreathe Protocol for the first time. CREW spent sleep period isolated in the JAL (Quest Airlock) at reduced pressure of 10.2 psia.</td>
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<td>- Max Q at 252:15:15:45Z (00m50s) - OMS Assist ignition was 252:15:17:08Z with burn duration of 2m62s</td>
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<td>- OMS-2 ignition was at 252:15:52:16Z (37:21 MET), burn duration 2m25s</td>
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<td>- SRMS/CRSS/LDR survey of nose tip, port, and starboard wing RCC on FD3</td>
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<td>- ISS Hatch Open at 1:21:11:19m; ISS crew welcoming</td>
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<td>- EVA 1 Crew began campout in ISS Airlock at 10.2 psia in prep for EVA 1. - EVA 1 Start at 256:09:14Z (3/17.51 MET) on 9/12/06, conducted from the ISS JAL (Quest Airlock). The astronauts used a new prebreathe protocol first tested during the handover of Expedition 12. EV1/Joe Tanner and EV2/Heidemarie Piper spent the night isolated in the JAL (Quest Airlock) with a reduced pressure of 10.2 psi while the ISS remains at 14.7 psi. This prebreathe protocol is called Prebreathe Campout Protocol (PBCOP). The Integrated Truss Segment (ITS) P3/P4 was attached to the Port 1 (P1) segment using the SSRMS. EVA crew connected power cables, released SABS and BGA restraints to prepare SARJ for operations. During removal of launch lock cover, a bolt/spring and a washer were accidentally released and lost. The EVA duration was 6:26.</td>
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<td>- EVA 2 Start at 256:09:14Z (4/17.51 MET) on 9/13/06, EVA/Steven Burbank and EVA/Steven MacLean slept in the JAL for Spacewalk Prebreathe Campout Protocol. They completed preparations for the activation of SARJ for operations. EVA 2 duration was 7:11.</td>
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<td>- Hatch closed at 7/19:27 MET after saying goodbyes to Expedition 13 crew.</td>
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S115-E-05801 (13Sept. 2006) --- Burbank (red leg stripes) and MacLean/CSA (above & right) complete activation of SARJ.
### SPACE SHUTTLE MISSIONS SUMMARY

**Events (continued):**

- Atlantis undocking completed at 260:12:49:50Z, 7/19:27 MET - Total cargo transferred from Atlantis to the ISS was 36678 lbs (included 35552 lbs for P4/P5, but excluding water)
- Total cargo transferred from ISS to Atlantis was 993 lbs
- Total consumables transferred from Atlantis to ISS was 1110.5 lbm of water (11 CWC's with 1043.8 lbm and four PWR's with 66.1 lbm). Total oxygen transferred to ISS was 103 lbm.

**Significant Anomalies:**

- Fuel Cell 1 Coolant Pump AC1 Phase A short caused launch scrub. (See Launch Scrubs.)
- ARD response to erroneous telemetry (ARD NO-GO)
- Elevon Positioning Procedure callout errors
- ASA 3 Speedbrake driver channel # erratic
- Starboard PLBD aft (B) closed indication ON should be OFF
- F4D Tyvek cover late release
- TPS tile and blanket anomalies (cleared for Entry)
- FES shutdown during Ascent
- Water supply dump line heater A abnormal temperature cycling
- Hydraulic System 3 TVC Pitch Actuator indication
- Water supply dump valve leak
- Sequential Stills Video failure
- APU 2 X-axis accelerometer data erratic
- S-band lower right antenna communication problems
- FES topping left duct sensor erratic/OSL
- MADIS BIT indication on FDM-2 MLX D
- Nosecap expansion seat RCC damage
- Engine 2 LO2 inlet pressure transducer reading low
- RHR heater failed on
- Alt sample bottles L1 and R2 leaking
- Starboard radiator MMOD strike

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**JSC2006-E-40599** --- Flight Director Bryan Lunney monitors data at his console in MOCR.

**JSC2006-E-40475** --- STS-115/12A ISS Orbit 2 flight control team portrait in the MCC. Flight Director John McCullough (center right) holds the STS-115 mission logo and CAPCOM Pamela A. Melroy holds the STS-115/12A mission logo.

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<table>
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<td>Mark L. Polansky</td>
<td></td>
<td>8:47:35 PMEST</td>
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<td>PAD 38B-B3</td>
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**MISSION HIGHLIGHTS**

- **ISS 12A.1** - ITS SPACEHAB SM (WSTP-92 UTILIZATION PAYLOAD)

--- View from Discovery AFD of payload bay and approaching ISS (background). Shown in PLB are shuttle's docking mechanism (foreground), Spacehab partially obscured, Canadian-built RMS robotic arm (right), and RMS/Orbiter Boom Sensor System (left, in stowed position).
ST5-116/ ISS12A-1  Continued...


S116-E-06472 --- STS-116 & Exp 14 crews gather in ISS Destiny Lab. From the left (front row): Reiter/Exp 14 FE/MS-Dn, Patrick/MS, Higginbotham/MS, & PLT Oefelein. From the left (center row): Curbeam/MS, Fuglesang/MS (ESA), & CDR Polansky. From the left (back row): CDR Exp14 Lopez-Alegria, Mikhail Tyurin/Exp14/FE (RSA), & Williams/MS-Up/Exp14/FE.

S116-E-05983 - Curbeam (left) and Fuglesang conduct EVA1 tasks for installation of P5 Truss. New Zealand and Cook Strait are seen in the background.

LEFT: S116-e-05983 - Curbeam (left) and Fuglesang conduct EVA1 tasks for installation of P5 Truss. New Zealand and Cook Strait are seen in the background.
STL-116/ISS 12A.1

Continued...

- OMS Assist ignition at 344:01:49:50Z (duration 1m38s)
- SRMS OBSS/LDRI survey of nosecap, port and starboard wing RCC (MLE's) completed
- R-Bar pitch maneuver started at 345:21:04:46Z and was completed 7m33s later. Photos of Discovery's tile surfaces by ISS crew
- ISS hatch open 345:23:54Z (1:22:06 MET), ISS Crew Welcoming
- IELK seat liner transfer at 346:01:00:00Z (1:23:12 MET). At that time, Thomas Reiter became a member (MS5) of STS-116 and Sunita Williams joined the ISS Expedition 14 as Flight Engineer 2.
- EVA 1: EV1 and EV2 completed nominal tasks including P5 truss installed to P4 truss and mated P4-P4 umbilicals. 5/8-in socket lost from Pistol Grip Tool. EVA 1 duration 6h36m
- FD5: P6 4B SAW retraction required a series of partial deploy/retract sessions into 19 bays out for P4 SARJ to be free to rotate. P6 4B SAW now 16.5 bays out
- Solar flares raised radiation level. Crew slept in areas with better shielding.
- EVA 2: EV1 and EV2 Ch 2/3 reconfig and transfer to permanent power. CETA cart relocate. EVA 2 duration 5h00m
- FD7: Several IVA tests “wiggling” SAW, then extension/retraction were unsuccessful, 17.5 bays out
- EVA 3: EV1 and EV3 Ch 1/4 reconfig and transfer to permanent power. T/S P6 SAW. In an attempt to free the wires and grommets, oscillations and retractions were attempted. An additional 6 bays retracted, leaving additional 11 bays out. During EVA, a digital camera floated away. EVA 3 duration 7h53m
- FD8: ISS and Space Shuttle Programs reached a joint decision to extend STS-116/12A.1 to 13+1 days to perform an unscheduled EVA to troubleshoot and complete P6 SAW retraction. Undocking now on FD11
- EVA 4: Curbeam and Fuglesang, unscheduled EVA 4 start at 352:19:00:00Z (8:17:12:25 MET). EVA crew successfully retracted P6 the last 36 feet by repeated actions of pulling on guide wires, shaking, and retract commands. Array was successfully retracted and folded into box. EVA duration 6h38m
- Total cargo transferred to ISS from Discovery was 4877 Ibs (middles 1305 lbs and logistics single module 3572 lbs).

Continued…

S116-E-05799 - A kink occurred in the port-side P6 solar array during the first attempt to retract that array on Dec. 13, 2006.

JSC2006-E-54706 --- FD Matt Abbott talks to Paul Hill, Mgr Space Shuttle Mission Ops in FCR during the final deployment of some small satellites.

JSC2006-E-53934 (12 Dec. 2006) --- John Shannon, Deputy Shuttle Program Manager and Manager, MMT, emphasizes a point during a MMT meeting in JSC MCC. Behind Shannon are Wayne Hale (left), Shuttle Program Manager; and Robert D. Cabana, JSC Deputy Director.

S116-E-06854 - FD10: EVA 4 Curbeam & Fuglesang (out of frame), working in tandem, used specially-prepared tape insulated tools to guide the P6 overhead SAW neatly inside its blanket box.
| FLT NO. | ORBITER | CREW (7) | LAUNCH SITE, LIFTOFF TIME, CROSSRANGE | LANDING SITE, LANDING TIMES, WINDS | SSME-TL NOM-ABORT EMERG THROTTLE PROFILE | SRB RSRM | ORBIT | FSW PAYLOAD | PAYLOADS/ EXPERIMENTS | MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.) |
|---------|---------|----------|--------------------------------------|-----------------------------------|------------------------------------------|---------|--------|------------|----------------|-----------------------|-------------------------------------------------|
| STS-116/ISS 12A.1 | | | | | | | | | | | | |

**STTS-116/ISS 12A.1 Continued…**

**EVENTS (Continued):**
- Total cargo transferred to Discovery from ISS was 4911 lbs (to middeck 1345 lbs and to logistics module 3566 lbs).
- Total consumables transferred to ISS: Oxygen tank transfer 69 lbn and total nitrogen tank transfer 47.2 lbn; total water transferred to ISS was 261.6 lbn (201.9 lbn in two CWC's and 59.7 lbn in three PWR's).
- Undocked at 353:22:09:35Z - A flyaround (1/2 lap) was initiated at 353:22:35:13Z. - Sep 1 and Sep 2 maneuvers resulted in orbit 171.1 by 182.5 nm by 192.5 nm.
- Micrometeoroid Orbital Debris late inspection was completed.
- MEPSI payload was deployed at 355:00:19:35Z (10:22:32:00 MET).
- RAFT payload was deployed at 355:01:56:46Z (11:00:09:11 MET).
- ANDE was deployed at 355:18:23Z (11:16:35 MET).
- No communications blackout during Entry.

**SIGNIFICANT ANOMALIES:**

- Orbiter:
  - Loss of RMS End Effector Auto Release Capability
  - Fuel Cell O2 Flowmeter Failed
  - FES Primary B Failed To Come Out Of Standby
  - Port Mid Payload Bay Floodlight Failed
  - A6U Aft Event Thumbwheel Failure
- SRB:
  - SRB Separation Debris Impact On Orbiter Not A Safety Issue
  - T-0 Umbilical 1/4-Inch Frangible Bolt Missing
  - Delaminated/Missing BTA on SRB BSM Housing
- RSRM:
  - Delaminated/Missing BTA on SRB BSM Housing
- SSME:
  - Delaminated/Missing BTA on SRB BSM Housing
- ET:
  - Delaminated/Missing BTA on SRB BSM Housing
- MOD:
  - Erroneous Procedure Callout on OBSS LCS Cue Card
  - MCC Automation System (MAS) File Server Failure
- Integration:
  - Ice Balls Noted Hanging From The North GOX Vent Arm Duct Exit Flap
  - Delaminated/Missing BTA on SRB BSM Housing
- GPS Receiver Failed To Change Satellites
- MADS Signal Dropout
- VHE IDS Sensor Unit Inadvertent Shutdown

**IN THE JSC CONTROL CENTER:**

- CENTER: JSC2006-E-53261 --- Karl A. Silverman with the Space Flight Meteorology Group pores through weather data.
- RIGHT: JSC2006-E-53290 --- CAPCOM Christopher J. Ferguson follows the latest data (in background Stephen N. Frick).
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLIT</th>
<th>ORBITER</th>
<th>CREW (6+1 UP=7 DN)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WALLS &amp; HAB</th>
<th>THROTTLE PROFILE, ENGINE &amp; EMERG</th>
<th>SRLB RMS</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRIBBLE/DAY)</th>
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<tbody>
<tr>
<td>STS-117/13A</td>
<td>ATLANTIS</td>
<td>Frederick W. Sturckow (Flt 3 - STS-88, STS-105)</td>
<td>PM 12:54 PM EDT (P) Friday (25) 8/6/07 (11)</td>
<td>LANDING WINDOW 1M 18S (FLT IN-PLANE)</td>
<td>TAL: 0.0000 ft 0.00 (P) 2:03 (A) PERF: NOMINAL 2 ENG TAL (ZZA) 2:48 (P) 2:54 (A) BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>SRLB RMS: 55 KG: 173:19:50:18</td>
<td>BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>BRIEF MISSION SUMMARY: STS-117/13A (21&quot; ISS mission) continued the construction of the International Space Station with the delivery and installation of the second starboard truss segment (S3/S4), the deployment of the third set of solar arrays, and the retraction of the P6 starboard solar array wing, and one radiator. The truss also contained a Solar Alpha Rotary Joint (SARJ) which rotates 360 degrees for &amp; S6 solar arrays tracking of the sun. In addition, performed unscheduled EVA repair to Port OMS Pod thermal blanket for damage incurred during ascent.</td>
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<td>KSC-118</td>
<td>RNO-35 FR4-28</td>
<td>Patrick G. Forrester (Flt 2 - STS-105) P72/2/M</td>
<td>PM 12:54 PM EDT (A) Friday (25) 8/6/07 (11)</td>
<td>LANDING WINDOW 1M 18S (FLT IN-PLANE)</td>
<td>TAL: 0.0000 ft 0.00 (P) 2:03 (A) PERF: NOMINAL 2 ENG TAL (ZZA) 2:48 (P) 2:54 (A) BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>SRLB RMS: 55 KG: 173:19:50:18</td>
<td>BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>KSC/WD: OPP 125, VAB 8, PAD 17, Rollback to VAB, then VAB 72, PAD 25 = 247 Total Work Days</td>
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<td>MLP-2</td>
<td>LPO4-28</td>
<td>Steven R. Swanson P72/2/M</td>
<td>PM 12:54 PM EDT (A) Friday (25) 8/6/07 (11)</td>
<td>LANDING WINDOW 1M 18S (FLT IN-PLANE)</td>
<td>TAL: 0.0000 ft 0.00 (P) 2:03 (A) PERF: NOMINAL 2 ENG TAL (ZZA) 2:48 (P) 2:54 (A) BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>SRLB RMS: 55 KG: 173:19:50:18</td>
<td>BIRK DEC: 86 KG5</td>
<td>DRAG CHUTE DEPLOY: 196 KEAS 173:19:49:05</td>
<td>KSC/WD: OPP 125, VAB 8, PAD 17, Rollback to VAB, then VAB 72, PAD 25 = 247 Total Work Days</td>
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<td>21ST SHUTTLE FLIGHT TO ISS</td>
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<td>KSC/WD: OPP 125, VAB 8, PAD 17, Rollback to VAB, then VAB 72, PAD 25 = 247 Total Work Days</td>
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**iss015e11705 S3 S4 PL:** The 17.8 ton S3/S4 truss to be added to the station is shown berthed in the Shuttle payload bay.
### SPACE SHUTTLE MISSIONS SUMMARY

**FLT**  | **ORBITER** | **CREW (7)** | **LAUNCH SITE, LIFTOFF TIME** | **LANDING SITE, ABORT TIMES** | **SSME-TL NOM/ABORT EMERG** | **SRB RS/FSM** | **ORBIT** | **FSW** | **PAYLOAD WEIGHTS** | **PAYLOADS/EXPERIMENTS** | **MISSION HIGHLIGHTS** (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)
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**STS-117/ISS 13A** Continued...

<table>
<thead>
<tr>
<th>NO.</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LANDING SITES, FLIGHT DURATION, WINDS</th>
<th>LANDINGS TIMES, ABORT TIMES</th>
<th>THROTTLE PROFILE, ENG. S/N</th>
<th>AND ET</th>
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ISS 13A Continued…

- **TI maneuver at 161:17:00:57Z**: Resultant orbit was 181.2 by 179.4 nm orbit.
- **Rbar Pitch Maneuver was performed**: Photos of Atlantis’ tile surfaces and the damaged OMS POD thermal blanket were taken by ISS crew. The thermal blanket damage was later determined to be from ET foam/ice shedding from LO2 line bracket during ascent.
- **ISEK Seat Liner transfer at 162:00:55Z** (7:55 PM CDT, June 10, 2007). At that time, Sunita Williams became a member of STS-120 and Daniel Tani joined the ISS Expedition 16 as Flight Engineer.
- STS-117 delivered new set of solar arrays on 21st flight to ISS; P6 Starboard array was retracted for over 3 days.
- “Suni” Williams was replaced by Clay Anderson on Expedition 15 and returned home on STS-117 with long duration space record for a female (see Firsts above).
- **FD4 - Station robotic arm used to install S3/S4 truss on S1 truss.**
- **FD4 EVA 1**: Reilly/EV1 & Olivas/EV2 completed the following tasks for S3/S4 Power Generation work: connected 13 power & data umbilicals, unstowed & deployed 1A & 3A solar arrays, and uncinched/unwinched photovoltaic radiator (PVR) for deployment. SARJ work included: installing 4 alpha joint I/F structure (AJIS) struts, installing drive lock assembly (later, EVA 2 determined a problem, see below), removed 6 SARJ locks, and released all swing bolts along SARJ. EVA 1 duration: 6h16m.
- **FD4 - MMT Management Decisions Summary**: On 06/11/07, the MMT concurred: (1) that the Port OMS Pod TPS Blanket is considered [to be] suspect in case of a contingency deorbit, (2) with performing a repair of the OMS Pod Blanket, and (3) with adding 2 extension days and a 4th EVA.
- **FD5**: Activities completed nominally. Solar Array deployment - 8 bays retracted. Array behavior similar to 4B retraction on STS-116 (sticking grommets, asymmetric folding).
- **FD6 - EVA 2**: Forrester/EV3 & Swanson/EV4 conducted partial retraction of P6 2B Solar Array (including cut leader). Inspected P6 aft radiator starboard PIP pin (only one confirmed). SARU work included: installed 4 SARU brace beams, installed DLA 1 (discovered DLA’s were cross wired on the ground), removed 10 SARU launch locks, and broke torque on 3 SARU launch restraints. EVA 2 duration: 7h16m.

**STID-06886 --- Reilly/EV1(center) Olivas/EV2 (right) connect power, data & cooling cables to S1 & S3, and deploy solar array blanket boxes on S4.**

**S117-E-07789 Forrester/EV3 (left) Swanson/EV4, participate in 4th EVA as construction continues on ISS. Among other tasks, Forrester and Swanson continued activation of the station’s new starboard 3 and 4 (S3/S4) truss segments.**
### SPACE SHUTTLE MISSIONS SUMMARY

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<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
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<td>STS-117/ISS 13A</td>
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<tr>
<td><strong>FLT</strong></td>
<td><strong>ORBITER</strong></td>
<td><strong>TITLE NAMES &amp; EVAS</strong></td>
<td><strong>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</strong></td>
<td><strong>LANDING SITE, ABORT TIMES</strong></td>
<td><strong>LANDING TIMES FLT DURATION, WINDS</strong></td>
<td><strong>THROTTLE PROFILE ENG.S/N</strong></td>
<td><strong>AND ET</strong></td>
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<td><strong>PAYLOAD WEIGHTS</strong></td>
<td><strong>PAYLOADS/EXPERIMENTS</strong></td>
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<td><strong>MISSION HIGHLIGHTS</strong></td>
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<td>- FD8 EVA3: Conducted by Reilly/EV1 &amp; Olivas/EV2: Removed Lab H2O Vent &amp; Installed Lab H2 Vent, repaired OMU Pod thermal blanket with skin stapler and pins, relocated 1 of 3 APFRR's for 13A.1, and finished retraction of P6 2B Solar Array. This was unscheduled EVA added by MMT. EVA 3 duration: 7h58m.</td>
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<td>- FD10 EVA4: Conducted by Forrester/EV3 &amp; Swanson/EV4: Activated S6M for rotation, cleared S3 Mobile Transporter path, relocated 2 of 3 APFRR's for 13A.1, released torque on S4 MMD Shield bolts, moved VSSA to Camera Port 1, cleared Node 1 Port for 10A Node 2 temporary stowage, and opened Lab H2 Vent. EVA duration: 6h 29m.</td>
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<td>- Mid-deck resupply cargo transfer to ISS from Atlantis was 1277 lbs.</td>
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<tr>
<td>- Mid-deck return cargo transfer to Atlantis from ISS was 1528 lbs.</td>
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<td>- Supply Water total to ISS was 751 L (1,656 lbm)</td>
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<td>- Oxygen (net) to ISS was 89 lbm</td>
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<td>- Nitrogen to ISS: to A/L tanks 17.3 lbm; into stack for repress 16 lbm</td>
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<td>- Lithium Hydroxide (LiOH): STS [used] to ISS = 3, ISS (new) to STS = 3</td>
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<td>- Undocked at 170:14:02Z followed by a fly-around (1/2 lap). - Sep 1 &amp; Sep 2 maneuvers resulted in orbit of 165.0 x 177.1 nm</td>
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<tr>
<td>- Micrometeoroid Orbital Debris late inspection was completed.</td>
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<td>- No communications blackout during Entry.</td>
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<td><strong>SIGNIFICANT ANOMALIES:</strong></td>
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<td><strong>Orbiter:</strong></td>
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<td>- MDM OA2 CARD 5 Failed - Invalid Data</td>
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<tr>
<td>- MADS Recorder Tape Speed Went To 120 IPS (Nom is 15) at Nose Wheel TD</td>
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<tr>
<td>- E3 LH Inlet Pressure Transducer Went OSH at T+ 3.5 Min</td>
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<td>- ET: Post-Launch Camera &amp; Film Rev. - Loss of LH2 Acreage Foam at Stations 1160, 1623 &amp; 1871</td>
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<td>- MOD: GDR Data Dropouts During Ascent</td>
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<td>- Ascent LOC Push Button Inoperative</td>
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<td>- LCC Activation Turning Off WLES PGSC</td>
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<td>- Tile Piece Liberated From Aft Fuselage Body Flap V1 During Ascent</td>
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<td>- FOD Found In Aft Compartment</td>
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<td>- Port OMS Pod Blanket Damage During Ascent</td>
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<td>- Rope-Like Material Noted Moving In Umbilical Well Imagery</td>
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<tr>
<td>- Propellant Use During FDS Extended Shuttle Attitude - Hold Approx 3 Times Higher Than Predicted</td>
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--- IN THE JSC MISSION CONTROL CENTER ---

**LEFT:** JSC2007-E-31063 -- Orbit 1 FCT: FD/Cathy Koerner (left) & CAPCOM Terry W. Virts Jr. hold STS-117 logo. **CENTER:** JSC2007-E-28303 --- A "fish-eye" perspective of MOCR activity: (lt to rt) CAPCOMs Terry Virts & Tony Antonelli; & FDs Norm Knight & Steve Stich. **RIGHT:** JSC2007-E-29876 --- Orbit 2 FCT. FD/Bryan Lunney (wearing business suit) is in foreground.
### STS-118/13A.1
#### Landing Site, Crew, Runway, Nom-Abort SRB, Orbit, Payloads, Experiments

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, LANDING TIMES, FLT DURATION, WINDS</th>
<th>TRIGGER PROFILE ENG.SN</th>
<th>SSB</th>
<th>RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-118/ISS 13A.1</td>
<td>OV-105 (Flight 20) ENDUROV</td>
<td>CDK: T. J. Kelly (Flt 2 - STS-103) P733/0253/02175/00200</td>
<td>KSC-319 RR04-27 FRG5-20</td>
<td>KSC 15 (KSC 65) 233:15:22:17Z - 12:32:17 PM EDT Tuesday (21) 09/01/07 (8)</td>
<td>104/104/104% PREDICTED</td>
<td>103/104/104.5% 104.5</td>
<td>ET</td>
<td>INC</td>
<td>HH/P</td>
<td>MISS: 1/EV1 ISS DURATION 4m14s</td>
<td>Launch Scrubs/Delays, Postponed to NET 06/01/04 on 04/17/03 due to Columbia accident.</td>
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<tr>
<td>SEQ FLT#/ 119</td>
<td>KSC-119</td>
<td>FL: Charles O. Hobaugh (Flt 2 - STS-104) P736/0259/0189/0204</td>
<td>ME 1R: Tracy E. Caldwell P735/0315/0154/0243</td>
<td>MGD: 1/20 OT: 0.79</td>
<td>MGD: 1/20 OT: 0.79</td>
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<td>ISS: 13A (22nd ISS mission) continued the assembly and resupply of the International Space Station and fulfilled a long-standing teacher's legacy. The new assembly included the delivery of the S5 Truss segment, installation of a spare parts platform, and changeout of a failed gyroscope. This was the last shuttle resupply mission using the SPACEHAB module. In addition, Barbara R. Morgan, who had served as backup to Christa McAuliffe in the Teacher in Space Project 21 years earlier, flew as the first Educator Mission Specialist. McAuliffe was a member of the crew that lost their lives in the 1986 Challenger accident.</td>
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<tr>
<td>PAD 39A-42</td>
<td>MLP-1</td>
<td>SS EVA 101</td>
<td>KSC-119 P736/0315/0154/0243</td>
<td>329 LBS</td>
<td>221660 LBS X CG: 1079.8 IN</td>
<td>221740 LBS</td>
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<td>22ND SHUTTLE FLIGHT TO ISS</td>
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**ISS015-E-21711 - Endavour delivers a new S6 std truss segment, cargo inside the SPACEHAB module (in center of bay), and the external stowage platform 3 to ISS.**
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-118/ISS 13A.1

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<tbody>
<tr>
<td>Continued...</td>
<td>MCC WHITE FCR (49)</td>
<td>Shuttle</td>
<td>FLIGHT DIRECTORS:</td>
<td>SHUTTLE:</td>
<td>A/E - J. S. Stich</td>
<td>O2 (FD1-FD6) - R. S. Jones</td>
<td>O2 (FD7-ECM) - M. L. Sarafin</td>
<td>ORBIT</td>
<td>FSW</td>
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<tr>
<td>Continued...</td>
<td>CAPCOMS:</td>
<td>SHUTTLE:</td>
<td>A/E - C. J. Ferguson</td>
<td>- J. P. Dutton (Wx)</td>
<td>LDU1 - S. K. Robinson</td>
<td>O2 - R. S. Kimbrough</td>
<td>O3/PLNG - S. W. Lucid</td>
<td>Team 4 - N/A</td>
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<tr>
<td>Continued...</td>
<td>ISS:</td>
<td>LDU2 - S. Walker</td>
<td>O1 - D. A. Antonelli</td>
<td>ORPLNG - L. McCullough</td>
<td>Team 4 - N/A</td>
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**Firsts/Lasts:**
- First flight of Endeavour in 5 years
- First flight test of new system to monitor ECO circuit voltage to fuel sensors. System allows Flight Controllers to recommend manual engine shutdown by the crew if sensor voltage has failed.
- First flight of Automated Meteorological Profiling System (AMPS) High Resolution (HR) as primary system for DOLILU wind measurements - replacement for Jimspheres.
- First flight that Station Shuttle Power Transfer System (SSPTS) available to provide extended duration capability to shuttle.
- First flight that three-string Global Positioning System (GPS) was used to replace landing TACAN System - previously flown single string only.
- First flight of SRB Command Receiver/Decoder (CRD). Replaced Integrated Receiver/Decoder (IRD) and Range Safety Distributor (RSD) due to obsolescence concerns.
- Last flight of SPACEHAB resupply module.
- First and last flight of Educator Mission Specialist Barbara R. Morgan. She left NASA and returned to Boise State University in 2008.

**Night Launch:**
- N/A

**Rendezvous/EDT:**
- Rendezvous and dock with ISS

**Ninth Shuttle Crewmember Replacement:**
- Clay Anderson was replaced by Drew in August 2007. (8th Shuttle crewmember replacement occurred on STS-121)

**Events:**
- OMS 2 ignition at 220:22:47.15Z resulted in a 172.2 by 124.7 nm orbit.
- SHMS/OBSS/LDR survey of noscap and port starboard wing RCC (WLEs) was completed.
- TI maneuver at 222:15:15:19Z - resultant orbit was 186.5 by 180.4 nm.
- During R-Bar Pitch Maneuver, a gouge in the heat shield below the right wing (site 3) was identified.
- Docking contact occurred at 222:18:01:54Z.
- Hard Dock occurred at 222:18:29:44Z.

**Performance Enhancements:**
- Include the standard set plus: 1) PE Operational High Q WIN/DEC, 2) OMS Assist, 3) a 52 nm MECO, and 4) Del Psi

**Flight Duration Changes/Landing:**
- On 8/12/07, FD5, the MMT concurred with extending the Mission to 14+2 days and adding EVA 4.

**First Launch:**
- N/A

**Rendezvous #67:**
- Rendezvous and dock with ISS

**Ninth Shuttle Crewmember Replacement:**
- Clay Anderson was replaced by Drew in August 2007. (8th Shuttle crewmember replacement occurred on STS-121)

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- OMS 2 ignition at 220:22:47.15Z resulted in a 172.2 by 124.7 nm orbit.
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<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (7) TITLE &amp; NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE, ENG. S/N</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
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**FLIGHT HIGHLIGHTS**: (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

**EVENTS (Continued)**:
- ISS Hatch open 22:20:04:00Z, 3:04 pm CDT, Friday, August 10, 2007, ISS crew welcoming.
- FD4: MMT, per Flight Rule 13A.1_A2-6 concurred that TPS was considered to be damaged.
- FD4, EVA 1: EV1 and EV2 installed SS on S4, relocated SS PVRGF to SS Keel (ground strap bolt would not seat again, like P5), retracted and cinched P6 Forward PVR, and retrieved EVA ratchet from STBD Z1 toolbox. EVA 1 duration 6h17m.
- FD5: MMT concurred that TPS was considered to be damaged and authorized focused TPS inspection. Mission was extended to 14+2 and EVA4 (preplanned) was added.
- FD6, EVA 2: EV1 and EV2 completed R&R of faulty CMG 3 into ISS Z1 truss, installed old CMG3/FSE/FRAM on nadir ESP-2 FRAM Site #5 with MLI cover (no straps), and retrieved EVA ratchet from PORT Z1 toolbox. The failed CMG will remain at its temporary stowage location until it is returned to Earth on a later shuttle mission. The new gyroscope is one of four CMG’s used to control Station attitude on orbit. EVA 2 duration 6h28m.
- FD8, EVA 3: EV1 and EV3 (Exp 15/16) relocated P6 SASA to P1 zenith, installed P1 S-band BSP and Xpdr, moved CETA cart 1 to STBD of MT (connected to MT), moved CETA cart 2 to STBD of MT (connected to CETA 1), and removed P6 S-band Xpdr (dummy box plate installed). EV1 EVA terminated early to EMU glove damage at EVA Phase Elapsed Time (PET) 4:20. The damage did not cause leakage, the suit pressure was unaffected. Due to the early termination, the S-band Antenna Structural Assembly (SASA) Spare Gimbal Locks and Materials International Space Station Experiment (MISSE) 3 and 4 tasks were not completed. EVA 3 duration 5h28m.
- FD8: EVA 4 delayed from FD9 to FD11 by MMT for potential tile repair.
- FD9: MMT decided that the TPS repair issue required a Programmatic assumption of risk and that the MMT was willing to assume that risk. The preponderance of data (including ground analysis and arc jet testing) indicated acceptable margins to fly as is. MMT decided that no TPS repair would be performed on Endeavour and that the nominal planned EVA 4 would be executed on FD11.
- FD11, EVA 4: EV2 and EV3 (Exp 15/16) installed CBSS OSE (2) on S1 zenith trunnions, re-torqued Z1 SASA gimbal bolts, removed MISSE 3 and MISSE 4 from A/L and returned on Shuttle, Lab EMIS antenna handrails and cable installed (Lab fwd endcone nadir – got 3 of 3 EOUs installed), and retrieved tools from A/L toolboxes. Did not perform Lab or Node MMOD shield cleanup or S3 WETA installation. EVA 4 duration 5h2m.
- FD12: MOD contingency plans for Hurricane Dean Preparedness included decreasing the flight control support to two teams and evacuation on military aircraft if required. The plan was not required to be implemented.
### SPACE SHUTTLE MISSIONS SUMMARY

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**CONTINUED...**

**EVENTS (Continued):**

- Transfers:
  - Hardware transferred to ISS (outside and inside): 14,740 lbs
  - Hardware/supplies returned from ISS: 3,297 lbs
  - Water delivered to ISS: 918.6 lbm
  - Oxygen to ISS: 77 lbm
  - Nitrogen to ISS: 33.8 lbs
  - Lithium Hydroxide (LiOH) cans from ISS to STS: 12 cans (9 old, 3 used)
  - LiOH new cans from STS to ISS: 30 cans
  - Power transferred from ISS to orbiter using the SPS was 119,655 kWh.

- Undocked at 170:14:42:00Z followed by a flyaround (1/2 lap)
- Sep 1 and Sep 2 maneuvers resulted in orbit 185.2 by 183.5 nm.
- Micrometeoroid Orbital Debris late inspection was completed.
- No issues.
- No communications blackout during Entry.

**SIGNIFICANT ANOMALIES:**

- **Orbiter:**
  - A Magenta Hue Appeared On Camera (GFE).
  - STS-118 Drag Chute Reefing Line Cutter Failure to Cut (GFE).
- **SRB:**
  - None.
- **RSRM:**
  - Gase Penetrations through Nozzle Joint 2 RTV, RSRM-97A&B SSME.
  - 3 Com Card/Cable Failed (GFE).
- **ET:**
  - XT-1973 Inboard LO2 Feedline Bracket Base Fitting TPS Crack on ET-117.
  - Post-Launch Camera and Film Review Showed Loss of LH2 Acreage Foam.
- **MCC:**
  - B30M Power Failure B-C Power Feeds.
  - Margi Output Error.
  - ET Umbilical Door Closure Timing.
  - SSRMS Movement Prior To Shuttle Ku Mask.
  - CEISS Sensor Mode Change From 8 to 2 per MCC.
  - Procedure Error on PGSC Setup Integration.
- **Mod:**
  - Partial Tyvek Cover Release.
  - SSRMS Movement Prior to Shuttle Ku Mask.
  - BFS Loss of Class III Alert from Spacehab E.

**RIGHT:** S118-E-07918 - Category 4 Hurricane Dean, viewed from Endeavour, was moving westerly in the Caribbean nearing Jamaica with sustained winds of 150 mph. MOD contingency evacuation plans were prepared, but not needed.

**TOP:** JSC2007-E-42079 -- In MCC Lead FD Matt Abbott follows the in-space ops. MIDDLE: JSC2007-E-41693 --- In MCC FD Richard Jones follows launch preps at KSC. BOTTOM: JSC2007-E-42074 --- In MCC Shannon Walker ISS CAPCOM, ISS Lead FD Joel Montalbano (right), & Steven W. Lindsey (standing), Chief of Astronaut Office, keep up with in-space ops.

**JSC2007-E-46429 (17 Sept. 2007)** — The STS-118 Ascent/Entry flight control team and crewmembers pose for a group portrait in the space shuttle flight control. Flight director Steve Stich holds mission logo with CDR Kelly (left), & CAPCOM Chris Ferguson (right). Additional crewmembers pictured are PLT Hobaugh, Morgan/MS, Caldwell/MS, & Mastracchio/MS.
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-120/10A

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6+1 LRP+1 DN)</th>
<th>LANDING TIMES</th>
<th>ORBIT</th>
<th>PAYLOAD/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-120/10A</td>
<td>OV-103</td>
<td>Pamela A. Melroy (Fil 3 - STS-92, STS-112)</td>
<td>100/104.5/104.5/72/104.5</td>
<td>100%</td>
<td>POST OMS-2: 100.8X123.3 NY</td>
<td><strong>Kentucky</strong> Missouri</td>
</tr>
<tr>
<td>SEQ FLT# 120</td>
<td>CMSS-PCDS-LPO1</td>
<td>Scott E. Parazynski (Fil 5 - STS-66, STS-86, STS-95, STS-100)</td>
<td>100/104.5/104.5/72/104.5</td>
<td>100%</td>
<td>PAYLOAD: CHARGEABLE</td>
<td><strong>FORT</strong> MINI</td>
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<tr>
<td>KSC-120</td>
<td>PFD-30A &amp; MLP-2</td>
<td>MRN-25 (PLT IN-PLANE)</td>
<td>100/104.5/104.5/72/104.5</td>
<td>100%</td>
<td><strong>DART</strong> C476 OFF</td>
<td><strong>MISSOURI</strong></td>
</tr>
<tr>
<td>PAE-30A-43</td>
<td>PFD-30A &amp; MLP-2</td>
<td>MRN-25 (PLT IN-PLANE)</td>
<td>100/104.5/104.5/72/104.5</td>
<td>100%</td>
<td><strong>DART</strong> C476 OFF</td>
<td><strong>MISSOURI</strong></td>
</tr>
<tr>
<td>23RD SHUTTLE FLIGHT TO ISS</td>
<td>PFD-30A &amp; MLP-2</td>
<td>MRN-25 (PLT IN-PLANE)</td>
<td>100/104.5/104.5/72/104.5</td>
<td>100%</td>
<td><strong>DART</strong> C476 OFF</td>
<td><strong>MISSOURI</strong></td>
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**MISSORY**: Historic first space meeting of female Women Commanders. Peggy Whitson (right), ISS EXP 16 CDR, greets Pam Melroy, STS-120 CDR.
<table>
<thead>
<tr>
<th>FLT NO</th>
<th>ORBITER</th>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES</th>
<th>FLY DURATION, WINDS</th>
<th>THROTTLE PROFILE ENG, S.N.</th>
<th>SSM/E-TL, NOM, ABORT EMERG</th>
<th>SSME-TL</th>
<th>RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tr>
<td>STS-120/ISS 10A</td>
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<tr>
<td>ISS016-E-009207 (3 Nov. 2007)</td>
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<td>While anchored to a foot restraint on the end of the OBSS, Parazynski/EV1 assesses his repair work as the solar array is fully deployed during EVA 4.</td>
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<tr>
<td>ISS016-E-000875</td>
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<td>Close-up view of the repaired solar array.</td>
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<tr>
<td>JSC2007-E-005788</td>
<td>---</td>
<td>In MCC, FDs, Knight (left) &amp; Lunney, monitor EVA repair of ISS solar panel shown in photos at right &amp; bottom.</td>
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<tr>
<td>ISS</td>
<td>ISS016-E-008875</td>
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<td>Close-up view of the repaired solar array.</td>
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**MISSION HIGHLIGHTS**

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**TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**

- Historical first meeting of two spacecrafts commanded by women: Peggy Whitson, the first woman to command the ISS, and Pamela A. Melroy, the second woman space shuttle commander.
- Successful first time operation of OV-103 Station-to-Shuttle Power Transfer System (SSPTS)
- First ET LO2 IFR bracket pockets filled with BX (replaces PDL in pockets) to minimize void formation.
- First flight of OI-32 Flight Software. Standard capability release included changes for enhanced crew safety and situational awareness, improved mated control of ISS, and other enhancements for ground and flight operations and safety.
- First High-definition TV coverage of Launch (by CNN)

**FIRSTS**

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- First flight of OI-32 Flight Software. Standard capability release included changes for enhanced crew safety and situational awareness, improved mated control of ISS, and other enhancements for ground and flight operations and safety.
- First High-definition TV coverage of Launch (by CNN)

**PERFORMANCE ENHANCEMENTS**

- Include the standard set plus: 1. PE Operational High Q TRN/OCT, 2. OMS Assist, 3. 52 nautical mile MECO, and 4. Del Psi. FLIGHT DURATION CHANGES/LANDING

---

**FLIGHT DURATION CHANGE/LANDING**

On FD7, MMT concurred with adding a docked extension day to the mission to extend EVA 4 for starboard SARJ inspections for cause of vibrations and drag.

**FLIGHT DURATION CHANGE/LANDING**

On FD7, MMT concurred with adding a docked extension day to the mission to extend EVA 4 for starboard SARJ inspections for cause of vibrations and drag.

Continued…

In JSC MCC, Ed Gonzalez/Ascent Trajectory Officer monitors prelaunch data. CENTER: JSC2007-E-095148 — In JSC MCC, FD Mike Moses (standing) escorted former President George H.W. Bush and former First Lady Barbara Bush shown talking to Shuttle & ISS crews on-orbit. AT RIGHT: JSC2007-E-097963 — On Nov.8 at Ellington Field, President George W. Bush greets returning CDR Melroy (pictured) and other crew members (out of frame) with JSC Director Mike Coats in the background.

ABOVE: In JSC MCC, Ed Gonzalez/Ascent Trajectory Officer monitors prelaunch data.

SIGNIFICANT ANOMALIES:

Orbiter: - V076-363736-201, Blanket R&R - Protrusion on the Arrowhead Plate (H0.38) - Protruding Ames Gap Filler (H0.21 & H0.29) - Blanket is lifted off left (Port) OMS Pod - The MSS Engine #1 OC, Inlet Temperature failed off scale high at 15:41:15GMT during STS-120 Ascent. - On STS-120/OV-103, Measurement V62T0519A was erratic, diverged from approximately 190 degrees F - Missing debris SRB: - Nonlinear separation on LH SRB of the Frustration/Forward Skirt Ordnance Ring for STS-120/B-131 - STS-120/ET-120 launched on 10/23/07: Post Launch camera and film review showed loss of foam at two locations. - RSRM: - Gas penetrations through Nzzle Joint 2 RTV, RSRM-98A&B - Gas penetration through RTV, Nzzle Joint 5, RSRM-98B - SSME: None ET: None MCD: - Missing step in PDRS STRID survey procedure - Typo - IMU align in Orb Ops Checklist - RMS Joint Angle Display Error INTEGRATION: - LH2 Umbilical ice noted prelaunch - GIUP ice bridged to ET Inertbank Foam - ET LH2 Tank foam clearance losses - Unexpected debris/expected debris exceeding mass allowable prior to pad clearance (ttftoff debris) - Debris release on outboard side of LO2 Feedline at ~277 sec MET

S120-E-008531 (5 Nov. 2007) — Back-dropped by the blackness of space and Earth’s horizon, the new ISS configuration is viewed from the departing STS-120 Discovery.
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6+1 LT-6+1 DN)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSRANGE</th>
<th>SSME-TL NOMABORT EMER</th>
<th>SRB RFSM AND ET</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
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</thead>
<tbody>
<tr>
<td>STS-122/1E ISS</td>
<td>CM-104</td>
<td>AOR</td>
<td>03:18:19:35:02Z</td>
<td>051:14:07:09Z</td>
<td>100/104.5</td>
<td>51.6</td>
<td>CI-32</td>
<td>40396 LBS</td>
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<tr>
<td>STS-122/1E ISS</td>
<td>CMS PODS</td>
<td>LPA 33</td>
<td>051:14:07:09Z</td>
<td>100/104.5</td>
<td>51.6</td>
<td>CI-32</td>
<td>40396 LBS</td>
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<td>STS-122/1E ISS</td>
<td>P755/1043</td>
<td>OV-104</td>
<td>051:14:07:09Z</td>
<td>100/104.5</td>
<td>51.6</td>
<td>CI-32</td>
<td>40396 LBS</td>
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<td>STS-122/1E ISS</td>
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<td>CCR</td>
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<td>51.6</td>
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<td>STS-122/1E ISS</td>
<td>MS 25</td>
<td>CSS</td>
<td>051:14:07:09Z</td>
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<td>STS-122/1E ISS</td>
<td>MS 26</td>
<td>CSA</td>
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<td>STS-122/1E ISS</td>
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<td>CRU</td>
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<td>STS-122/1E ISS</td>
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</table>

**SPACE SHUTTLE MISSIONS SUMMARY**

**ST-122/1E**

**ISS 1E**

**COLUMBUS MODULAR LABORATORY**

- Delivered the Columbus laboratory from Atlantis' payload bay to the starboard side of the Harmony module.

**ISS 1E**

- **Mission Highlights**
  - Postponed to TBD on 12/09/07, see LAUNCH SCRUBS below, launch was rescheduled to NET 01/02/08 contingent on development and implementation of fuel ECO sensor system troubleshooting plan.
  - Postponed to 12/09/07, see LAUNCH SCRUBS below, launch was rescheduled to NET 01/02/08 dependent on resolution of the problem with the fuel sensor system. Skip was to allow "as many people as possible to have time with family and friends at the time of year when it means the most." Tanking test using add-on Time Domain Reflectivity (TDR) instrumentation on 12/18/07 isolated ECO Sensor System failures to open circuit in the three-part "pass-through connector." TPS removal on the tank was authorized at the pad to begin moving toward removal of the hardware, if required, to solve the problem. Launch date remained unchanged.

**LAUNCH POSTPONEMENTS**

- Added STS-122 to FND - Launch date of 10/17/07 on 10/05/06.
- Postponed to 12/06/07 on 10/05/06 due to STS-117 rollback.
- After 12/06/07 scrub, see LAUNCH SCRUBS below, launch was reset for 24-hr turnaround on Friday, 12/07/07.
- Later, on 12/07/07, during MFT Scrub Turnaround Meeting, it was decided to extend a 24-hr turnaround for Saturday, 12/08/07 launch to allow additional time to address all concerns.

**COLUMBUS MISSIONS**

- **ISS 1E**
  - **Mission Highlights**
    - BREF MISSION SUMMARY: STS-122/1E (24th ISS mission) delivered the European Space Agency's Columbus research laboratory module to the ISS. Columbus, measuring 23 ft in length and 15 ft in diameter, is ESA's largest contribution to the expansion of the ISS. Also delivered were ESA experiments and two ESA astronauts with one of them to join the ISS crew for operation of Columbus research. This mission also saw the Columbus Control Center in Oberpfaffenhofen, near Munich, Germany, brought on-line for initial checkout and future operations of the laboratory.
  - Postponed to 12/09/07, see LAUNCH SCRUBS below, launch was rescheduled to NET 01/02/08 dependent on testing of removed ECO connector, installation of replacement connector, and replacement and retesting procedures of Ascent Thrust Vector Control (ATVC) unit.
**SPACE SHUTTLE MISSIONS SUMMARY**

### STS-122/1E

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6+1 UP/6+1 DN)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, CROSSRANGE</th>
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<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>TITLE, NAMES, &amp; EVA'S</strong></td>
<td><strong>LANDING TIMES, ABORT TIMES</strong></td>
<td><strong>LANDING TIMES</strong></td>
<td><strong>FLT DURATION, WINDS</strong></td>
<td><strong>THROTTLE PROFILE, ENG.S/N</strong></td>
<td><strong>AND ET</strong></td>
<td><strong>INC</strong></td>
<td><strong>HAHP</strong></td>
<td><strong>TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.</strong></td>
</tr>
</tbody>
</table>

**Continued…**

**CAPCOMS: SHUTTLE**

A/V - J. P. Dutton
- T. W. Virts (Wx)
LD/O1 - K. A. Ford
O1 - R. C. Dempsey
C3/PLNG - C. J. Cassidy
Team 4 - N/A

**ISS**

OT - H. Getzelman
LD/O2 - C. J. Cassidy
C3/PLNG - C. E. Zajac
Team 4 - N/A

**CAPCOMS: STS-122**

OV-104:

DISTANCE: 5,296,842 sm
TOTAL SHUTTLE DISTANCE: 461,345,650 sm

- New "work to" launch date of NET 02/07/08 established on 01/14/08. Testing of removed ECO connector confirmed problem in the connector.
- Officially postponed launch to 02/07/08 on 01/28/08. Slip was due to ECO sensor problems experienced during December launch attempt and implementation of ECO sensor connector soldered mod. (Also, LCC went back to the standard three of four valid ECO sensor readings.)

**LAUNCH SCRUBS**

- Thursday, 12/06/07 launch attempt was terminated 2 hours into tanking when two of four engine cutoff (ECO) low-level LH2 fuel sensors failed wet/dry test. (The 5% sensor also failed wet during drain-back.) The ECO sensors are required for backup engine shutdown command to avoid catastrophic failure in the event of early fuel depletion. Launch was scrubbed at 8:56 am CST. Technical Scrub.
- Sunday, 12/09/07 launch attempt was terminated when one of previously failed sensors failed again during tanking, a couple of minutes into fast-fill. Engineers stated that the ET feedthrough and connector assembly was the most likely source of the problems. The 12/06/07 and 12/09/07 launch attempts produced previously unavailable time trending data that showed sensor faults occurring shortly before and after the feedthrough and connector were immerged in the super-cold propellants. Technical Scrub.

**LAUNCH WINDOW**

- Total launch window was 10m1s with window open at 038:19:40:29Z and close at 038:19:50:30Z. Preferred Launch Time was 038:19:45:30Z (In-Plane Time) for a launch window of 5m1s.

**LAUNCH DELAYS**

- None. Launch occurred on time at 038:19:45:30Z, 1:45:30 PM CST on Thursday 02/07/08.

**TAL WEATHER**

Weather for the Transoceanic Abort Landing (TAL) sites during launch was benign. High pressure at the surface and aloft produced clear skies and light winds for Moron, Spain (MRN), Zaragoza, Spain (ZZA), and Istres, France (ESTRES). All three TAL sites were forecast GO throughout the launch count.

**CONTINUED…**
## PERFORMANCE ENHANCEMENTS
Include the standard set plus: 1) PE Operational High Q WIN/FEB, 2) OMS Assist, 3) a 52 nm MECO, and 4) Del Psi.  

## FLIGHT DURATION CHANGES/LANDING
On FD4, MMT concurred with formally changing mission duration from 11+1+2 to 12+0+2 to honor ISSP request for extra docked day for commissioning Columbus. (Activity did not fit 11-day mission.)

On FD7, MMT concurred with extending the mission duration to 13+0+2 to provide additional time needed to complete the activation of the Columbus module. Landing day was moved to 02/20/08.

## FIRSTS/LASTS
- First flight ECO sensor connector soldered mod
- First flight of new RSRM Nozzle-to-Case J-leg Joint Insulation configuration
- New Annex Flight Rule in place to outline operational use of ECO sensor voltage measurements
- Addition of the Modified Adjustable Protective Mitten Assemblies (APMA's) or Overgloves
- First operational support from the Columbus Control Center in Oberpfaffenhofen, Germany
- First reboost of ISS since December 2002
- Last Shuttle Mission for Shuttle Program Manager N. Wayne Hale, Jr., a 30-year veteran of NASA who helped lead the space agency’s recovery from the 2003 Columbia Disaster.

## MEMENTOS
- Mementos carried aboard STS-122 included three green starter flags celebrating the 50th anniversary of NASA and the 50th running of the Daytona 500 NASCAR Race, a dried red rose to be woven into a NASA-themed 50th anniversary float for the Tournament of Roses Parade, and 20 ESA flags whose use will be to commemorate the addition of Columbus to the ISS.
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<tbody>
<tr>
<td>STS-122/ISS 1E</td>
<td>Continued...</td>
<td>IELK Seat Liner Transfer at 040:23:20Z (5:20 PM CST, Feb. 9, 2008). At that time Daniel Tani became a member of STS-122 and Leopold Eyharts/ESA joined the ISS Expedition 16 as Flight Engineer.</td>
<td>- Landing occurred at KSC on Wednesday 02/20/08 at 9:07 AM EST, 46 years to the day after the first American, John Glenn, orbited the Earth. - Daniel Tani returned home after 120 days.</td>
<td>SIGNIFICANT ANOMALIES:</td>
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**NOTES:**
- Landing occurred at KSC on Wednesday 02/20/08 at 9:07 AM EST, 46 years to the day after the first American, John Glenn, orbited the Earth.
- Daniel Tani returned home after 120 days.

**SIGNIFICANT ANOMALIES:**
- Overexposed video due to suspected AUV.
- Fuel Cell 3 O2 flowmeter is erratic.
- During flight, Port AFT MPM Pedestal Stow indications came on approximately 11 hours after actual stow.
- SSR1#1 intermittent comm dropsouts.
- Suspect indication of possible IM crack on noted tile.
- CCIV black and white video shows intermittent color.
- Mid Port Payload Bay Floodlight not illuminating SRB.
- One of the three main parachutes on BI-132 LH showed significant damage in the canopy.
- FSRRM: Missing piece of forward factory joint weather seal, FSRRM-99B
- SSME: None

**ET:**
- ET-124 - Post Launch camera and film review showed LH2 acreage foam loss at Sta. 1160 during Launch.
- A crack in the +Y SRB Pal Ramp was observed prior to the ET-125 tanking test on 12/18/07.
- A crack in the +Y Longeron Closeout was observed during the post-drain walkdown after the ET-125 tanking test on 12/18/07.
- During the first launch attempt of ET-125 on 12/06/07, ECO/S #3 and #4 failed wet.

**HO:**
- STS-122/ET-125 launched on 02/07/08. Post Launch camera and film review showed LH2 acreage foam loss at Sta. 1145 during Launch.
- STS-122/ET-125 - Post Launch camera and film review showed TPS losses at the intertank to LH2 flange closeout at two locations.

**MOD:**
- High-speed data dropouts during Launch.
- Trajectory Server GPS time misconfiguration.

**Integration:**
- Stinger tile observed falling after SSME startup.
- Ku-Band radiated in Hi Power.
- Unexpected debris expected debris exceeding mass allowable prior to pad clearance (liftoff debris)
- LH2 to LH2 Flange closeout foam loss.
- 2 locations of red foreign material located on SRB.
- LO: Umbilical Cable Tray foam loss (aft of X1-2096).
- STS-122 LH2 ECO failure.
- LH2 acreage loss adjacent to X1 1129 LQ, Feedline base closeout.
- LH2 acreage loss aft of +Y bipod.
- Missing/peeled SF-EPDM on RH Forward Segment Factory Joint.

**ABOVE:** JSC2008-e-012993 --- The STS-122 Orbit 1 Flight Control Team pose for a portrait in the Space Shuttle FCR at the JSC MCC. Flight Director Mike Sarafin (center right) holds the STS-122 mission logo.

**BELOW:** JSC2008e020392 --STS-122 Ascent FCT poses with the crew in JSC MCC. FD Norm Knight (left) & CAPCOM Jim Dutton hold the mission logo. Crew pictured are CDR Frick, PLT Poindexter, Melvin/MS, Walheim/MS, & Schlegel/MS. (Not pictured was Love/MS.)

---

**NASA agreed to open its California landing strip on Wednesday, 02/20/08 so Atlantis could land that day, even if weather was bad at KSC. “The reason is to give the military the biggest possible window and maximum flexibility to ensure the success of the satellite intercept” per Lead Shuttle Flight Director Sally Davis.**

**Transfers:**
- Hardware transferred to ISS (outside and inside): 3040lbs
- Columbus - ESA Laboratory: 21657 lbs.
- Hardware/supplies transferred from ISS: 3358 lbs
- H2O transferred to ISS: 1386 lbs
- O2 transferred to ISS: 95 lbs
- N2 transferred to ISS: 27 lbs

**FD19:**
- Reboost at 047:12:17:00.0Z resulted in 187.8 by 177.6 nm orbit (first reboost since December 2002).
- ISSP estimated prop savings to get 400 lbs of logistics gains.

**FD20:**
- Uncloaked at 049:09:24:42Z following a Syrion (2012 lap)
- Separation Burn 1 at 049:10:34:02Z resulted in 188.9 by 175.8 nm orbit.
- Separation Burn 2 at 049:11:01:30.0Z resulted in 187.9 by 175.5 nm orbit.
- No communications blackout during Entry.

---

**CONTINUED...**

- During crew health issue, EVA1 postponed from FD4 to FD5.
- FD5 EVA 1: EV1 and EV3 (sub for EV2, health issue) performed Columbus prep activities: connected data, power, and communications lines; removed LTA cable and CEM seal cover; installed PORF; performed NTA prep activities; and stowed OTSD. Columbus second stage bolting completed at 3:44 PM CST Monday, 02/11/08. EVA1 duration 7h58m.
- FD7 EVA 2: EV1 and EV2 completed primary task to R&R a spent Nitrogen Transfer Assembly, outfit Columbus with trunnion covers, and repair Lab MMCD shield. EVA 2 duration 6h45m. The CMS Pod stinger tile was cleared for entry.
- FD9 EVA 3: EV1 and EV3 transferred SOLAR to Columbus, installed Columbus keel pin cover and handrail, transferred CMG to PLB, transferred EUTEF, and performed Avlock handrail damage swatch test. EVA 3 duration 11h28m.
- FD11 EVA 4: EVA NOTE: One EMU glove from STS-122, S/N 6197, had a 0.16-inch hole in the Ventra of left thumb that wasn’t seen until postflight inspections on the ground. S/N 6197 was Rex Walheim’s left glove worn on all three EVAs (per STS-123 03/11/08 MMT notes).
<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW/ (6+1 UP/6+1 DN)</th>
<th>LANDING SITE/ LIFTOFF TIME</th>
<th>LANDING TIME/ LANDING TIMES</th>
<th>LANDING SITE/ ORBIT/ CROSSRANGE</th>
<th>THROTTLE PROFILE ENG. S/N</th>
<th>ORBIT/ SRB RSRM</th>
<th>PAYLOAD WEIGHTS/FLOW</th>
<th>MISSION HIGHLIGHTS</th>
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<tbody>
<tr>
<td>STS-123/1JA</td>
<td>ENDEAVOUR</td>
<td>07/01/06/142</td>
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<tr>
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<tr>
<td>25TH SHUTTLE FLIGHT TO ISS</td>
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</table>

**ORBITER**: ENDEAVOUR, ISS 1JA

**CREW**

- 07/06/142: Dominic L. Gorie
- 03/11/08/112: Robert L. Behnken
- 03/26/08/10: Garrett E. Reisman

**LANDING SITE/ LIFTOFF TIME**

- 07/01/06/142: KSC 39A
- 03/11/08/112: P759/R231/V195/M201
- 03/26/08/10: P759/R231/V195/M201

**MISSION HIGHLIGHTS**

- **ORBITER**: ENDEAVOUR, ISS 1JA
- **CREW**
  - Dominic L. Gorie
  - Robert L. Behnken
  - Garrett E. Reisman
- **LANDING SITE/ LIFTOFF TIME**
  - KSC 39A
  - P759/R231/V195/M201
  - P759/R231/V195/M201

**PAYLOADS/ EXPERIMENTS**

- **CARGO**: 36,155 LBS
- **PAYLOAD CHANGEABLE**: 3,072 LBS
- **DEPLOYED**: 1,242 LBS
- **NON-DEPLOYED**: 1,132 LBS
- **DEPLOYED**: 1,132 LBS
- **SHUTTLE ACCUMULATED WEIGHTS**: 1,132 LBS
- **DEPLOYED**: 1,242 LBS
- **NON-DEPLOYED**: 1,132 LBS

**MISSION HIGHLIGHTS**

- BREST MISSION SUMMARY: STS-123/1JA (25th ISS mission)
- Delivered the first pressurized component of the Japanese Kibo Laboratory to ISS, delivered a Canadian robotic device called Dextre, and provided five spacewalks. Endeavour's 16-day flight was the longest shuttle mission to the ISS. The Japanese Experiment Logistics Module Pressurized Section (ELMFS or JLP), the smaller of two pressurized modules of Kibo, was attached temporarily to a docking port on the space-facing side of Harmony. Kibo, which means "hope," is the major Japanese (JAXA) contribution to the Station, and will increase its research capability in a variety of disciplines. The robot Dextre is designed somewhat like the human form with a torso, a head area (camera), and arm appendages. It rides on the SSRMS as a "dexterous tool for ORU changeout without requiring a space walk." This mission included representation of all five Station partner interests - the U.S., Japan, Canada, Russia, and the European Space Agency (ESA).

**LANDING SITE/ LIFTOFF TIME**

- 07/01/06/142: KSC 39A
- 03/11/08/112: P759/R231/V195/M201
- 03/26/08/10: P759/R231/V195/M201

**LAUNCH POSTPONEMENTS**

- Added STS-123 to FDRD - launch date of NET 12/08/07 on
- Postponed to 02/14/08 on 04/16/07. Slip due to STS-117 rollback
- Postponed to 03/11/08 on 01/29/08. Slip due to ECO sensor problems experienced during December launch attempt of STS-122

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**Space Shuttle Missions Summary**

**STL-123/ISS 1JA**

**Title Names & Evas**

- ISS016-E-032598 (12 March 2008) — The Canadian-built Dextre robotic system and the Japanese Kibo laboratory (JLP) are visible in Endeavour’s cargo bay on approach to ISS.

- ISS016-E-033684—Crews: STS-123 (green shirts) & ISS Exp 16 (blue shirts), ISS CDR Peggy Whitson (second right, rear), Yuri Malenchenko/FSA FE (left, front), and Garrett Reisman/FE (left rear). Also in green shirt is Leopold Eyharts/ESA (right rear), former Exp 16 FE, who has moved over to the STS-123 crew. Leaving ISS with Eyharts are the Endeavour crew CDR Dominic Gorie (second left, rear), PLT Gregory H. Johnson (behind Malenchenko), Takao Doi/JAXA MS (right front), Rick Linnehan/MS (behind Doi); Mike Foreman/MS (second right, center row); Robert L. Behnken/MS (far left, center row).

**Crew (6+1 LRb+1 DN)**

- MCC WHITE FOR (52)
- MCC WHITE FOR (52)
- MCC WHITE FOR (52)
- MCC WHITE FOR (52)
- MCC WHITE FOR (52)
- MCC WHITE FOR (52)

**Launch Site, Lift Off Time, Cross Range, Emerg and ET**

- WINDS: 1.5T 1.3L KTS
- OFFICIAL: VI01002P03 KTS
- DENS ALT: -336 FT
- FLT DURATION: 15:18:10:52
- SIT: 115°55:00-57:10
- OV-106: 235:02:18:33
- DISTANCE: 6,577,857 sm
- TOTAL SHUTTLE DISTANCE: 467,923,507 sm

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**Mission Highlights (Launch Scrubs/Delays)**

- TAL WEATHER: Weather at the TAL sites was tricky as showers were monitored near Zaragoza, Spain and Istres, France during the launch countdown. Post cold front low level wind flow from the northwest brought showers to the windward sides of the Pyrenees and central French mountains. These showers dissipated as they crossed the high terrain. TAL weather was GO.

- PERFORMANCE ENHANCEMENTS: Include the standard set plus: 1) PE Operational High Q Win/MAR, 2) OMS Assist, 3) A 52 nm MECO, and 4) Del Psi

- Flight Duration Changes/Landing:
  - Decolet burn was planned for 086:21:58:14Z. Due to low clouds moving in at KSC, the decort burn was delayed to second opportunity at 086:23:33:13.9Z. Landing occurred at 087:00:39:06Z, Wednesday, 03/26/08, at 8:39:06 PM EDT.

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**Flight Directors**

- ASC - B. C. Lunney
- LD/O2 - D. J. Weigel
- O1 - K. L. Alibaruho
- O2 - R. E. LaBrode
- PLNG - M. R. Abbott
- ENT - R. S. Jones
- MOD - P. L. Engelauf
- Team 4 - R. S. Jones/ A. J. Cecconacci

**Shuttle**

- ISS: LDOR - B. C. Lunney
- O1 - K. L. Alibaruho
- O2 - R. E. LaBrode
- PLNG - M. R. Abbott
- ENT - R. S. Jones
- MOD - P. L. Engelauf
- Team 4 - R. S. Jones/ A. J. Cecconacci

**CAPCOMs**

- SHUTTLE: ATE - J. F. Dutton
- K. A. Ford (Wx)
- LDOR - T. W. Virts
- O2 - N. J. Patrick
- PLNG - B. A. Drew
- Team 4 - N/A

---

**Payloads/Experiments**

- First 16-day Space Station Assembly Mission, 12 days docked. (Longest mission is STS-67 - Spacelab, 16D 21H 47M 35S.)

- ISS - This is the last modified tank (before Columbia) and the next will be a tank built with all mods done in line.

- First flight with John Shannon as Shuttle Program Manager.

- A redesign to RSRM Nozzle Joints 2 and 5, the latter with an additional bolt enhancement, follows up the new Nozzle-to-Case J-leg Joint insulation configuration that debuted on STS-122’s motors.

- First flight of a lighting system derived from an off-the-shelf flash (Nikon SB800) was added to a digital camera (in orbiter umbilical well) to capture photos of ET after separation for about 130 ft away.

- This is the test modified tank (before Columbia) and the next will be a tank built with all mods done in line.

- First on-orbit test of orbiter tile repair technique.

- First time the OBSS was left on the Station so that the next flight can deliver the large JAXA Kibo module.

- This mission marks a significant milestone with the inauguration of the JAXA IP support to real-time operations, adding them to the fold with ESA, CSA, and Russia. “We have reached a new pinnacle in the ‘international’ part of the Space Station operations.”

- Spacelab Logistics Pallet (SLP) used by Dextre made its fourth and final flight to space, “concluding a long history that can be traced back before the first shuttle left the launch pad.” — PAO.

- First flight with John Shannon as Shuttle Program Manager. NOTE: The unmanned cargo ship Jules Verne, the ESA’s first Automated Transfer Vehicle (ATV), launched toward ISS on March 7. It was parked well away from ISS at a safe distance until Endeavour’s departure.
STS-123
ISS 1JA  

**Title Names & EVAs**

**Crew**
- FLT 01 - Z. Jones
- LDV2 - S. K. Robinson
- GS - M. T. Vande Hei
- Team 4 - R. C. Dempsey

**Events**
- OMS2 ignition at 071:07:07:06:44.0Z resulted in a 124.9 by 84.8 nm orbit.
- SRMS OBSS/LDRI survey of nosetop and port and starboard wing RCC (WLE's) was completed.
- TI maneuver at 073:00:42:21.9Z resulted in a 186.3 by 180.6 nm orbit.
- R-Bar Pitch Maneuver was performed. No issues
- Docking contact occurred at 073:03:45:54.0Z.
- Hard Dock occurred at 073:04:02:11.0Z
- ISS Hatch opened at 073:05:36:00.0Z, 12:36 AM CDT, Thursday, March 13, 2008, ISS crew welcoming
- EVA Seat Liner Transfer at 073:07:50:00.0Z (2:50 AM CDT, March 13, 2008). At that time Leopold Eyharts/ESA became a member of STS-123 and Garrett Reisman joined the ISS Expedition 16/17 as Flight Engineer.
- The first transfer item after hatch opening was swapping Garrett Reisman/MS for Leopold Eyharts (ESA)/Expedition 16 FE. The transfer was official when the form-fitting Soyuz seatliners were swapped. Eyharts spent 33 days as a member of ISS Expedition 16. With the on-time landing of March 26, Eyharts spent a total of 48 days in space.
- FD4/5: EVA 1: EV1 & EV4: JLP prepped for unberthing, shuttle robot arm grappled JLP, Orbital Replacement Unit (ORU) and Tool Changeout Mechanism installed on the Canadian Special Purpose Dexterous Manipulator (SPDM or Dextre) arm 2 and arm 1, shuttle arm unberthed JLP, and shuttle arm installed JLP onto Harmony zenith port (temporary location until Kibo delivery on STS-124). Unable to provide keep-alive power to SPDM (later determined to be flawed cable in pallet). EVA 1 duration 7:01
- FD6: While Expedition 16 and STS-123 crewmembers brought the Kibo logistics module to life, Dextre's power supply unit was brought to life via the SSRMS.
- FD6: EVA 2: EV1 & EV4: EVA ran long due to problems with the SPDM Arm Expandable Diameter Fasteners (EDFs) not releasing per procedure. Crew ended up using a pry bar. Time didn't permit removing some of the SPDM blankets. EV3 experienced RTV delamination. Per Rule (1JA C2-105), EMU OVERTIGHT EXCEPTIONS, crew continued the SPDM assembly task without donning overgloves due to the thermal constraints on SPDM. EV3 donned overgloves once the thermal critical tasks were complete. ISS multimeter was repaired and would later be swapped with shuttle multimeter prior to hatch closure. Installed the Node 2/JLP vestibule barrier assembly. EVA 2 duration 7:09

**Payloads/ Experiments**

**Payload Weights, Mission Highlights**

**FLT ORBITER CREW**

**Launch Site, Lift Off Time, Landing Sites, Abort Times**

**Landing Times, FLT Duration, Winds**

**Throttle Profile, ENG. SN**

**SMM - TL NOM - ABORT EMERG**

**SRB RSRM**

**Launch Scrubs/Delays, No. Title, Names & EVA’s, Landing Sites, Abort Times, Landing Times, FLT Duration, Winds, Throttle Profile, ENG. SN, SSM - TL NOM - ABORT EMERG, SRB RSRM, ORBIT, FSW, PAYLOAD WEIGTS, PAYLOADS/ EXPERIMENTS**

**TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**
STS-123/ISS 1JA

Flight Directors Bryan Lunney & Norm Knight in JSC MCC

- FD8: RRT Loss in EVA Gloves: EV3's gloves were NO-GO for subsequent EVAs. First spare set used on EVA 4.
- FD8: EVA3: EV1 & EV2: Finished assembly of Dextre, including installation of tool holder assembly and a Camera Light Pan Tilt Assembly (CLPA) which serves as Dextre's eyes. Also, the Spacelab Logistics Pallet used for assembly was prepared for return to shuttle cargo bay. Attempted to install MISSE-6 experiment (unsuccessful - moved to EVA5). EVA 3 duration 6:24

FD10: Japanese Prime Minister called to congratulate the crew.
- FD10: During press interview, asked to describe the fast-growing Space Station, Reisman said the crew was struck by the view during final approach and similarities with the famous Space Station scene in the movie “2001: A Space Odyssey” by Stanley Kubrick and Arthur C. Clarke. Clarke died during this mission on 3/19/08 at the age of 90. Clarke in “First on the Moon” stated, “The inspirational value of the space program is probably of far greater importance to education than any input of dollars... a whole generation is growing up which has been attracted to the hard disciplines of science and engineering by the romance of space.”
- FD11: EVA4: EV2 & EV3: Tasks were Remote Power Control Module removal and replacement, and the Tile Repair Ablator Dispenser (T-RAD) detailed test objective worksite setup and demonstration. The demonstration was considered a “huge” success, but needs results from post-landing detailed analysis. EVA 4 duration 6:02

SIGNIFICANT ANOMALIES:
Orbiter:
- Sensor Unit S/N 1150 on the port wing had excessive triggers (quantity 4452) during the first hour of MMOD monitoring for Late Inspection.
- Integrated Sensor Inspection System Sensor Pack 1 Pan Till Unit 10 degrees offset
- DCS OH card 1 failure
- FEES shutdown on Primary A Controller
- GG Chamber pressure indicated a shift upward
- APU 1 fuel tank pressure decay
- LH CMO Pod mid surface temperature
- Sensor Unit 1150 (Ref Des: 65V08A01) on the port wing
- APU 3 seal cavity drain line pressures indicate slow decay.
- Body Flap tile damage
- Aft arrowhead damage
- STEED PVM RAD Retract Flexhose did not fully retract into RRSC
- DCS OH card 1 failure
- APU 1 Gas Generator Chamber Pressure Transducer shift
- Cabin Temp Controller 1 noisy
- MPS E-3 LOX Inlet pressure showed a shift of 30 psi at Liftoff.
- MADS PCM MSPWNT gradually and abruptly moved to CSH throughout the MADS and MIV1/SSS1 recording phase.
- Lost OMS POD (RH OMS224) pufy control during the STS-123-101044-174 (B6-18) tile
- Damage to the STS-191101-043 (B6-18) tile
- SRB:

- Loss of data from SRB RHET Observation Camera during Ascent
- RSM: None
- SSME: None
- ET: None
- MCC: None
- White-VTS-Server hung Integration:
- Unexpected debris/expected debris exceeding mass allowances prior to pad clearance (Liftoff debris)
- Stub Tile damage during SSME ignition
- Tile chips on orbiter stringers during SSME ignition

Hardware transferred to Station (outside and inside: 25639 lbs)
- Hardware transferred to Station (outside): 23776 lbs
- Hardware transferred to Station (inside): 1863 lbs
- Japanese pressurized logistics module: 18177 lbs
- Dextre - Special Purpose Dexterous Manipulator: 3431 lbs
- Middelkamp items received from ISS aboard Endeavour: 1565 lbs
- Water transferred to Station: 650 lbs
- Oxygen transferred to Station: N/A
- Nitrogen transferred to Station: 23 lbs

Communications blackout time during Entry: 8m

NOTE: Currently, 590826 lbs mass in space of the ISS and ISS assembly 70% complete.
STS-124/ISS 1J

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6+1 LPS+1 DN)</th>
<th>LANDING SITE, LIFTOFF TIME</th>
<th>LANDING TIMES</th>
<th>LANDING DAY, CROSSRANGE</th>
<th>LIFTOFF SITE, CROSSRANGE</th>
<th>LIFTOFF TIMES</th>
<th>SRB</th>
<th>PAYLOADS/EXPERIMENTS</th>
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<tbody>
<tr>
<td>STS-124/ISS 1J</td>
<td>OV-103 (Flight 35)</td>
<td>DISCOVERY</td>
<td>KSC 39A</td>
<td>152:21:00:12Z</td>
<td>5:01:12 PM EDT (9)</td>
<td>05/31/08 (9)</td>
<td>164:14:10:12Z</td>
<td>FSW</td>
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<td>KSC-123</td>
<td>PD 39A-46</td>
<td>MLP-3</td>
<td>LANDING WINDOW 6M-475 (FLT IN-FLIGHT)</td>
<td>KSC 15 (KSC 69)</td>
<td>166:15:15:18Z</td>
<td>11:15:18 PM EDT (Saturday) 06/14/08 (8)</td>
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<td>164:14:10:12Z</td>
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<td>MS 24/25/08-2048 (8)</td>
<td>MS 24/25/08-2048 (8)</td>
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<td>TAL 15 NIN</td>
<td>TAL 16 NIN</td>
<td>TAL 17 NIN</td>
<td>X RANGE: 270.2 NM</td>
<td>X CG: 1088.03 IN</td>
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<td>0.500 (6)</td>
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<td>701.98 (6)</td>
<td>1000.00 (6)</td>
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<td>1900.00 (6)</td>
<td>2030.00 (6)</td>
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<td>ACTUAL: 104/104.5/104.5</td>
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<tr>
<td>MS 5 SPS</td>
<td>(Exp 17/18)</td>
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<td>M405</td>
<td>51.6 (28)</td>
<td>DIRECT INSERTION</td>
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<td>SPECIAL EDUCATOR</td>
<td>“BZZ” Lightyear (UPSPC 18)</td>
<td>See “Firsts”</td>
<td>M405</td>
<td>51.6 (28)</td>
<td>DIRECT INSERTION</td>
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**MISSION HIGHLIGHTS**

**LAUNCH POSTPONEMENTS**
- Added STS-124 to RDO - launch date of 02/28/08 on 02/22/07.
- DLS to 02/24/08 on 02/16/07. Slip due to STS-117 rollback.
- DLS to 03/25/08 on 03/07/08. Slip due to ET delivery delay and beta angle restriction.
- DLS to 05/31/08 on 04/30/08. Slip due to adverse weather conditions affected on dock delivery date of ET-128.

**LAUNCH SCRUBS:** None

**LAUNCH WINDOW**
Total launch window was 75 minutes 45 seconds with window open at 152:21:01:14Z and close at 152:21:01:59Z. Preferred Launch Time was 152:21:01:12Z (In-Plane Time) for a launch window of 6m7a.

**PAYLOADS/EXPERIMENTS**
- P4: 160/160/160 LBS
- FPR: 2251 FUEL BIAS: 1063 FINAL TOEP: 1308 RECON: 2513

**MISSION SUMMARY:** STS-124/1J (26th ISS mission) delivered the second and main segment of the Japanese (JAXA) Station Kibo (Hope) Laboratory. This segment known as the Japanese Pressurized Module (JPM) is the ISS’s largest laboratory measuring 14.4 feet in diameter and 36.7 feet long. The Kibo complex also includes: an airlock and two robotic arms also delivered on this flight; the Japanese Experiment Logistics Module Pressurized Section (launched on STS-123); and an exterior platform for experiments exposed to space, scheduled for delivery on STS-127. The STS-124 mission is the first in which the JAXA Flight Control Team activated and controlled a module from Kibo Mission Control in Tsukuba, Japan. Also, as the STS-124 launch countdown got underway, a special Russian pump was added to Discovery’s manifest to fix “a faulty toilet” on the ISS.

**LAUNCH DELAYS:**
Launch occurred on time at 152:21:01:12Z, 5:02:12 p.m. EDT, Saturday, May 31, 2008. On launch day, the sea breeze pushed across KSC with showers just west of the launch pad several hours before launch time. However, the sea breeze had pushed west of KSC by early afternoon with near ideal conditions for launch. Thunderstorms were occurring over central Florida but were well outside the 20 nautical mile thunderstorm flight rule limit. “Nice day to send ‘Hope’ to the ISS” – PAO. Caff “If you watched today, you saw a flawless countdown.”

Continued…
## SPACE SHUTTLE MISSIONS SUMMARY

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SPACE SHUTTLE MISSIONS SUMMARY

FLT ORBITER CREW (7) LAUNCH SITE, LIFTOFF TIME, LANDING SITE/ RUNWAY, CROSSRANGE SSME-TL NOM-ABORT EMERG SIRB RSRM ORBIT FSW PAYLOAD WEIGHTS, PAYLOADS/ EXPERIMENTS MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAI WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

STS-124/ ISS 1J

Continued...

CAPCOMS:

SHUTTLE
ATE: T. W. Virts
- K. A. Ford (Wx)
LDO1: N. J. Patrick
C2: B. A. Drew
PUNG: S. W. Lucid
Team 4 - N/A

ISS:
C1: M. T. Vande Hei
LD/O1: C. J. Cassidy
LD/O2: M. C. Jensen
Team 4 - N/A

EVENTS:

- Shuttle launch sent asbestos 1,800 feet from pad. The 6 million pounds of thrust from Discovery’s engines, channeled by the flame trench, blasted bricks, concrete rubble, and asbestos beyond a perimeter fence some 1,800 feet away. Bricks and some asbestos landed in a retention pond behind the fence. No damage to Shuttle.
- OM2S ignition at 152:21:39:32.5Z resulted in a 170.3 by 125.0 NM orbit.
- NOTE: SRMS OBSS/LDRI survey of nosecap and port and starboard wing RCC (WLE’s) was not performed until post undocking (no OBSS on Shuttle).
- FD2: TI Maneuver at 154:15:16:26.0Z resulted in a 183.9 by 182.2 NM orbit.
- R-Bar Pitch Maneuver was performed. No issues
- FD3: Docking Contact occurred at 154:18:03:20Z
- Hard Dock occurred at 154:18:16:30Z.
- ISS Hatch opened at 154:19:30:00Z, 2:30 PM CDT, Monday, June 02, 2008; welcomed by ISS crew.
- FD4: EVA 1: Egress was delayed by about 1 hour to reconnect Fossum’s comm cap - lost comm during pre-breathe. Fossum & Garan, prepared the Kibo (JPM) for its removal from the Shuttle payload bay, disconnecting cables and removing covers. JAXA MSHoshide and MS/Nyberg robotically removed Kibo from the Shuttle P6 bay and latched it to Harmony, Node 2. Hoshide noted: “We have a new ‘Hope’ on the ISS.” EV1 & EV2 assisted in the transfer of the OBSS from its ISS stored position (since STS-123) back to the Shuttle. The OBSS would be used with the shuttle robotic arm on FD12 to inspect the Orbiter heat shield. EV1& EV2 also demonstrated a technique that could be used to clean the starboard SARJ, which has had limited capability for several months. EV2 installed a new bearing and EV1 verified by inspection that a spot on earlier EVA’s was a divot. This will feed into further analysis of the origin of the damage. EVA 1 duration 6:48.
- FD5: Based on review of launch imagery, the MMT decided that the focused inspection of the Orbiter heat shield was not required.
- FD6: EVA 2 - Fossum & Garan outfitted the outside of the JPM, installing covers and external television equipment and removing thermal covers and insulation on the JAXA RMS and top hatch. They also loosened bolts holding two Nitrogen Tank Assemblies in place on the Station’s truss. Those tanks will be swapped during EVA 3. They also retrieved a failed external television camera from the port truss. In addition, Fossum inspected the left SARJ, which had been performing perfectly. No shavings or debris found, but photos were taken to be sent to the ground for review. EVA 2 duration 7:11.

Continued...

AT RIGHT: S124-E-005615 --- STS-124 & Exp 17 crews greet each other shortly after docking. Left Foreground: EXP17 CDR Sergei Volkov (RSA). Left, partially obscured CDR Kelly & PLT Ham. Fossum/MS (center left), Reisman/MS (center right); Oleg Kononenko/FE EXP17/RSA (right), Garan/MS, Chamitoff/MS, & Nyberg/MS. BELOW: Hoshide/MS (JAXA), not in photo at right, works in newly installed Kibo JPM.

ABOVE: S124-E-009982 (11 June 2008) — View of ISS configuration post Shuttle sep shows Kibo attached to Harmony at bottom center with first ESA ATV Docked at top center. AT LEFT: S124-E-010186 — The Kibo laboratory (center left) is shown after attachment to port side of Harmony Node with: Kibo logistics module at bottom left, Columbus lab at center right, and at top center is Dextre along with two docked Russian spacecrafts.
### Mission Highlights

#### STS-124/ISS 1J

- **FD9:** EVA 3: Fossum & Garan began the EVA 30 minutes ahead of schedule. The EVA was highlighted by Garan’s dramatic robot ride some 80 feet over the top of the ISS to replace a 550 lb nitrogen tank on the starboard truss. The ride was dubbed the “windshield wiper maneuver” or as Mark Carreau (Houston Chronicle) headlined it: “Wild robot-arm ride caps workday at Space Station.” Fossum returned to the port SARJ (inspected on EVA 2) taking particulate matter from inside the joint, using a strip of tape that was returned to Earth for analysis. He also removed thermal insulation from the Kibo robotic arm’s wrist and elbow cameras and launch locks from one of the Kibo windows and deployed debris shields on Kibo. Other tasks by the pair included: The repaired video camera retrieved on EVA 2 was re-installed and several extra tasks (installation of thermal cover on Harmony, relocation of foot restraint aid, and removal of SARJ launch lock) were conducted. EVA 3 duration 6:33.

- **Transfers:**
  - Hardware transferred to ISS (outside & inside): 34,363 lbs
  - Hardware transferred to ISS (inside): 1,787 lbs
  - Hardware transferred to shuttle (outside – OBSS): 536 lbs
  - Hardware/supplies transferred from ISS (inside): 1,807 lbs
  - H2O delivered to ISS: 569 lbs
  - O2 used for the 3 EVA’s: 92 lbs
  - O2 used for “stack maintenance:” 29 lbs
  - N2 transferred to ISS: 15 lbs
  - FD12: Undocked at 163:11:41:54Z followed by a fly-around (1/2 lap).
  - Conducted the late inspection of the Shuttle’s heat shield using the OBSS. No issues.
  - FD14: Rudder/Speedbrake thermal spring tab was seen floating away from the vehicle during the FCS checkout. The function of the tab is to prevent a flow path for ascent heating and is not required for entry. The TPS was cleared for entry.
  - [Post-flight, this issue was presented to 08/07/08 PRCB; decision was made to continue to fly as is. PRCB directed a new ascent thermal environmental assessment to consider flying without the tabs.]
  - No communications blackout during Entry

- **Significant Anomalies:**

  **Orbiter:**
  - TCS Dropouts during Rendezvous
  - Engine #2 Dome Heat C/P Tile Damage
  - Imagery Showed F3D (V070-421558-024) and F44 (V070-421558-025) Tyvek Rain Covers Released Late
  - IMU 1 Z Gyro excessive drift
  - The Left Hand ET Door BRI-18 Tile V070-395055-255
  - Rudder Speed Brake Thermal Tab found dislodged and floating
  - A buildup of ceramic adhesive identified under the Thermal Barrier
  - Closed 2 Indication failed to Transfer On when door was closed
  - Crew reported difficulty latching the External Airlock Upper Hatch prior to Undocking

  **KSC:**
  - STS-124 Pad debris items
  - SRB:
    - STS-124/B-134th Data Acquisition System failed to record video and obtained erroneous Accelerometer data
  - RSRM None. SSME None. MOD None ET:
    - STS-124/ET-128 Post-Launch Camera Film Review showed two foam losses (80971008428-510) on XI 1129 LC2 Feedline Support Fitting Closeout Integration:
      - Unexpected Debris/Expected Debris Exceeding Mass Allowable prior to Pad clearance (Ultrathick Debris)
      - Late Tyvek partial cover releases
      - Roll Moment during SRB Tail-off
      - Liberated Refractory Brick, NE Flame Trench Wall Pad A
      - ET TPS loss at ~XI 1129, near LO, Feedline Bracket

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**STS124-S-072** — A close look at Discovery post landing at KSC. From left: KSC Director Bill Parsons and Bill Gerstenmaier, NASA Associate Administrator for Space Operations. At right: JAXA Director of Program Management & Integration Yuichi Yamaura & VP Kaoru Mamiya.

**JSC2008-E-043220** — John McCullough (left), chief of the Flight Director Office, part of the Mission Operations Directorate at JSC, and Bryan Lunney, Flight Director and a mission manager observe KSC launch from MCC.
### SPACE SHUTTLE MISSIONS SUMMARY

**STS-126/ULF2**

**ORBITER:** OV-105 (Endeavour)

**FLIGHT NO.:** STS-126

**Crew:**
- **CDR:** Chris Ferguson
- **FD:** Sandy Magnus
- **LM:** Eric Boe
- **SR:** Steve Bowen
- **SS:** Shane Kimbrough
- **MS:** Donald Pettit
- **P7:** Chris Ferguson
- **P8:** Sandra Magnus
- **P9:** Eric Boe
- **P10:** Steve Bowen
- **P11:** Shane Kimbrough

**Launch Site/Landing Site:** KSC-39A/KSC-39A

**Launch Time:** 7:55:39 PM EST (P)

**Duration:** 1:25:09 PM PST

**Landing Time:** 335:20:19:29Z

**Entry Point:** LRG 193.1 NM

**Entry Velocity:** 219 KGS

**Entry Angle:** 72/104.5/104.5

**Entry Range:** 158.215W 36.202S 2040 FT

**Weighed:**
- **Orbiter:** 1760 LBS
- **Payload:** 18532 LBS
- **Total:** 1760 LBs

**Payloads/Experiments:**
- **Science:**
  - **SSME-TL:** 6+1 up/6+1 down
  - **Landing Sites:** SSME-TL
  - **Landing Times:** ET-129
  - **payloads:** RSRM
  - **Eng. S.N.:** 32
  - **Eng. S.N.:** 30432 LBS

**Mission Highlights:**

- Brief Mission Summary: “Extreme Home Improvements”

- STS-126/ULF2 (27th ISS mission) outfitted the ISS to increase accommodations from a crew of three to six. Life support and habitability additions included: an advanced resistive exercise device, a second toilet, a galley, two sleep stations and an integrated water recycling system.

- The mission also included EVA’s for lubricating the sluggish Solar Alpha Rotary Joints (SARJ) and installation of other external systems.

### STS-125 (HST Service) & LON Vehicle on Pads 39A & 39B

- **LON Vehicle:** STS-125 was ppd to 2009. Picture courtesy of Rod Ostoski/KSC-USA.

### Launch Postponements

- Added STS-126 to FDRD - launch date of 09/18/08 on 08/15/07.
- Ppd. to 10/16/08 on 02/14/08. Slip due to ECO sensor problems experienced during December launch attempt of STS-125.
- Ppd. to 11/12/08 on 09/08/08. Slip due to Hurricane Faye impacts to HST payload readiness.
- Ppd. to 11/16/08 on 09/24/08. Slip due to launch pad controversy.
- Ppd. to 10/16/08 to 10/14/08 caused by Hurricane Ike.
- Launched on Friday (26) 11/14/08 (15) STS-125.
- Ppd. to 10/16/08 on 02/14/08. Slip due to Hurricane Faye impacts to HST payload readiness.
- Ppd. to 11/12/08 on 09/08/08. Slip due to Hurricane Faye impacts to HST payload readiness.
- Ppd. to 11/16/08 on 09/24/08. Slip due to launch pad controversy.
- Ppd. to 10/16/08 to 10/14/08 caused by Hurricane Ike.

### STS-125/ULF2

- **Launch Window:** 72/104.5/104.5

- **Launch Scrubs:** None.

**Payloads:**
- **P1:** OMDL-176
- **P2:** MPS: 211 LBS

**Mission Highlights:**

- Brief Mission Summary: “Extreme Home Improvements”

- STS-126/ULF2 (27th ISS mission) outfitted the ISS to increase accommodations from a crew of three to six. Life support and habitability additions included: an advanced resistive exercise device, a second toilet, a galley, two sleep stations and an integrated water recycling system.

- The mission also included EVA’s for lubricating the sluggish Solar Alpha Rotary Joints (SARJ) and installation of other external systems.

**Endeavour was originally rolled to Launch Pad 39B as the Launch on Need (LON) vehicle in support of STS-125 HST servicing mission. Last minute complications with HST caused an indefinite delay for STS-125. Endeavour was rolled to Launch Complex 39A and prepared for the STS-126 November launch date. (Shuttles have only moved from one spacecraft launch pad to another twice before in the program’s history, in 1990 and 1993.)

**KSC WD**

- **CID:**
  - **MS:**
    - **MS1:** Heidemarie Stefanyshyn-Piper
    - **MS2:** Steve Bowen
    - **MS3:** Heidemarie Stefanyshyn-Piper
    - **MS4:** Shane Kimbrough
  - **P7:** Chris Ferguson
  - **P8:** Sandra Magnus
  - **P9:** Eric Boe
  - **P10:** Steve Bowen
  - **P11:** Shane Kimbrough

- **Payloads:**
  - **MIDDECK:** 211 LBS
  - **Shuttle:**
    - **ACCELEROMETERS:**
      - **WEIGHT:**
        - **MIDDECK:** 18532 LBS
        - **CARGO TOTAL:** 399716 LBS

- **Launch Site/Landing Site:** KSC-39A/KSC-39A

- **Launch Time:** 7:55:39 PM EST (P)

- **Duration:** 1:25:09 PM PST

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  - **Payload:** 18532 LBS
  - **Total:** 1760 LBs

- **Payloads/Experiments:**
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    - **SSME-TL:** 6+1 up/6+1 down
    - **Landing Sites:** SSME-TL
    - **Landing Times:** ET-129
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    - **Eng. S.N.:** 32
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**KSC WD**

- **CID:**
  - **MS:**
    - **MS1:** Heidemarie Stefanyshyn-Piper
    - **MS2:** Steve Bowen
    - **MS3:** Heidemarie Stefanyshyn-Piper
    - **MS4:** Shane Kimbrough
  - **P7:** Chris Ferguson
  - **P8:** Sandra Magnus
  - **P9:** Eric Boe
  - **P10:** Steve Bowen
  - **P11:** Shane Kimbrough

- **Payloads:**
  - **MIDDECK:** 211 LBS
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    - **ACCELEROMETERS:**
      - **WEIGHT:**
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        - **CARGO TOTAL:** 399716 LBS

- **Launch Site/Landing Site:** KSC-39A/KSC-39A

- **Launch Time:** 7:55:39 PM EST (P)

- **Duration:** 1:25:09 PM PST

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- **Entry Velocity:** 219 KGS

- **Entry Angle:** 72/104.5/104.5

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- **Weighed:**
  - **Orbiter:** 1760 LBS
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  - **Total:** 1760 LBs

- **Payloads/Experiments:**
  - **Science:**
    - **SSME-TL:** 6+1 up/6+1 down
    - **Landing Sites:** SSME-TL
    - **Landing Times:** ET-129
    - **payloads:** RSRM
    - **Eng. S.N.:** 32
    - **Eng. S.N.:** 30432 LBS

- **Mission Highlights:**

  - Brief Mission Summary: “Extreme Home Improvements”

  - STS-126/ULF2 (27th ISS mission) outfitted the ISS to increase accommodations from a crew of three to six. Life support and habitability additions included: an advanced resistive exercise device, a second toilet, a galley, two sleep stations and an integrated water recycling system.

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Continued…

**ISS-ULF2**

DOCKED QUEST EVA 49
EMU/TETHERED EVA 119
SCHEDULED EVA 117
DURATION 6:45

DOCKED QUEST EVA 50
EMU/TETHERED EVA 120
SCHEDULED EVA 118
DURATION 6:57

DOCKED QUEST EVA 51
EMU/TETHERED EVA 121
SCHEDULED EVA 119
DURATION 6:07

MCC WHITE FLIGHT FCR
(s4)

FLIGHT DIRECTORS:
SHUTTLE
ASC-Bryan Lunney
LD01- Mike Foreman
C02-Jerry Ross
C03-Paul Dye
Team 4-Richard Jones

ISS
C01 – Holly Ridings
LD02- Ginger Kerrick
C03 – Brian Smith
Team 4- Courtenary McMillan

Continued…

**STS-126**

DOCKED QUEST EVA 50
EMU/TETHERED EVA 119
SCHEDULED EVA 117
DURATION 6:45

DOCKED QUEST EVA 50
EMU/TETHERED EVA 120
SCHEDULED EVA 118
DURATION 6:57

DOCKED QUEST EVA 51
EMU/TETHERED EVA 121
SCHEDULED EVA 119
DURATION 6:07

MCC WHITE FLIGHT FCR
(s4)

FLIGHT DIRECTORS:
SHUTTLE
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C03 – Brian Smith
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Continued…

**MISSION HIGHLIGHTS**

LAUNCH WINDOW:
Total launch window was 9 minutes 26 seconds with window open at 320:00:50:52Z and close at 320:01:00:18Z. Preferred Launch Time was 320:00:55:39 (In-Plane Time) for a launch window of 4m39s.

LAUNCH DELAYS: None. Launch occurred on time at 320:00:55:39Z, 7:55:39 p.m. EST, Friday, November 14, 2008. Weather on launch day was acceptable. Isolated afternoon showers were observed at 60 miles south of KSC along the sea breeze late in the day. The showers diminished by sunset - not a threat for the evening launch time or RTLS.

TAL WEATHER:
Weather at the TAL sites was forecast/observed GO.

PERFORMANCE ENHANCEMENTS:
Include the standard set plus: 1) PE Operational High Q TRN/NOV, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del Psi

FLIGHT DURATION CHANGES/LANDING:
- FD 1 MMT decision made for a one-day extension for additional on-orbit time for the MCC WHITE FLIGHT FCR.
- Weather for landing was quite complex. Both KSC and EAFB were activated on Sunday (EOM) & Monday (EOM+1). Spaceflight Meteorology Group (SMG) weather forecasts were "NO GO" for KSC with crosswind, ceiling, precipitation, and thunderstorm flight rule violations. Also, two Tornado Watches were issued for central FL generating numerous thunderstorms and isolated tornadoes by mid day. The weather continued to deteriorate across central FL, prompting the MMT to assess the possibility of staying on orbit and attempting EOM+1 landing at KSC. The SMG forecasts for that day indicated marginal conditions for a safe return to KSC. After waving off the first opportunity to KSC and with weather conditions deteriorating through the day at KSC, the decision was made to land at EAFB. Weather conditions at EAFB were nearly ideal with light northeast surface winds and mostly clear skies. Endeavour touched down at 335:21:25:09Z (3:25 PM CST, November 30, 2008) on temporary runway 04. This runway was built due to construction and resurfacing of the primary runway.

At Left: STS126-S-044 — NASA Administrator, Michael Griffin (front) & Associate Administrator for Space Operations Bill Gerstenmaier watch the launch of the Space Shuttle Endeavour from KSC Launch Control Center on Nov. 14, 2008.
## SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
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<th>CREW TITLE, NAMES &amp; EVA'S</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABDORT TIMES</th>
<th>SSME-TL, ORBITER</th>
<th>SRB EMERG</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
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**STS-126/ISS-ULF2**

**CAPCOMS:**
- SHUTTLE
  - A/E – Alan Poindexter
  - Greg (Box) Johnson (Wx)
  - LD01 – Steve Robinson
  - O2 – Jim Dutton
  - Planning – Shannon Lucid
  - Team 4 - N/A
- ISS
  - O1- Terry Virts
  - LD/O2- Mark Vande Hei
  - O3 – Robert Hanley
  - Team 4 – N/A

**FIRSTS/SECONDS:**
- First water regeneration system to recycle urine into drinking water delivered and installed on ISS.
- First flight OI-33 Flight Software. Several minor changes made to improve Post MECO attitude control and reduce the risk of recontact with the ET.
- First flight of new SSME controller SW to downlink Advanced Health Management System (AHMS) data on orbit - provides backup to MADS data.
- First flight of redesigned EVA Prime Flight Glove TMG, a Turtleskin® reinforcement layer sandwiched between molded palm and RTV on thumb and index finger and new RTV-3145.
- First flight of redesigned LO2-to-Intertank Flange closeout per RTF B/L Plan
- First flight of ATK BSMs in both forward and aft positions.
- First flight of BSM Forward Segment Grain Redesign - eliminated waiver.
- First flight of SRB Installed Enhanced Data Acquisition System (EDAS) Units and Instrumentation.
- First flight of SRB Redesigned Frangible Nut with Pyrotechnic Crossover Assembly to help prevent stud hang-up.
- A Second: “World Toilet Organization (WTO) is a global nonprofit organization committed to improving toilet and sanitation conditions worldwide. World Toilet Day November 19th - During this mission the crew did their bit for WTD with installation of a new second toilet facility on ISS.”

**NIGHT LAUNCH:** # 31 NASA Test Director Charlene Blackwell-Thompson, “Endeavour is ready to go. And we’re really excited to share our version of a sunrise with you...”

**RENDEZVOUS:** #71 Rendezvous and dock with ISS.

**EVENTS:**
- AT L-1 hr NASA Security was informed of an inbound threat to the Shuttle about two miles off shore. Security sweeps came up all clear. At L-5 min officials determined no threat and cleared Shuttle for launch. The perpetrator of the hoax was later arrested, found guilty and sentenced to jail in November 2010.
- FD1: CM/S2 ignition at 320:01:33:58.3Z resulted in a 125.7 by 84.6 NM orbit.
- FD2: RCC inspection found no areas of concern - focused inspection cancelled on FD4.
- T1 maneuver at 321:19:26:48.02 resulted in a 192.4 by 184.3 NM orbit
- FD3: R-Bar Pitch Maneuver was performed. No issues.
- Docking Contact occurred at 321:22:01:17Z.

**S126-E-012247** — Endeavour & Exp 18 crews shared a Thanksgiving meal on middeck. At top Center, Magnus /STSUp/FE Exp18. Clockwise from her: Kimbrough/MS, PLT Boe, Yury Lonchakov/FE Exp 18, Bowen/MWS (partially visible behind Lonchakov), Pettit/MSDn, Exp 18 CDR Michael Fincke, Chamitoff/MS, Stefanyshyn-Piper/MS, CDR Ferguson (partially visible top L).
### SPACE SHUTTLE MISSIONS SUMMARY

#### MISSION HIGHLIGHTS

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<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, TIMES</th>
<th>ABORT TIMES</th>
<th>SSME-TL, ENG. S/N</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/EXPERIMENTS</th>
</tr>
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<tbody>
<tr>
<td>STS-126/ISS-ULF2</td>
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<td></td>
</tr>
</tbody>
</table>

---

#### EVENTS:

- **Flight in route to KSC**

- **STS-126 Ferry Flight in route to KSC**

---

#### SIGNIFICANT ANOMALIES:

- **Orbiter:**
  - The Fuel Cell 1 SN P760106 Hydrogen Flowmeter Measurement began Drifting High And Erratic at 320/12:36 GMT.
  - MER-02, LV57 E2 GH, FOC, After Engine Throttle up E2 GH. Line Shows a Drop of 200 Psi.
  - MPS Helium Bottle Lost 140 Psi During Ascent, OMPSD Allows 60 Psi Max. (MER-10).
  - GNC Bypass of Ku-Band Radar Data
  - Title Damage on Edge .63 x .23 x .05d

- **KSC:**
  - RDUnassigned - Column parity errors on all ME FEPs.
  - IRANS Failed at GMT Rollover.
  - STS126B136 Squawk 126-001: HDP 3 Blast Container Debris Containment Failure

- **SRB:**
  - STS126/B136 Squawk 126-001: HDP 3 Blast Container Debris Containment Failure
  - RSFSM, SSME, ET: None.

- **Mod:**
  - Updating Minimum EPS Consumables
  - Loss of Crewlock Bag during Eva #1
  - Over Torque of Trundle Bearing Assembly Mount
  - Middock Return Item Weights Missing
  - Debris Released Near the LH2 T-0 Plate Integration
  - SM GPC Failure to Send GCIL Commands
  - Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)

---

#### SIGNIFICANT ANOMALIES:

- **Orbiter:**
  - The Fuel Cell 1 SN P760106 Hydrogen Flowmeter Measurement began Drifting High And Erratic at 320/12:36 GMT.
  - MER-02, LV57 E2 GH, FOC, After Engine Throttle up E2 GH. Line Shows a Drop of 200 Psi.
  - MPS Helium Bottle Lost 140 Psi During Ascent, OMPSD Allows 60 Psi Max. (MER-10).
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  - RDUnassigned - Column parity errors on all ME FEPs.
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  - STS126/B136 Squawk 126-001: HDP 3 Blast Container Debris Containment Failure

- **SRB:**
  - STS126/B136 Squawk 126-001: HDP 3 Blast Container Debris Containment Failure
  - RSFSM, SSME, ET: None.

- **Mod:**
  - Updating Minimum EPS Consumables
  - Loss of Crewlock Bag during Eva #1
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  - Debris Released Near the LH2 T-0 Plate Integration
  - SM GPC Failure to Send GCIL Commands
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---

#### EVENTS:

- **IELK Seat Liner Transfer at 322:02:50:00Z (8:50 PM CST, Nov 16, 2008).** At that time Greg Chamitoff became a member of STS-126 and Sandra Magnus joined the ISS Expedition 18 as Flight Engineer.
  - FD5: Based on review of launch imagery, the MMT decided that the focused inspection of the Orbiter heat shield was not required.
  - FD5: EVA 1: Piper & Bowen transferred the Nitrogen Tank Assembly (NTA) from the External Stowage Platform (ESP)-3 to Lightweight MPESS Carrier (LMC), followed by the Flex Hose Rotary Coupler (FHRC) transfer from LMC to ESP-3. JEM EFBM Multi-Layered Insulation (MLI) Cover was removed in prep for c/o of EFBM (to be installed on 2JA later in 2009). Stbd SARJ trundle bearing assembly (TBA) #10 and #6 were replaced, and the stbd race ring was partially cleaned and lubed. A crew equipment bag was inadvertently released during the EVA, but there was sufficient redundant cleaning and lube equipment to finish scheduled tasks. EVA 1 duration 6:52.
  - FD5: Home improvements continued aboard ISS with installation of two new bedrooms and preparations to activate the water recycling facility.
  - FD7: EVA2:  Piper & Kimbrough relocated the CETA carts in prep for 15A install of Water Recovery System (WRS) rack in Destiny lab.
  - FD8: UPA anomalous shutdown due to centrifuge speed below limits & high motor current.
  - FD9: UPA anomalous shutdown due to centrifuge speed below limits & high motor current.
  - FD9: EVA3: Piper & Bowen continued cleaning of ISS stbd SARJ; R&R’ed the remaining TBA; and cleaned area around SARJ’s drive lock assemblies. EVA3 duration 6:57.
  - FD10: EVA4: Bowen & Kimbrough completed stbd and port SARJ lube tasks; P1 lower inboard camera installed in camera port 7; external facility berthing mechanism latch bolt retracted via EVA override and cover reinstalled; JEM GPS A installed and heaters checked out ok, JEM GPS B deferred to stage or next flight; and, no get-ahead radiator imagery was taken. EVA4 duration 6:07.
  - FD11: EVA5: Bowen & Kimbrough completed stbd and port SARJ lube tasks; P1 lower inboard camera installed in camera port 7; external facility berthing mechanism latch bolt retracted via EVA override and cover reinstalled; JEM GPS A installed and heaters checked out ok, JEM GPS B deferred to stage or next flight; and, no get-ahead radiator imagery was taken. EVA5 duration 6:07.
  - FD12: EVA6: Bowen & Kimbrough completed stbd and port SARJ lube tasks; P1 lower inboard camera installed in camera port 7; external facility berthing mechanism latch bolt retracted via EVA override and cover reinstalled; JEM GPS A installed and heaters checked out ok, JEM GPS B deferred to stage or next flight; and, no get-ahead radiator imagery was taken. EVA6 duration 6:07.
  - FD13: EVA7: Bowen & Kimbrough completed stbd and port SARJ lube tasks; P1 lower inboard camera installed in camera port 7; external facility berthing mechanism latch bolt retracted via EVA override and cover reinstalled; JEM GPS A installed and heaters checked out ok, JEM GPS B deferred to stage or next flight; and, no get-ahead radiator imagery was taken. EVA7 duration 6:07.
  - FD14: EVA8: Bowen & Kimbrough completed stbd and port SARJ lube tasks; P1 lower inboard camera installed in camera port 7; external facility berthing mechanism latch bolt retracted via EVA override and cover reinstalled; JEM GPS A installed and heaters checked out ok, JEM GPS B deferred to stage or next flight; and, no get-ahead radiator imagery was taken. EVA8 duration 6:07.
  - FD15: Undocked at 333:14:47:26Z followed by Sep-1, Sep-2 and Sep-3; OBSS surveys on starboard, nose cap and port; and, LTDs downlink.
  - Communications blackout during Entry: “There were a few drop outs but nothing big around GMT 335:21:09 D/H.”

---

#### Significant Anomalies:

- Orbiter:
  - The Fuel Cell 1 SN P760106 Hydrogen Flowmeter Measurement began Drifting High And Erratic at 320/12:36 GMT.
  - MER-02, LV57 E2 GH, FOC, After Engine Throttle up E2 GH. Line Shows a Drop of 200 Psi.
  - MPS Helium Bottle Lost 140 Psi During Ascent, OMPSD Allows 60 Psi Max. (MER-10).
  - GNC Bypass of Ku-Band Radar Data
  - Title Damage on Edge .63 x .23 x .05d

- KSC:
  - RDUnassigned - Column parity errors on all ME FEPs.
  - IRANS Failed at GMT Rollover.
  - STS126/B136 Squawk 126-001: HDP 3 Blast Container Debris Containment Failure
  - RSFSM, SSME, & ET: None.

- Mod:
  - Updating Minimum EPS Consumables
  - Loss of Crewlock Bag during Eva #1
  - Over Torque of Trundle Bearing Assembly Mount
  - Middock Return Item Weights Missing
  - Debris Released Near the LH2 T-0 Plate Integration
  - SM GPC Failure to Send GCIL Commands
  - Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6+1 LRP+1 DN)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE/ RUNWAY, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NO/ABORT EMERG</th>
<th>SRB RSRM AND ET</th>
<th>INC</th>
<th>HA/HP</th>
<th>PAYLOAD WEIGHTS</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-119/ ISS-15A</td>
<td>OV-103</td>
<td>CDR: Lee Archambault</td>
<td>KSC 39A, 074:23:43:44Z</td>
<td>KSC 15 (KSC 70) 067:19:13:26Z 21:13:04PM CDT</td>
<td>Saturday (23) 03/28/09 (10)</td>
<td>DIRECT INSERTION POST OMS-2: 120.0, 84.9, 9</td>
<td>104/104</td>
<td>51.6 (28)</td>
<td>Bi-135</td>
<td>39088 LBS</td>
<td>PRL</td>
<td>30008 LBS</td>
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<tr>
<td>SEQ</td>
<td>FLT # 125</td>
<td>OMS PODS LPA-101</td>
<td>KSC 39A, 074:23:43:44Z</td>
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<tr>
<td>KSC-125</td>
<td>P797/R37/M265</td>
<td>FLT: Tony Antonelli</td>
<td>KSC 39A, 074:23:43:44Z</td>
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<td>PAL 39A</td>
<td>P780/R303A</td>
<td>Loss of Mission Aborted, April 29, 2003</td>
<td>KSC 39A, 074:23:43:44Z</td>
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<td>MLP 1</td>
<td>P781/R335/M290</td>
<td>Loss of Mission Aborted, April 29, 2003</td>
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<tr>
<td>28th SHUTTLE FLIGHT TO ISS</td>
<td>P782/R308/M266</td>
<td>MS1: Joseph Acaba</td>
<td>KSC 39A, 074:23:43:44Z</td>
<td>KSC 15 (KSC 70) 067:19:13:26Z 21:13:04PM CDT</td>
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<tr>
<td>MS2</td>
<td>P783/R336/M291</td>
<td>MS2: Steve Swanson</td>
<td>KSC 39A, 074:23:43:44Z</td>
<td>KSC 15 (KSC 70) 067:19:13:26Z 21:13:04PM CDT</td>
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<tr>
<td>MS3</td>
<td>P784/R266/V203/M232</td>
<td>MS3: Richard Arnold</td>
<td>KSC 39A, 074:23:43:44Z</td>
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<tr>
<td>MS4</td>
<td>P785/R208/V164/M181</td>
<td>MS4: John Phillips</td>
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<tr>
<td>MS5</td>
<td>P786/R284/V200/F36</td>
<td>MS5: Dafra Dave</td>
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### STS-119 - Waiting for GO! Moon - Waiting for Constellation!

(It will be a long wait - President directed cancellation of Constellation in 2010.)

STS-119/Moon.jpg
FLIGHTS (7)  ORBITER  CREW  LAUNCH SITE, LIFTOFF TIME, CROSSRANGE  LANDING SITE, ABORT TIMES  LANDING TIMES FLT DURATION, WINDS  THROTTLE PROFILE ENG. S/N  SRB RSRM  ORBIT  FSW  PAYLOAD WEIGHTS  PAYLOADS/ EXPERIMENTS  MISSION HIGHLIGHTS (LAUNCH DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

STS-119/ISS-15A

CONTINUED...

Continued...

SS EVA 131
D OCKERED QUEST EVA 54
EMU/TETHERED EVA 124
SCHEDULED EVA 122
DURATION 6:27
MCC WHITE FOR (55)
FLIGHT DIRECTORS:
SHUTTLE:
ASC/ENT- Richard Jones
LD/O1- Paul Dye
O2- Mike Sarafin
(FD1- FD12)
O2- Tony Ceccacci
(FD13-ECM)
O3- Richard LaBrode
(Prelaunch – FD1)
O3- Normen Knight
(FD2-FD6)
O3- Bryan Lunney
(FD8-ECM)
Planning- Norm Knight
MOD – John Mullough
Team 4 – Tony Ceccacci

Continued...

Continued...

WINDS:
MECO CMD:
18 HKT 0.3L
V:
25619.0 25619.6
CMS-2:
38.00 38.30.0 97.7 FPS 98.1 FPS

DENS ALT: 1718 FT
FLT DURATION:
12:19:29:42
S/T: 1196:11:09:28
CV-103:
315:03:39:51
DISTANCE:
5,304,106 sm
TOTAL SHUTTLE DISTANCE:
485,578,259 sm

ABOVE: STS-119 launch panorama into twilit sky. Photo by Ryan R. Smith (KSC-BOE-K2)
http://www.ryan smithphotography.com/


Continued...

LAUNCH DELAYS: None. Launch occurred on time at 074:23:43:44Z, 7:43:44 p.m. EST, Sunday, March 15, 2009. Launch weather was relatively benign at KSC. A sea breeze developed at KSC and moved west of the Banana River about 3 hours prior to launch. The movement of the sea breeze inland produced favorable weather conditions with widely scattered clouds.

TAL WEATHER
TAL sites at both Zaragoza and Moron, Spain were acceptable for launch due to a high pressure system. Winds at Istres were out of limits following the passage of a cold front the day prior to launch, but launch proceeded with two acceptable TAL sites.

PERFORMANCE ENHANCEMENTS:
Include the standard set plus: 1) PE Operational High Q WIN/MAR, 2) OMS Assist, 3) 52 nautical mile MECO, & 4) Del Psi

FLIGHT DURATION CHANGES/LANDING:
- When STS-119 launch was slipped to March 15, 2009, (due to earlier scrub) the mission duration was reduced from 14 to 13 days to accommodate a Russian Soyuz mission to ISS later in the month. This also reduced number of EVA’s from 4 to 3.
- For first KSC landing opportunity weather was no go with cloud decks building in at lower than anticipated broken (5/8) at 3000. Weather improved as did the wind direction. Discovery was given “Go” to land on second KSC opportunity. Landing occurred at 087:19:13:26 (2:13:26 PM CDT Saturday, 03/28/09).

FIRSTS/SECONDS/LASTS:
- SSME ECP 1514 – LPOTP Bearing Ball Process Change - SRB Hold Down Post Debris Containment mod
- SSME: Orbiter LH-1 T-0 Unbilled Ice: Update to IDBR-01 and NSTS-60959 to reflect new expected debris source.
- Last to be installed on ISS, the 45-foot S6 aluminum girder weighing more than 31,000 pounds was the first truss segment built (stored at KSC for six years).
- Second time a bat attempted to fly into space on Space Shuttle ET, coincidentally Koichi Wakata was on both flights.
- Discovery served as a hypersonic test bed during entry for new heat shield tiles in development for NASA’s next-generation spacecraft.
### SPACE SHUTTLE MISSIONS SUMMARY

**FLT NO.**
<table>
<thead>
<tr>
<th>CREW TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME, ORBITER CROSSTRADE</th>
</tr>
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<tbody>
<tr>
<td>STS-119/ISS-15A</td>
<td>Continued …</td>
</tr>
<tr>
<td>ISS LD/O1 - Kwatsi Alibaruho</td>
<td>Continued …</td>
</tr>
<tr>
<td>C2 - Heather Ranick</td>
<td>C3 - David Korth</td>
</tr>
<tr>
<td>Team 4 - Robert dempsey</td>
<td></td>
</tr>
<tr>
<td>ISS LD/O1 – Rick Davis</td>
<td></td>
</tr>
<tr>
<td>C2 – Lucia McCullough</td>
<td></td>
</tr>
<tr>
<td>C3 – Jay Marshke</td>
<td></td>
</tr>
<tr>
<td>Team 4 – N/A</td>
<td></td>
</tr>
</tbody>
</table>

**PAYLOAD EXPERIEMENTS**

- March 27, 2009: In a rare example of overlapping space missions, a U.S. space shuttle [STS-119] is set to return to Earth on Saturday just a few hours after a Russian Soyuz arrives at the ISS. Togethe the crews of the three craft total 13 people, tying the record for humans in space, first set 14 years ago this month. [Robert Pearlman - collectSPACE.com]

**MCC ROSES:**

This was the 100th flight since the Challenger accident that a beautiful bouquet of roses was delivered to the Houston MOCR to celebrate each mission since the landing of STS-26 in 1988. In 1989 it was determined that the roses were sent by the Shelton family (Mark, MacKenzie & Terry) of Bedford, TX. On March 27, 2009, the Sheltons personally delivered their 100th bouquet in recognition of STS-119. They received a warm welcome in the MOCR, led by James “Milt” Heflin, JSC Associate Director, Technical. They also received several JSC mementos for their kindness and dedication to the Space Program.

**FIRSTS/SECONDS/LASTS:**

- March 27, 2009: In a rare example of overlapping space missions, a U.S. space shuttle [STS-119] is set to return to Earth on Saturday just a few hours after a Russian Soyuz arrives at the ISS. Togethe the crews of the three craft total 13 people, tying the record for humans in space, first set 14 years ago this month. [Robert Pearlman - collectSPACE.com]

**NIGHT LAUNCH:** #32  (Into twilit sky)

**RENDZVOUS:** #72  Rendezvous and dock with ISS.

**EVENTS:**

- FD1: OMES ignition at 075:00:22:14Z resulted in a 126.0 by 84.9 NM orbit.
- FD2: RCC inspection found no areas of concern.
- FD3: R-Bar Pitch Maneuver was performed. No issues.
- Docking Contact occurred at 076:21:19:49Z. St. Patrick’s Day
- Hard Dock, hooks closed, occurred at 076:21:33:59Z
- FD5: Based on review of launch imagery, MMT cancelled FD6 focused inspection of Orbiter heat shield.
- FD5: EVA 1: Steve Swanson & Ricky Arnold. Activities included: S6 Connected to ISS, SABB Unstow, PCDF-PU Transfer, PVR Deploy, and 1B & 3B solar arrays deployed EVA1 duration 6:07.

**SEE: MCC ROSES:** Above right under Mission Highlights Column
<table>
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<tr>
<th>FLT NO.</th>
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<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT</th>
<th>TSW</th>
<th>PAYLOAD/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

### STS-119/ISS-15A

**Title: Events**
- Downlinked, P3 UCCAS Deploy unsuccessful, temporary tethers installed. S3 PAS Deploy deferred to EVA3, and Z1 Patch Panel Reconfig unsuccessful. EVA2 duration 6:30.
- FD6: CDR Lee Archambault maneuvered the Shuttle-ISS “stack” to avoid a 9-year-old piece of Chinese space junk (4” fragment) that could have been a close encounter during upcoming EVA3. (A 4” fragment from a Russian satellite had previously passed at a safe distance prior to Shuttle/ISS docking.)
- FD9: 2 Firsts accommodated: CETA coupler, S1/S3 SSAS panel BBC reconfig, S1 FHRC outboard p-clamps released 2 of 6 (#5, #6), and retrieved bungee caddy from Nadir STBD A/L toolbox. EVA3 duration 6:27.
- Transfers:
  - 32,962 lbs of hardware transferred to ISS (S6 Truss & Middeck)
  - 1963 lbs of hardware returned from ISS to Discovery (middeck)
  - 1142 lbs of water transferred to ISS

**Continued…**

**In JSC MCC at Landing Support Officer (LSO) console:** On left, Marty Linde/USA, Lt. Col. Dave Impiccini/USAF (standing), Wayne Hensley/USA (on phone), & Brenton Hartung (student observer in rear). Laughter caused by photographer always catching Wayne on telephone.

**Significant Anomalies:**
- Galley Water Leakage.
- WLES Group 2 Sensor S/N# 1033 Time Slip
- During Initial Launch Attempt of STS-117/Et-127, a GH2 Leak was Detected at Approximately One Minute After Start of LH2 Topping MOD:
  - Inadvertent Abort Light Command Sent from FDO Integration:
  - Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)
  - High GH2 Concentrations at the Ground Umbilical Carrier Plate (GUCP)
  - MRS LH2 ORB Umbilical Plate Gap Pressure LCC Violation
  - Stub Tile Damage

**Continued…**

---

Two of FCT’s That Participated In ISS USOS Complete

JSC2009-E-060960 (20 March 2009) --- Group portrait of Shuttle STS-119 Orbit 1 Flight Control Team in JSC MCC. FD Paul Dye (left) is visible on the front row.

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<th>LANDING SITE/ Runaway, Crossrange</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
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<th>SRB RSRM</th>
<th>ORBIT</th>
<th>FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-125</td>
<td>OV-104</td>
<td>CDR Scott Altman, PLT Gregory C. Johnson, LMP Michael Good</td>
<td>KSC 39A 131:18:01.56Z</td>
<td>EDW22 CONC EDW53 CONC 34</td>
<td>104/104/10%</td>
<td>Bi-137</td>
<td>28.48</td>
<td>ORBIT 5 - DIRECT INSERTION</td>
<td>CI-32</td>
<td>32418 LBS</td>
<td>Brief Mission Summary: STS-125 was the 9th and final service mission (SM) visit to the 19 year old Hubble Space Telescope (HST) deployed on STS-31 in 1990. This was the 4th planned SM for HST. The 3rd SM was conducted in two parts, 3A on STS-103 &amp; 3B on STS-106. HST improvements included a new camera, a new spectrophotometer, repair of two other instruments, and replacement of six batteries and six gyroscopes. These improvements resulted in a higher definition view of the universe and HST life extension into the next decade. A launch-on-need (LON) vehicle, STS-400, was readied on Pad B for potential crew rescue since there was no ISS safe haven on this mission. STS-400 release from rescue duty occurred on May 21st, 2009, as the STS-125 crew prepared for the first deorbit/landing opportunity.</td>
</tr>
<tr>
<td>SEQ FLT #: 126</td>
<td>OV-104</td>
<td>MS1 Megan McArthur</td>
<td>KSC 39A 5/11/09 131:18:01:56Z</td>
<td>EDW22 CONC EDW53 CONC 34</td>
<td>104/104/10%</td>
<td>Bi-137</td>
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</tr>
<tr>
<td>KSC-126</td>
<td>OV-104</td>
<td>MS2 Andrew Feustel</td>
<td>KSC 39A 5/11/09 131:18:01:56Z</td>
<td>EDW22 CONC EDW53 CONC 34</td>
<td>104/104/10%</td>
<td>Bi-137</td>
<td>28.48</td>
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</tr>
<tr>
<td>Pad 39A (49)</td>
<td>OV-104</td>
<td>MS3 John Grunsfeld</td>
<td>KSC 39A 5/11/09 131:18:01:56Z</td>
<td>EDW22 CONC EDW53 CONC 34</td>
<td>104/104/10%</td>
<td>Bi-137</td>
<td>28.48</td>
<td>ORBIT 5 - DIRECT INSERTION</td>
<td>CI-32</td>
<td>32418 LBS</td>
<td>Brief Mission Summary: STS-125 was the 9th and final service mission (SM) visit to the 19 year old Hubble Space Telescope (HST) deployed on STS-31 in 1990. This was the 4th planned SM for HST. The 3rd SM was conducted in two parts, 3A on STS-103 &amp; 3B on STS-106. HST improvements included a new camera, a new spectrophotometer, repair of two other instruments, and replacement of six batteries and six gyroscopes. These improvements resulted in a higher definition view of the universe and HST life extension into the next decade. A launch-on-need (LON) vehicle, STS-400, was readied on Pad B for potential crew rescue since there was no ISS safe haven on this mission. STS-400 release from rescue duty occurred on May 21st, 2009, as the STS-125 crew prepared for the first deorbit/landing opportunity.</td>
</tr>
<tr>
<td>MLP-2</td>
<td>OV-104</td>
<td>MS4 Mike Massimino</td>
<td>KSC 39A 5/11/09 131:18:01:56Z</td>
<td>EDW22 CONC EDW53 CONC 34</td>
<td>104/104/10%</td>
<td>Bi-137</td>
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<td>ORBIT 5 - DIRECT INSERTION</td>
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</tr>
</tbody>
</table>

**S125-E-012154 --- HST Service Crew pose on middeck. Front row (left to right): PLT Johnson, CDR Altman, and McArthur/MS. Back row (left to right): Good/MS, Massimino/MS, Grunsfeld/MS, and Feustel/MS.**

**POSTPONEMENTS:**
- Added STS-125 to FDRD - launch date of 08/07/08
- Ppd. to 08/28/08 on 02/14/08. Slip due to ECO sensor problems experienced during December launch attempt of STS-122.
- Ppd. to 10/08/08 on 05/27/08. Slip due to delays in delivery of ET 127 & ET-129 (STS-400).
- Ppd. to 10/14/08 on 09/24/08. Slip due to Hurricane Ike impacts to HST payload readiness.
- Ppd. to NET Mid-Feb 2009 on 10/02/08. Slip due to checkout problems with HST spare control unit.
- Selected May 12, 2009 launch date on 12/04/08. Advancing one day provided a 3rd launch opportunity before range conflicts.
- Selected May 12, 2009 launch date on 12/04/08. Continued...

**KSC W/D:**
- OFF Run 1: 17B+2H+3Wx
- OFF Run 2: 120+11H
- VAB Run 1: 12+0C
- VAB Run 2: 8+0C
- Pad Run 1: 40+2C
- Pad Run 2: 38+4C
- Total Work Days = 396 (OPF Processing occurred over a total time period of 314 days.)

**LAUNCH SCREWS:**
- None.

**MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)**
- POSTPONEMENTS:
- Added STS-125 to FDRD - launch date of 08/07/08 on 06/29/07.
- Ppd. to 08/28/08 on 02/14/08. Slip due to ECO sensor problems experienced during December launch attempt of STS-122.
- Ppd. to 10/08/08 on 05/27/08. Slip due to delays in delivery of ET 127 & ET-129 (STS-400).
- Ppd. to 10/14/08 on 09/24/08. Slip due to Hurricane Ike impacts to HST payload readiness.
- Ppd. to 10/14/08 on 09/24/08. Slip due to Hurricane Ike impacts to HST payload readiness.
- Selected May 12, 2009 launch date on 12/04/08. Continued...
- Advanced from 05/12/09 to 05/11/09 on 05/01/09. Advancing one day provided a 3rd launch opportunity before range conflicts.

**LAUNCH SCREWS:**
- None.
**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-125**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW TITLE &amp; NAMES &amp; EVA’S</th>
<th>LAUNCH SITE &amp; LIFTOFF TIME</th>
<th>LANDING SITE &amp; ABORT TIMES</th>
<th>LLANDING TIMES</th>
<th>ORBITER, CROSSRANGE</th>
<th>ENG. S.N.</th>
<th>THROTTLE PROFILE ENG. S.N.</th>
<th>Tanks</th>
<th>SRB</th>
<th>PAYLOAD WEIGHTS</th>
<th>FSW</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
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</thead>
<tbody>
<tr>
<td>STS-125</td>
<td>Continued…</td>
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<td>Continued…</td>
</tr>
</tbody>
</table>

**FLIGHT DIRECTORS:**
- ASC/ENT: Norm Knight
- LD/O1: Tony Cuccaci
- O2: Rick LaBrode
- Planning: Paul Dye
- MOD: John Mccullough
- Team 4: Bryan lunneyi

**CAPCOMS:**
- A/E: Greg (Box) Johnson
- LD/01: Dan Burbank
- O2: Alan poindexter
- Planning: Janice Voss
- Team 4: N/A

**SE BYD 134**
- EVA 134
- EMUT/TETHERED EVA 127
- SCHEDULED EVA 125
- DURATION 6:36

**SSM/CMD**
- 8.23 (P) 8.24 (A)
- V: 26088.0 (P) 26066.0 (A)
- CMS-2: 43.46 (P) 43.45 (A)
- 142.5 (P) 139.7 (A)
- FPS

**SE ABORT**
- 104
- 5:39 (P) 5:46 (A)
- 5:59 (P) 6:02 (A)
- 6:22 (P) 6:29 (A)

**MECO CMD**
- 8.23 (P) 8.24 (A)
- V: 26088.0 (P) 26066.0 (A)
- CMS-2: 43.46 (P) 43.45 (A)
- 142.5 (P) 139.7 (A)
- FPS

**FLIGHT DURATION CHANGES/LANDING**
- For both KSC landing opportunities on Friday, May 22nd the unstable weather was no go with low ceilings and thunderstorms expected. Landing was postponed to Saturday (EOM + 1).
- KSC weather was no go for EOM+1 with broken low ceilings and thunderstorms. Little change was expected for Sunday (EOM+2) as moisture remained abundant over KSC.
- KSC landing for Sunday (EOM+2) waved off due to weather. Next opportunity to EDWs was selected on EOM+2 with typical summer weather and mostly clear skies. Landing occurred at 144:15:40:13 Z (10:39:04 AM CDT Sunday, 05/24/09).

**FIRSTS/LASTS:**
- First mission post-STS-107 incident without ISS safe haven. LON STS-400 mission was on standby on PAD 39B. “First time since 2001 that two such birds have simultaneously perched on NASA’s twin shuttle launch pads” - Todd Halvorson, Florida Today.
- 116 new EVA tools (GSFC) were developed to meet unique demands of this HST SM.
- First flight of food bars and Metamucil wafers
- First ET build with elimination of “Hand Pack Ablator (SLA)”

**S125-E-007221 (14 May 2009)**-- Grunsfeld & Feustel and mirrored reflection during first HST EVA. Activities included installation of a new WFC3 and SI C&DH unit.
### STS-125

**Title:** Hugging the Hubble!
**Date:** 18 May 2009
**Activities:**
- Replaced batteries, a Fine Guidance Sensor, and three thermal blankets (NOBL).

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**Firsts/Lasts:**
- First flight of ATK BSM’s in both forward and aft positions
- SRB Frangible nut redesigned with pyrotechnic crossover assembly
- Mike Massimino first to ‘Tweet’ from space, through email to JSC to his Twitter.
- First job offer in space: John Grunsfeld, while flying high in space, was named an adjunct professor at the University of Colorado at Boulder
- Fifth & last HST Service mission.

**Night Launch:** N/A

**Rendezvous:** #73

**Events:**
- FD1: OMS2 ignition at 131:18:45:40.9Z resulted in a 298.1 by 106.6 NM orbit
- FD2: RCC inspection found no areas of concern - no requirement for Focused Inspection.
- FD3: HST Grapple by McArthur occurred at 133:17:14Z. Timeline was about 20 min. behind schedule due to a comm. problem with HST that delayed HST prep for capture.
- FD4: EVA 1: Grunsfeld & Feustel: Activities included installing and completing good aliveness tests for new WFC3 and SI C&DH unit. The HST can now see farther into space and across a wider spectrum of colors. EVA ran 50 min longer than planned as the crew encountered difficult (aging) latches and bolts. EVA1 duration 7:20.
- FD5: EVA 2: Massimino & Good: Activities included Rate Sensor Unit changeouts & Bay 2 Battery checkout. EVA ran long due to the challenges for seating and bolting of RSU’s. EVA2 duration 7:56.
- FD7: EVA 4: Massimino & Good: Activities included refurbishment of Space Telescope Imaging Spectrograph and replacement of 6 Gyros. EVA 4 duration 8:02 (6th longest in program history).
- FD8: EVA 5: Grunsfeld & Feustel: Activities included Bay 3 battery changeout and FGs 2 changeout. On way back to A/L crew found debris liberated from carrier and head under HST. On retrieving the debris, PLSS contact damaged the TPS cover on the Low Gain Antenna (LGA). The LGA cover was reinstalled. The HST was in a good configuration for long term exposure to space. EVA5 duration 7:02.
- On departing the telescope, astronaut Grunsfeld called the week a “tour de force of tools and human ingenuity.” He also added: “Hubble Isn’t Just a Satellite. It Is About Mankind’s Quest for Knowledge.”
- FD9: HST was released at 139:12:57:00Z. This was followed shortly by OBSS late inspection of Atlantis TPS.
- During Entry comm blackout occurred at GMT 144/1513 - 1517 due to plasma effect.

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**Note:**
Dr. John M. Grunsfeld was later appointed Deputy Director of the Space Telescope Science Institute (STScI) in Baltimore, Md. effective January 4, 2010.
### SPACE SHUTTLE MISSIONS SUMMARY

#### MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

**STS-125**

*After Shuttle release, the HST orbital observatory returns to its cosmic duties, see photos at right and below.*

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**SIGNIFICANT ANOMALIES:**

- **Orbiter:**
  - FWD STBD PLB FLOODLIGHT (#2) FAILED DURING STS-125
  - DURING SSME IGNITION, AN ELECTRICAL ANOMALY OCCURRED THAT CAUSED ASA 1 TO BE LOST.
  - AFTER CARRIER PANEL REMOVAL AN IN-FLAME CRACK WAS DETECTED AT THE DENITRIFICATION LAYER INTERFACE WITH BASE MATERIAL ON TILES V070-395018-143 (SERIAL 583057) AND V070-395018-151 (SERIAL 778120).
  - THE CREW DISCOVERED CARRYOVER OR UNPROCESSED CONDENSATE IN THE IMMEDIATE AREA OF THE HUMIDITY SEPARATORS IN THE LOWER EQUIPMENT BAY.
  - DURING SSME IGNITION AN ELECTRICAL SHORT OCCURRED ON THE 26VAC EXCITATION CIRCUIT BETWEEN AEROSURFACE SERVOAMPLIFIER 1 (ASA 1) AND THE RIGHT HAND INBOARD ELECTRON ACTUATOR PRIMARY DELTA PRESSURE TRANSUDER.
  - MOI CRT 4 REPORTED MESS.COM 1553B ERROR, ‘MESSAGE 1553B FAIL’ AND ‘WEBS 10 ERROR’ IN DOWNLIST AT NOSE GEAR TOUCHDOWN. KSC.
  - Fondu-Fyre Liberated from SRB Main Flame Deflector, STS-125, Pad A
  - Brick Liberated from East Flame Trench Wall, SSME Side, STS-125, Pad A
  - None. SSME: None. ET: None. MOD: None. RSRM: None.
  - MISSING STIFFENER RING FOAM WITH DISCOLORATION, STIFFENER RINGS, RSRM-105B

Integration:

- Aerosurface Servo Amplifier-1 (ASA-1) Power Supply Failed
- Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearence (Liftoff Debris)
- Ice Internal and External to the LH2 T-0 Umbilical
- Gap Filler Releases From Port OMS Pod

**At Left:** **HUBBLE DETECTS - MOST ANCIENT OBJECT**

On Jan 26, 2011, NASA reported that Hubble using its new camera, discovered a faint red blob (see ultra-deep-field exposure insert above right) thought to be the most distant object ever seen: a small proto galaxy some 13.2 billion light years away (faint optical image in insert below right). This galaxy existed 480 million years after the “Big Bang”. These exposures were taken in 2009 & 2010.

Credit NASA, ESA, G. Illingworth (U. of Calif Santa Cruz & R. Bouwens (U. of Calif, Santa Cruz & Leiden U.), & HUDF09 Team.
**SPACE SHUTTLE MISSIONS SUMMARY**

| FLT   | ORBITER       | CREW (6+1 UP/6+1 DN) | LAUNCH SITE, LIFTOFF TIME | LANDING SITE, ABDOR TIMES | LANDING SITE/ RUNWAY, CROSSRANGE | LANDING TIMES ORBIT, DURATION, WINDS | SSHM-TLE NOMABORT EMERG | SRM RSRM | ORBIT | FSW | PAYLOAD, WEIGHTS | PAYLOADS/ EXPERIMENTS | MISSION HIGHLIGHTS (LAUNCH SCRUBS/DAYS) |
|-------|---------------|----------------------|---------------------------|---------------------------|----------------------------------|--------------------------------------|-------------------------------|----------------|------|-----------------|-------------------------|---------------------------------------|
| STS-127/ISS-2JA |               |                      |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
| KSC-127 | PAD 39A (50)  |                      |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
| MLP-3  |                |                      |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
| 29F SHUTTLE FLIGHT TO ISS |       |                      |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
| MS 4   | Dave Wolf     | (Flt 4 - STS-58, Up to Mir on STS-86, On on STS-89, STS-112) |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
| MS 5   | UP Stay ISS   | EXP20,FLTENG         |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |
|        |               |                      |                           |                           |                                  |                                      |                               |                |      |                 |             |                                      |

**Gaseous hydrogen vent line leak caused STS-119 scrub in March 2009, also caused two scrubs on STS-127. This line connects the Ground Umbilical Carrier Plate (GUCP), attached to ET, to “flare stack” for burn-off of vented gaseous hydrogen.**

**Brief Mission Summary:** STS-127 (9th mission to ISS) was a “16 day marathon construction mission”. The final pieces of the Japanese Kibo Complex, including an Experiment Exposed Facility (“Porch in Space” - PAO) and the unpersuaded Experiment Logistics Module were delivered along with spare equipment intended to keep ISS operational long after Shuttle is retired. Five EVA’s and operations of three robotic arms were conducted for completion of all objectives.

**KSC WD:**
- OPP: 109 + 9H
- VAE: 7 + 0C
- PAD B: 32 + 10C + 1 SD (STS-125 launch) + 1 CR (Crew Rest Day)
- PAD A: 42 + 3C + 1 H
- Total Work Days = 190 (OPF processing occurred over a total time period of 118 days.)

**POSTPONEMENTS:**
- Added STS-127 to FDRD - launch date of 04/23/09 on 04/24/08.
- Ppd. to 05/15/09 on 07/03/08. Slip due to ET deliveries.
- Ppd. to 06/13/09 on 03/10/09. Slip due to interim changes while Cx and SSP schedules were assessed and prioritized.

**LAUNCH:**
- Launch scrubbed officially on Saturday, 06/13/09 at 12:26 a.m. EDT due to GH leak at the GUCP – the same type of leak that scrubbed STS-119 in March. Launch rescheduled for 06/17/09. Technical Scrub.
- Launch scrubbed officially on Wednesday 06/17/09 at 1:55 EDT with the recourcement of the same type of GUCP leak as previous scrub. Launch rescheduled for 07/11/09. Technical Scrub.
- Launch officially scrubbed during L-11 Hour Hold at MMT meeting on Saturday morning, 07/11/09, due to unstable weather and lightning strikes overnight in KSC area. Seven strikes hit the lightning protection system, but none hit the vehicle. Launch rescheduled for 07/12/09. Weather Scrub.
- Launch scrubbed during a final hold at T-9 minute mark on Sunday 07/12/09 due to predicted thunderstorms within 20 mm limit of SLF. Launch rescheduled for 07/13/09. Weather Scrub.
- Launch scrubbed at 6:36 PM EDT on Monday 07/13/09 due to weather violations in KSC area. Launch rescheduled for 07/15/09. Weather Scrub.
Continued…

MS 5 DN EXP 18/19/20
FLT ENG (Japan)
Koichi Wakata
(Flt 3 - STS-72, STS-92,
Up on STS-119 stay ISS)
P801/R208/V164/M181

SS EVA 137
DOCKED QUEST EVA 65
EMU/TETHERED EVA 131
SCHEDULED EVA 129
DURATION 6:53

SS EVA 139
DOCKED QUEST EVA 56
EMU/TETHERED EVA 130
SCHEDULED EVA 128
DURATION 5:32

SS EVA 138
DOCKED QUEST EVA 56
EMU/TETHERED EVA 130
SCHEDULED EVA 129
DURATION 6:53

SS EVA 135
DOCKED QUEST EVA 56
EMU/TETHERED EVA 130
SCHEDULED EVA 128
DURATION 5:32

SS EVA 141
DOCKED QUEST EVA 59
EMU/TETHERED EVA 134
SCHEDULED EVA 132
DURATION 4:54

JSC2009-E-143033 --- Retired NASA Launch Director
Robert Sieck, right, talks with Associate Administrator
for Space Operations Bill Gerstenmaier in KSC Firing
Room during a built-in launch countdown hold.

ISS020-E-022626 (20 July 2009) --- Endeavour’s
crew cabin, along with the ISS’s Kibo laboratory
and Harmony node are shown during 2nd EVA.
**SPACE SHUTTLE MISSIONS SUMMARY**

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<tr>
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<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE/FLT DURATION</th>
<th>SSME-TL ENG. S.N.</th>
<th>ABORT TIMES</th>
<th>SRB</th>
<th>ORBIT</th>
<th>PAYLOAD WEIGHS</th>
<th>PAYLOADS/EXPERIMENTS</th>
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</thead>
<tbody>
<tr>
<td>ISS</td>
<td>O1: Brian Smith</td>
<td>LD/2: Holly Ridings</td>
<td>O3: Derek Hassmann</td>
<td>Team 4: Ron Spencer</td>
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<tr>
<td>CAPCOMS: SHUTTLE</td>
<td>A/E: Alan Poindexter</td>
<td>LD/O1: Greg (Box) Johnson</td>
<td>O2: Janice Voss</td>
<td>Planning: Stan Love</td>
<td>- Shannon Lucid</td>
<td>Team 4: N/A</td>
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<tr>
<td>ISS</td>
<td>O1: Hal Gehretzman</td>
<td>LD/2: Akihiko Hoshide</td>
<td>O3: Jason Hutt</td>
<td>Team 4: N/A</td>
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</table>

**EVENTS:**

- During liftoff, several pieces of foam insulation came off the ET. Shuttle was hit two or three times, said Bill Gerstenmaier. Some scuff marks were spotted on the belly, but that probably is coating loss and considered minor, he said. That was later determined to be the case.
- FD1: OMS2 ignition at 196:22:41:40.9Z resulted in a 125.4 by 85.1 NM orbit.
- FD2: RCC inspection found no areas of concern.
- T1 maneuver at 198:15:17:25.9Z resulted in a 188.7 by 184.0 NM orbit.
- FD3: R-Bar Pitch Maneuver was performed. No issues.
- Reboost (~2.5 fps postgrade delta V). Increased altitude approx. 4700 ft.
- Cleared vehicles of conjunction with Object 84180.
- FD4: Based on review of launch imagery, MMT cancelled FD5 focused inspection of Orbiter heat shield.
- FD4: EVA 1: David Wolf & Tim Kopra: Activities included: JPM berthing mechanism prep and install, CETA cart mods, and the P3 Nadir UCCAS deploy. EVA was shortened due to suit consumables. The PAS deploy was ppd. EVA1 duration 5:32.
- Using the SSRMS and SRMS the JEM Exposed Facility (JEF) was successfully unberthed from the Shuttle P/B and captured on the Japanese Experiment Module (JEM).
- FD6: EVA2: Dave Wolf & Tom Marshburn: Activities included: Transfer of ORU's (Space-to-Ground Antenna, Linear drive Unit & Pump Module) from the Integrated Cargo Carrier (ICC) to the External Stowage Platform. Installation of the JEF forward Vision Equipment (VE) was deferred. EVA2 duration 6:53.
- FD10: EVA4: Chris Cassidy & Tom Marshburn: Activities included: Successful R&R of all batteries and successful latching of the ICC-VLD back into the Shuttle P/L bay for return. EVA4 duration 7:12.

**S127-E-009733 (28 July 2009) --- Record Size Space Crew:** The STS-127 and Expedition 20 crew members pose for a group portrait in ISS Harmony Node. From left (front row) are NASA astronauts Michael Barratt, Exp 20 FE; Mark Polansky, STS-127 CDR; cosmonaut Gennady Padalka, Exp 20 CDR; and NASA astronaut Dave Wolf, STS-127 MS. From left (middle row) are JAXA astronaut Koichi Wakata, STS-127 MS; Canadian astronauts Julie Payette, STS-127 MS and Robert Thirsk, Exp 20 FE; and NASA astronaut Tom Marshburn, STS-127 MS. From left (back row) are cosmonaut Roman Romanenko, Exp 20 FE; NASA astronauts Christopher Cassidy, STS-127 MS; Doug Hurley, STS-127 Pilot; Tim Kopra, Exp 20 FE; and ESA astronaut Frank De Winne, Exp 20 FE.
### SPACE SHUTTLE MISSIONS SUMMARY

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (6+1 UP/6+1 DN)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, RUNWAY, CROSSRANGE</th>
<th>SSME-TL NOM-ABORT EMERG</th>
<th>SRB RSRM</th>
<th>ORBIT FSW</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-127/ISS-2JA</td>
<td>Continued…</td>
<td>S127-E-009372 (27 July 2009) Marshburn (left) &amp; Cassidy, STS-127 MS's, participate in fifth and final EVA as construction and maintenance continue on the ISS.</td>
<td>S127-E-011200 (28 July 2009) --- The ISS is seen from Space Shuttle Endeavour as the two spacecraft begin their relative separation.</td>
<td>JSC2009-E-145586 --- Orbit 1 Lead FD Paul Dye (foreground) on console during docking of STS-127 Endeavour to ISS. In background are CAPCOM’s Dominic Gorie (far left) and Greg Johnson.</td>
<td><strong>SIGNIFICANT ANOMALIES:</strong> Continued…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EVENTS:** Continued…

- FD13: EVA5: Chris Cassidy & Tom Marshburn: Activities included: completion of Z1 patch panel reconfig, SPDM covers, JEF Vision Equipment installation and several get-aheads (JEM handrail and WIF installation, Lab cable tiedowns, Node 2 Gap Spanner installation, and relocating two APFRs for STS-128). The S3 Zenith Outboard PAS task was not performed due to lack of time based on predicted METOX capability. EVA5 duration 4:54.
- Transfers: 24,638 Pounds of hardware transferred to ISS (inside & out) 10,479 Pounds of hardware returned aboard Endeavour 2,175 Pounds of middeck items delivered to ISS aboard Endeavour 1,980 Pounds of middeck items returned from ISS to Endeavour 1,225 Pounds of water transferred to ISS 45 Pounds of Oxygen used for “stack maintenance” 12 Pounds of Nitrogen transferred to ISS
- ISS Mass in space 685,986 mass - pounds FD14: Undocked at 209:17:26:00Z (12:26 PM CDT, July 28, 2009)
- After undocking, Hurley initiated Endeavour fly-around at a distance of 400 feet from ISS and completed Sep-maneuver at 209:19:09:00Z (2:09 PM CDT, July 28, 2009)
- During Entry comm blackout occurred at 212:14:34:05Z - 212:14:36:24Z due to plasma effect.
- **SIGNIFICANT ANOMALIES:** Orbiter:
  - MICROBIAL REMOVAL ASSEMBLY LEAKAGE
  - FUEL CELL 3 SN 121 SUSTAINING HEATER TURNED ON WHEN THE FC STACK OUT TEMPERATURE REACHED A VALUE OF 185 DEG F
  - DURING THE RCS HOTFIRE TEST, FORWARD RCS THRUSTER F2F EXHIBITED LOW PC (V42P1542A) OF APPROXIMATELY 16 PSI. F2F WAS DECLARED FAILED OFF AND AUTO DESSELECTED BY RCS RM AT MET 14/10:45:40 (GMT 211/08:48:50).
  - The Istres Backup Azimuth system is in a Hard Overscan Alarm
  - STS-127 Post Launch Debris
  - MSFC CONVERGENT COATING (MCC-1) MISSING ON AFT SKIRT TPS ACPEAGE (BOTH LEFT & RIGHT HAND) POST FLIGHT OF STS-127B/138
  - LEFT-HAND SOLID ROCKET BOOSTER ENHANCED DATA ACQUISITION SYSTEM (EDAS) ASSEMBLY CHANNEL 4 DID NOT RECORD NOMINAL STRAIN RESPONSE.

**ET:**
- POST-LAUNCH CAMERA AND FILM REVIEW SHOwing LOSS OF FOAM AT SEVERAL LOCATIONS ON THE INTERTANK
- POST-LAUNCH CAMERA & FILM REVIEW SHOwED LOSS OF FOAM IN THE AFT INBOARD CORNER OF THE LO2 ICE FROST RAMP AT STATION 718
- ET TPS Loss Outboard Section of the -Y Bipod Closeout MOD: None
- Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)
- LH2 Leak at ET Ground Umbilical Carrier Plate (GUCP)
- Ice Internal and External to the LH2 T-0 Umbilical

**SRB:**
- TOP LAYERS OF MSFC CONVERGENT COATING (MCC-1) MISSING ON AFT SKIRT TPS ACPEAGE (BOTH LEFT & RIGHT HAND) POST FLIGHT OF STS-127B/138
- LEFT-HAND SOLID ROCKET BOOSTER ENHANCED DATA ACQUISITION SYSTEM (EDAS) ASSEMBLY CHANNEL 4 DID NOT RECORD NOMINAL STRAIN RESPONSE.

**SSME:** None.

**RSRM:** None.

Continued at left…
**STL-128 (17A)**  
**SEQ FLT # 128**  
**KSC-128**  
**PAD 39A (51)**  
**30th SHUTTLE FLIGHT TO ISS**

**Brief Mission Summary:** The STS-128 (30th mission to ISS), dubbed "Packing Up New Science" by PAO, main objective was to deliver science and environmental racks to dramatically enhance the scientific capability of the ISS. These racks were carried in the Leonardo MPLM. Included in the cargo was the highly publicized Combined Operational Load Bearing External Resistance Treadmill (COLBERT) named after TV comedian Stephen Colbert. Three EVAs were conducted and included replacement of the massive ammonia tank used by the ISS Thermal Control System.

**POSTMISSIONS:**  
- Added STS-128 to FDRD - launch date of 07/30/09 on 06/23/08.  
- Ppd. to 08/18/09 on 06/30/09. Slip due to STS-127 GUCP delays.  
- Ppd. to 08/25/09 on 08/20/09. Slipped to support KSC processing.

**LAUNCH SCRIBBS:**  
- 08/26/09 weather did not cooperate, systems looked good. Setting up for the next opportunity, window open at 12:05am CDT tomorrow with the in-plane time at 12:10am. Weather Scrub.  
- 08/26/09 the 3rd launch attempt was scrubbed officially at 4:52 p.m. CDT (5:52 Eastern) by Launch Director Pete Nickolenko due to stuck "fill & drain valve during ET loading.  
- Ppd. to 06/09/09 on 12/10/08. Interim manifest while HST final placement is considered.  
- Ppd. to 06/07/09 on 06/08/09. Slip due to MA direction.  
- Ppd. to 06/19/09 on 06/20/09. Slip due to STS-127 GUCP delays.  
- Ppd. to 08/25/09 on 08/29/09. Slipped to support KSC processing.

**LAUNCH SITES, ABORT TIMES**

<table>
<thead>
<tr>
<th>FLT</th>
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<th>FSW</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>PAYLOAD/ WEIGHTS</th>
<th>TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.</th>
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<tbody>
<tr>
<td>STL-128-S-011 (28 Aug. 2009) — Viewed from the Banana River Viewing Site, the Space Shuttle heads toward Earth orbit and rendezvous with ISS. Night launch #33.</td>
<td></td>
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</tr>
</tbody>
</table>
### STS-128 (17A)

**Mission Highlights**

- **Title, Names & EVA's**
  - SS EVA 142
  - Docked Quest EVA 60
  - EMT/hich EVA 135
  - Scheduled EVA 133
  - Duration 6:35

- **Land EVA's**
  - SS EVA 143
  - Docked Quest EVA 61
  - EMT/hich EVA 136
  - Scheduled EVA 134
  - Duration 6:39

- **Launch Scrubs/Delays**
  - Weather scrubs launch.
  - Xenon lights over Launch Pad 39A compete with the lightning strike.
  - Photo source: Not identified.

- **Flight Directors**
  - Shuttle
    - A/E - Richard Jones
    - LD/O1 - Tony Cecchi
    - O2 - Kwatsi Alibaruho
    - Planning - Gary Horlacher
    - MOD - John Mccullough
    - Team 4 - Mike Sarafin
  - ISS
    - O1 - Ron Spencer
    - LD/O2 - Heather Rarick
    - O3 - Royce Renntho
    - Team 4 - Derek Hassmann

- **Performance Enhancements**
  - Include the standard set plus: 1) PE Operational High Q - SUM/AUG, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del Psi

- **Flight Duration Changes**
  - Thursday, Sep 10, 2009, first deorbit opportunity waved off for violations of showers within 30nm & crosswind violations at 17 kts.
  - Second opportunity also waved off, showers, instability, broken cloud deck and crosswind violation.
  - Flight extended for EOM +1 day to Friday.
  - 4 opportunities available. First & second opportunities at KSC were again waved off due to weather.
  - EDW had no violations and low winds, first opportunity shows winds 230 8p12 kts. GO for EDW given. Landed on EDW Runway 22 at 255:00:53:20Z, Friday, Sep 11, 2009.

- **Firsts**
  - RSRM Improved Resiliency O-rings, Nozzle-to-Case Joint. Fly with higher margins.
  - RSRM Inactive Stiffener Stub Removal - Eliminated four debris liberation/debris impact causes

- **Night Launch**
  - #33

---

**Launch Window**

- Total launch window was 9M 36S with window open at 241:03:54:49Z and close at 241:04:04:25Z. Preferred Launch Time was 241:03:59:37Z (In-Plane Time) for a launch window of 4M 48S.

---

**Landing**

- Location: Edwards Dryden LA 22 & 25
- Time: 255:00:53:20Z
- Duration: 6:39
- Wind: 8p12 kts
- Weight: 74,317

**Mission Highlights**

- **Title, Names & EVA's**
  - SS EVA 142
  - Docked Quest EVA 60
  - EMT/hich EVA 135
  - Scheduled EVA 133
  - Duration 6:35

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  - SS EVA 143
  - Docked Quest EVA 61
  - EMT/hich EVA 136
  - Scheduled EVA 134
  - Duration 6:39

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  - Photo source: Not identified.

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  - ISS
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  - Scheduled EVA 134
  - Duration 6:39

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  - Xenon lights over Launch Pad 39A compete with the lightning strike.
  - Photo source: Not identified.

- **Flight Directors**
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- **Performance Enhancements**
  - Include the standard set plus: 1) PE Operational High Q - SUM/AUG, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del Psi

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  - RSRM Inactive Stiffener Stub Removal - Eliminated four debris liberation/debris impact causes

- **Night Launch**
  - #33
Construction and maintenance continued on the ISS.

ABOVE: S128-E-007229 (1 Sept. 2009) --- Nicole Stott/EXP 20 FE, during EVA 1with Danny Olivas/MS3 (out of frame). Activities included removal of an empty ammonia tank from ISS truss.

BELOW: S128-E-007720 (5 Sept. 2009) --- Olivas/MS3 (left) & Christer Fuglesang/ESA/MS4, participate in EVA3 activities.

Continued…

**RENDZVOUS: #75** Rendezvous and dock with ISS.

**EVENTS:**
- FD1: OMS2 ignition at 241:04:38:36.9Z resulted in a 127.5 by 84.4 nm orbit.
- FD2: MCC inspection found no areas of concern
- T1 maneuver at 242:22:26:17Z resulted in a 193.2 by 181.6 NM orbit
- FD3: R-Bar Pitch Maneuver was performed. No issues.
- Docking Contact occurred at 243:00:53:56Z
- Hard Dock, hooks closed, occurred at 243:01:07:23Z
- IEUK Seat Liner Transfer at (10:50 PM CDT, Aug 30). At that time Tim Kopra became a member of STS-128 and Nicole Stott joined ISS Exp 20.
- MMT FD3 reported VRCS jet F5R experienced a jet fail leak at 00/4:37 MET. ISS to perform all attitude control & maneuvers during the docked mission.
- MMT FD5 concurred that no Focused Inspection of Orbiter was required.
- FD5: "Leonardo" MPLM transferred to ISS, Zero-G stowage rack t"Harmony" node & COLBERT treadmill transferred.
- EVA 1: Olivas & Stott successfully completed: Prep of P1 truss Ammonia Tank Assembly (ATA) for removal, EuTEF & MISSE experiment removal from Columbus module. EVA1 duration 6:35.
- EVA2: Olivas & Fuglesang: Activities included: Deploy S3 Truss Payload Attach System, Rate Gyro Assembly R&R, S0 Truss Remote Power Control Unit R&R, Global Positioning System 4 installation, "Tranquility" Node 3 avionics cable routing (full), & Oxygen Generator Assembly water filter R&R. A lens became mechanically detached from Fuglesang’s helmet at the end of the EVA. Without intact helmet tights he headed to the AL before sunset. His PET was 6:22. Olivas performed cleanup. EVA3 duration (PET) 7:01.
STS-128 (17A) Continued…

S128-E-009998 (8 Sept. 2009) — Back-dropped by Earth’s horizon and the blackness of space, ISS as seen from Discovery as the two spacecraft begin their relative separation.

ISS020-E-038322 --- STS-128 & Exp 20 crew in-flight portrait on ISS. STS-128 red-clad crew are: front row, from left, CDR Sturckow, Hernandez, & Forrester; middle row in red, PLT Ford, Olivas, & Fuglesang (ESA). EXP 20 crew (in blue) are: bottom left, Kopra, who joined ISS crew in July, now scheduled to return to Earth with STS-128. Clockwise from him are: Stott, Robert Thirsk/CSA, Roman Romanenko/RSA, Frank De Winne/ESA, Gennady Padalka/RSA, and Michael Barratt.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-129/ULF3

<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS-129/ULF3</td>
<td>ATLANTIS</td>
<td>CDR: Charles O. Hobaugh</td>
<td>None.</td>
<td>Brief Mission Summary: The STS-129 (31th mission to ISS), dubbed “Stocking the Station” by PAO, main objective was to deliver nearly 14 tons of ISS systems spares. The most critical spares being transferred were two 600 lb. control moment gyros. “They’ve done a tremendous job of really meeting the needs, essentially through its lifetime,” Bill Gerstenmaier, NASA Associate Administrator for Space Operations.</td>
</tr>
<tr>
<td>SEQ</td>
<td>FLT # 129</td>
<td>MS 1, 2, 3</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td>KSC-129</td>
<td>MLP-3</td>
<td>MS 4, 5</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td>PAD 39A (52)</td>
<td>31th SHUTTLE FLIGHT TO ISS</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td>None.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
</tbody>
</table>

### NOTES

- 40x654: Page 2-217 - STS-129/ULF3
- SSME-TL:
- CREW:
- LAUNCH SITE, RUNWAY, SRB ORBIT PAYLOAD
- MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAIL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

### TLE:

- 0.000 (P) -0.072 (A)
- 760.9 (P) 733.8 (A)

### SRB STG:

- 2.030 (P) 2.040 (A)

### PAYLOADS/ EXPERIMENTS:

- POST OM-2 125.0x84.8 NM

### PAYLOADS/ EXPERIMENTS:

- TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

### PAYLOADS/ EXPERIMENTS:

- None.

### PAYLOADS/ EXPERIMENTS:

- None.

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- None.
## SPACE SHUTTLE MISSIONS SUMMARY

### STS-129/ULF3

**FLT ORBITER**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>TITLE, NAMES &amp; EVAS</th>
</tr>
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<tbody>
<tr>
<td>STS-129/ULF3</td>
<td>Continued...</td>
</tr>
</tbody>
</table>

**CREW** *(6 UP/6+1 DN)*

- **SS EVA 147**
- **DOCKED QUEST EVA 65**
- **EMU/TETHERED EVA 140**
- **SCHEDULED EVA 138**
- **DURATION 5:42**

**LAUNCH SITE, LIFTOFF TIME, LANDING TIMES**

- **LIFTOFF TIME**: 8:24.2 (P) 8:24.3 (A)
- **LANDING TIMES**: 331:14:45:04Z

**LANDING SITES, ABORT TIMES**

- **LANDING SITES**: KSC Runway 33
- **ABORT TIMES**: 331:14:45:04Z

**LANDING DURATION, WINDS**

- **DURATION 5:42**
- **WINDS**: 11H KTS -1L KTS

**THROTTLE PROFILE**

- **ENG. S.N.**
- **SFC**
- **THROTTLE PROFILES**
- **INC**
- **HA/HP**

**PAYLOAD/WEIGHTS**

- **PAYLOADS/EXPERIMENTS**
- **TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**

**PAYLOADS**

- **MIDDECK**
  - **ISS-ULF3, MAUI, SEITE, SIMPLEX, RAMBO-2**
  - **5 CRYO TANK**
  - **ODS, SRMS (86)**

**EVENTS**

- **FD1**: OMS2 ignition at 320:20:06:25Z resulted in a 125.0 by 84.8 NM orbit.
- **FD2**: RCC inspection found no areas of concern
- **FD3**: R-Bar Pitch Maneuver was performed.
- **FD4**: Damping Controller Pitch Maneuver was performed.

**FIRSTS/SECONDS/LASTS**

- **Second child born while astronaut dad in space.**
  - Randy Bresnik's wife, Rebecca, gave birth to Abigail Mae Bresnik, 6 lbs 13 oz, at 11:04 p.m. Saturday, Nov. 21st, in Houston.
  - First Orthopedic Surgeon in space: Dr. Robert Satcher, Jr.
  - First flight of new variable Alt DAP
  - First flight ET replaced LH2 ice Frost Ramp (IFR) base TPS with NCFI at 14 locations
  - First Flight SSME Nozzle Corrosion Inhibitor Application Change
  - First Monarch Butterflies delivered to ISS. Butterflies took flight on 12/09/09 as monitored by thousands of students back on Earth.
  - Super Bowl XLIV opening-toss coin flown to ISS & returned.

**FLIGHT DURATION CHANGES**

- None.

**PERFORMANCE ENHANCEMENTS**

- Include the standard set plus: 1) PE Operational High Q -TRN/NOV, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del Psi

**FLIGHT DURATION CHANGES**

- None. Landed on KSC Runway 33 at 331:14:44:21Z, Friday, November 27, 2009, at 8:24:21 CST.

**FIRSTS/SECONDS/LASTS**

- **Second child born while astronaut dad in space.**
  - Randy Bresnik's wife, Rebecca, gave birth to Abigail Mae Bresnik, 6 lbs 13 oz, at 11:04 p.m. Saturday, Nov. 21st, in Houston.

**RENDZVOUS**

- **#76** Rendezvous and dock with ISS.

**MISSION HIGHLIGHTS**

- **TAL WEATHER**: Weather on launch day caused a couple minor issues at back-up site, Istres. Weather conditions at Zaragoza, the prime TAL site, and Moron were observed and forecast acceptable throughout the countdown. However, a cloud ceiling developed at Istres 2 hours prior to launch limiting the use of that landing site. (Courtesy NASA SMG Post-Mission Summary.) Istres became GO close to launch update.

**PAYLOADS/EXPERIMENTS**

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**RENDZVOUS**

- **#76** Rendezvous and dock with ISS.

**EVENTS**

- **FD1**: OMS2 ignition at 320:20:06:25Z resulted in a 125.0 by 84.8 NM orbit.
- **FD2**: RCC inspection found no areas of concern
- **FD3**: T1 maneuver at 322:14:05:57Z resulted in a 185.6 by 179.5 NM orbit
- **FD4**: Damping Controller Pitch Maneuver was performed.
- **FD5**: Damping Controller Pitch Maneuver was performed.
- **FD6**: Damping Controller Pitch Maneuver was performed.

**RENDZVOUS**

- **#76** Rendezvous and dock with ISS.

**EVENTS**

- **FD1**: OMS2 ignition at 320:20:06:25Z resulted in a 125.0 by 84.8 NM orbit.
- **FD2**: RCC inspection found no areas of concern
- **FD3**: T1 maneuver at 322:14:05:57Z resulted in a 185.6 by 179.5 NM orbit
- **FD4**: Damping Controller Pitch Maneuver was performed.
- **FD5**: Damping Controller Pitch Maneuver was performed.
- **FD6**: Damping Controller Pitch Maneuver was performed.

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- **#76** Rendezvous and dock with ISS.

**EVENTS**

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- **FD4**: Damping Controller Pitch Maneuver was performed.
- **FD5**: Damping Controller Pitch Maneuver was performed.
- **FD6**: Damping Controller Pitch Maneuver was performed.
STS-129/ULF3 Continued…

CAPCOMs:

SHUTTLE
A/E - Chris Ferguson
- Steve Frick (Wx)
LDQ1 - Stan Love
C2 - Megan McArthur
Planning - Aki Hoshide
Team 4 - N/A

ISS
O1 - Drew Feustel
LDQ2 - Steve Swanson
O3 – Ryan Lien
Team 4 – N/A

EVENTS: Continued...

- Hard Dock, hooks closed, occurred at 322:17:03:49
- ISS Hatch opened at 12:28 PM CST, Nov. 18, 2009, welcomed by ISS crew. At that time Stott ended her stay as EXP 21 FE and became an STS-129 MS.
- FD4: Foreman & Satcher successfully completed all ISS maintenance and spares transfer tasks ahead of schedule. A get-ahead task was the most difficult. In releasing a cargo platform, a spring loaded device jammed and had to be manhandled to achieve release. EVA1 duration 6:37.
- MMIT concurred that no Focused Inspection of Orbiter was required.
- FD6: EVA2: Russian false depress event overnight, but EVA2 was conducted on time. Foreman & Bresnik completed all nominal tasks plus the following get-aheads: S3 Nadir/Inboard PAS Deploy, SGRANT Y-cable check (CHIT 8025), Tool stanchion relocation to P1 WIF 3, & APFR 5 retrieve. EVA2 duration 6:08.
- FD8: EVA3: Satcher & Bresnik: EVA-3 started one hour late due to EV2’s drink bag valve coming loose. All tasks successfully completed included: transfer of HPGT  & MISSE & from ExPRESS Logistics Carrier 2 to Quest airlock. Towards the end of the EVA two [unknown] items were lost overboard at 327:17:37Z. All tools were accounted for. EVA3 duration (PET) 5:42.

Continued…

SPACEMEN AT WORK

ISS021-E-030165 (19 Nov. 2009) Foreman installing a spare S-band antenna structural assembly to the Z1 segment of the station’s truss. EVA 1.

S129-E-007762 "New Dad In Space", Bresnik, installing a Grappling Adaptor to On-Orbit Railing Assembly (GATOR) on Columbus Lab. EVA 2. (21 Nov. 2009)

S129-E-008103 (23 Nov. 2009) Satcher moves debris shields from Quest airlock to the External Stowage Platform #2. EVA 3.

-------- SPACEMEN AT WORK --------

ISS021-E-032724--- (24 Nov. 2009) Portrait Time: Twelve internationally-represented astronauts and cosmonauts spend time together in space. The group includes the seven STS-129 astronauts CDR Hobaugh, PLT Wilmore; & Mission Specialists Stott, Foreman, Melvin, Satcher, & Bresnik, plus the five ISS crewmembers; Jeffrey Williams, Frank De Winne/ESA, Robert Thirsk/CSA and Russia’s FSA Roman Romanenko & Maxim Suraev.

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SIGNIFICANT ANOMALIES:

**Orbiter:**
- Waste dump stopped prematurely. The waste water dump initiated post-undock at approx. 329/12:07:38 GMT, exhibited a nominal waste dump rate (approx. 2.0 %/min) until approx. 329/12:19:36 GMT when the waste dump rate degraded to 0.3%/min. Waste dump was terminated by closing the dump valve and nozzle was reheat to approx. 286 deg F. Dump valve was then opened at 329/12:35:34 GMT for continuation of the dumping operation. The observed dump rate continued off-nominally at near 0%/min and the waste dump was terminated after 19 minutes. This IFA is considered a constraint to STS-132/ULF4 (next flight of OV-104), but is expected to be resolved with a dump line filter change.
- APU water tank heater A (504/46-101A) did not operate at expected temp. APU water tank temp:
- RCS BFS fuel and oxidezer quantities increased off nominal

**SRB:**
- RH solid rocket booster aft skirt foam on the outboard side of holddown post M2 near the GN2 purge line is observed to crack during liftoff.

**RSRM:**
- None.

**SSME:**
- None.

**ET:**
- None.

**MOD:**
- None.

**Integration:**
- Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Liftoff Debris)
- Single Transient SRB I/O Error at Liftoff
Brief Mission Summary: The STS-130 (32nd mission to ISS) main objectives were to deliver and assemble the final U.S. module (Tranquility) and the Italian built Cupola Node plus delivery of ISS equipment, supplies, and experiments. Tranquility provides additional room for the ISS crew and life support systems. The Cupola is a robotic control station and provides a panoramic view of earth through seven windows, “A Room With a View” - PAQ. The mission included 3 EVA’s.

POSTPONEMENTS: - Baseline STS-130 to FDRD - launch date of 12/10/09 on 11/17/09. - Ppd. to 02/04/10 on 03/10/09. Interim change while Cx and SSP schedules were assessed and prioritized. - Ppd. to 02/07/10 on 12/17/09. Launch date change supports efficient use of KSC ground operation resources.

LAUNCH SCRAM: Sunday, 02/07/10 launch attempt was terminated an hour before scheduled launch of 4:40 AM EST. Launch scrub was due to a massive area of low cloud ceilings that blanked the northern half of Florida. None. Launch occurred on time at 39:09:14:07Z on Monday 02/08/10. Spaceflight Meteorology Group (SMG) reported Win/Feb, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del

LAUNCH WINDOW: Total launch window was 11M 57S with Preferred Launch Time was 39:09:14:07Z (In-Plane Time) for a launch window of 7M32S.

CEPT: 118.0% BASELINED STS-130 to FDRD - launch date of 12/10/09 on 11/17/09. - Ppd. to 02/04/10 on 03/10/09. Interim change while Cx and SSP schedules were assessed and prioritized. - Ppd. to 02/07/10 on 12/17/09. Launch date change supports efficient use of KSC ground operation resources.

LOADS: 1654133 LBS NO-DEPLOYED: 1628311 LBS CARGO TOTAL: 4210259 LBS PAYLOADS: PLB: ISS-20A (NODE 3 WAC/POLCA) MIDDKE: ISS-20A, MAUI, SEISTE, SIMPLEX, RAMBO-2 5Cryo TANK SETS: CDs, SMS, ISSPTS, SPHER

Shuttle approaches ISS with Node 3/Cupola.

iss022e068832

iss022e062672

Before launch, the STS-130 began its approach to the International Space Station (ISS) as part of the Expedition 22 (Exp 22) mission. The space shuttle Endeavour departed NASA's Kennedy Space Center on February 8, 2010, with the first mission of the Space Shuttle Program post-Columbia and the third mission of the STS-130 series. The mission involved complex operations such as the landing of the orbiting module, installation of the Tranquility Module, and deployment of the Cupola.
### Mission Highlights

- **Flight Duration Changes:**
  
  On FD6, MMT agreed to add +1 day to nominal flight plan to facilitate complete transfer of the regen ECLSS racks to Node 3 as well as assist with accomplishing other flight objectives.


- **Firsts/Lasts:**
  
  - Shuttle’s last night launch.
  
  - Last U.S. on-orbit Segment (Node 3) installed on ISS.
  
  - Orbiter: First flight of Main Engine Ignition Overpressure Acoustic Instrumentation.

- **Night Launch:** 34

- **Night Landing KSC #17:** (#23 in Shuttle history)

- **Rendezvous:** #77

- **Events:**
  
  - FD1: OMS2 ignition at 039:09:51:49Z resulted in a 124.0 by 110.0 NM orbit.

  - FD2: During RCC surveys the crew downlinked some views of pulled up portion of port wing upper surface flapper door seal area. Area was cleared.

  - T1 maneuver at 041:02:28:25Z resulted in a 187.4 by 180.7 NM orbit.

  - FD3: R-Bar Pitch Maneuver was performed. No issues. MMT concurred no focus inspection required.

  - Docking Contact occurred at 041:05:05:56Z. Hard Dock, hooks closed, occurred at 041:05:54:12Z.


  - FD4: EVA 1: Behnken & Patrick successfully completed preparations for unberthing Tranquility (Node 3). ISS arm unberthed Node 3 & installed it on Node 1 port side followed by crew activation. EVA1 duration 6:32.

  - FD7: EVA2: Behnken & Patrick All planned activities were completed including installation of the ammonia jumpers, integrating Node 3 to EATCS Loop A, and installing the Node 3 port center disc cover (CDC). Cupola was successfully relocated. EVA2 duration 5:93.

- **Capcoms:**

  - **Shuttle:***
    - A/E: Rick Sturckow
    - LD/O1: Danny Olivas
    - LD/O2: Hal Getzelsman
    - O2: Mike Massimino
    - Planning: Shannon Lucid
    - Team 4: N/A

  - **ISS:***
    - O1: Robert Hanley
    - LD/O2: Hal Getzelsman
    - O3: Kathy Boll

- **Payloads/Experiments:**

  - PTM (US 181 FPS): 6:10(P) 6:12(A)
  
  - SE PRESS: 1046.57(P) 6.56(A)

  - MECC CMD: 8:22.5(P) 8:21.4(A)

  - Vt: 25819(P) 25817(A)

  - CMS-2: 37-44(P) 37-42(A)

### Space Shuttle Missions Summary

**STS-130/20A**

**Flight Directors:**

- SHUTTLE: A/E- Norm Knight, LD/O1- Kwatsu Alibaruho, O2- Gary Horlacher, Planning- Chris Edelen, Team 4- Paul Dye

- ISS: O1 - Royce Renfrew, LD/O2 - Bob Dempsey, O3 - Mike Lammers, Team 4 - Dana Weigel

**PTM (U/S 181 FPS):**

- MECO CMD: 8:22.5(P) 8:21.4(A)

- Vt: 25819(P) 25817(A)

**Payloads/Experiments:**

- PTM (US 181 FPS): 6:10(P) 6:12(A)

- SE PRESS: 1046.57(P) 6.56(A)

- MECC CMD: 8:22.5(P) 8:21.4(A)

- Vt: 25819(P) 25817(A)

**Pre Launch in JSC MOCR: Flight Dynamics Officer (FDO) Mark McDonald works on abort landing site planning.**

**Endeavour launch as seen in time lapse photo from top of the Intracoastal Waterway Bridge in Ponte Vedra, FL, 115 Miles from the launch site, Monday, February 8, 2010 @ 4:14 am EST.**

Photo by: James Vernacotola, copyright 2010: [www.jamesvernacotola.com](http://www.jamesvernacotola.com)
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (6)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>SSME-TL, NAM, ABORT EMERGENCIES AND ET</th>
<th>ING ENG. N</th>
<th>FSW</th>
<th>PAYLOAD/EXPERIMENTS</th>
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<tbody>
<tr>
<td>STS-130/20A</td>
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**EVENTS:** Continued...

- FD6: Cupola unberthed and moved from forward end to nadir port of Tranquility.
- FD10: EVA3: Behnken & Patrick. All planned and a number of get ahead tasks were completed including Loop B QD opening (integration of EATCS Loop B with Node 3 heat exchanger), PMA-3 cable installation, Cupola MLU removal, and VSC video cable routing. EVA3 duration (PET) 5:48.

- Transfers:
  - 36,130 Pounds of hardware transferred to ISS (inside & out)
  - 29,788 Tranquility Node 3 weight in pounds (as installed)
  - 3,594 Cupola
  - 757 Integrated Stowage Platform cargo
  - 24 Pounds of Oxygen transferred into ISS Airlock tanks
  - 0 Pounds of Nitrogen transferred (N2 was used to repress the stack)
  - 1,991 Pounds of middeck items delivered to ISS aboard Endeavour
  - 1,803 Pounds of middeck items returned from ISS to Endeavour
  - ~1,095 Pounds of water transferred to ISS

ISS construction and maintenance continue.


Below: ISS022-E-065750 -- Behnken during EVA 2

2010-02-17-0001Hz --- U.S. President Barack Obama, with members of Congress and middle school pupils, waves goodbye to Shuttle crew from the White House.
STS-130/20A Continued…

SIGNIFICANT ANOMALIES:

Orbiter:
- During STS-130 Ascent monitoring, WLE Sensor Unit S/N 1155 experienced two (2) off-scale high data spikes.
- MUX bypass switch will not switch to Bypass front for OCA 45Mbps downlinks.
- Audio drop-out during EVA 1.
- Trajectory Control Sensor (TCS) had trouble transitioning to CW mode. CW data became ratty and unusable.

KSC:
12 IFA’s entitled “STS-130 Post Launch Debris”

SRB: None.

RSRM: None.

SSME: None.

ET:
- POST-FLIGHT REV. IDENT. 2 FOAM LOSSES +Z SIDE INTOANK NCFI 24-124 ACREAGE, 19 FOAM LOSSES -Z SIDE OF THE INTOANK NCFI 24-12 ACREAGE MOD
- INCORRECT TAL RUNWAY SURFACE IN FLIGHT RULE
- Integration: None.

ISS022-E-067184 — Behnken (left) & Patrick removing insulation blankets & launch bolts from Cupola’s windows.

S130-E-010380 — Soichi Noguchi/ JAXA/FE ISS Exp 22, takes earth photo from a window in Cupola.

ISS022-E-068724 — CDR Zamka tries out view from Cupola.

JSC2010-E-017955 — Flight Directors in JSC MCC: From left: Chris Edelen, Norm Knight, Kwatsi Alibaruho and Gary Horlacher.

S130-E-012188 — ISS as seen by Endeavour post-undocking and separation. Tranquility & Cupola are located just left of center.

STS130-S-128 — Drag chute is deployed at MLGTD on KSC Runway 15 at 10:20:29 PM EST on Feb. 21, 2010. It was the 23rd night landing in Shuttle history and the 17th at KSC.

Quoting Oscar Wilde’s “Life imitates art far more than art imitates life”, Dave Zani — CinemaBlend.com, sees the Cupola window as the inside window of a Star Wars TIE Fighter.
<table>
<thead>
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<th>FLT</th>
<th>ORBITER</th>
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<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLT DURATION, WINDS</th>
<th>SSME-TL, NOMABORT EMERG.</th>
<th>SRB RFSM AND ET</th>
<th>ORBIT</th>
<th>PAYLOADS/EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS)</th>
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</thead>
<tbody>
<tr>
<td>STS-131/19A</td>
<td>DISCOVERY</td>
<td>OV-103</td>
<td>G. A. Poindexter (Ft 1-STS-122)</td>
<td>04/05/10 04:20:10 (18)</td>
<td>109:12:02:59Z</td>
<td>20.4 NM</td>
<td>140.0x123.8</td>
<td>14.2 NM</td>
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<td>KSC-131</td>
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<td>MS 1</td>
<td>Rick Mastracchio (Ft 3 - STS-103, STS-118)</td>
<td>04/05/10 04:20:10 (18)</td>
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<td>20.4 NM</td>
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<td>PAD 30A (54)</td>
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<td>MS 2</td>
<td>Dorothy Metcalf-Lindenburger</td>
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<td>MLP-3</td>
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<td>MS 3</td>
<td>Stephanie Wilson (Ft 3 - STS-121, STS-120)</td>
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<td>33rd SHUTTLE FLIGHT TO ISS</td>
<td></td>
<td>MS 4</td>
<td>Naoko Yamazaki (JAXA)</td>
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**ISS023-E-020718 --- ISS robotic Canadarm2 relocates Leonardo (MPLM) from Discovery's PLB to port on Harmony node.**
<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW (T)</th>
<th>LAUNCH SITE, LIFTOFF TIME</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>SSME-TL NO/MABORT EMERG</th>
<th>SRB RSFM</th>
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<tr>
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<tr>
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<td>C1: Courtenay McMillian</td>
<td>LD/C2: Roy Spencer</td>
<td>C3: Ed Van Cleve Team 4: Brian Smith</td>
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</tr>
</tbody>
</table>

**CAPCOMS**

**SHUTTLE**
- A/E: Rick Sturckow, George Zamka/Wx
- LD/O1: Rick Sturckow
- C2: Aki Hoshide Planning: Megan McArthur
- Team 4 – N/A

**ISS**
- O1: Mike Jensen
- LD/C2: Stan Love
- C3 – Marcus Reagant
- Team 4 – N/A

**CAPCOMS**

**SHUTTLE**
- A/E - Rick Sturckow
- LD/O1 - Rick Sturckow
- O2 - Aki Hoshide Planning - Megan McArthur
- Planning - Chris Cassidy
- Team 4 - N/A

**ISS**
- C1 - Mike Jensen
- LD/C2 - Stan Love
- C3 – Marcus Reagant
- Team 4 – N/A

**CAPCOMS**

**SHUTTLE**
- A/E - Bryan Lunney
- LD/O1: Richard Jones
- O2: Mike Sarafin Planning: Ginger Kerrick MOD: John Mollilcher Team 4: Gary Horlacher

**ISS**
- C1 - Courtenay McMillian
- LD/C2: Roy Spencer
- C3: Ed Van Cleve Team 4: Brian Smith

**WINDS**
- 2.1H KTS 2.2R KTS
- OFFICIAL: 02003P05KT (X0P0 H5P6)

**DISTANCE**
- 6,232,235 sm
- TOTAL SHUTTLE DISTANCE: 519,613,765 sm

**FIRSTS/LASTS**
- Last return trip for MPLM Leonardo. After STS-133 it will remain on ISS as a permanent fixture.
- First time for four women living in space.
- First time for two Japanese astronauts in space together.
- First special cookies from the Italian Café in Seabrook, TX, requested originally by Col. Timothy Creamer after a 6-month ISS tour, were delivered to ISS. The sand tarts passed NASA tests with the request to go light on the powdered sugar.

**RENDZVOUS:**
- #78 Rendezvous and dock with ISS.

**EVENTS:**
- FD1: OMS2 ignition at 095:10:58:39Z resulted in a 140.0 by 123.8 NM orbit.
- FD2: During RCC surveys showed no areas of concern.
- T1 maneuver at 097:05:06:44Z resulted in a 189.3 by 181.7 NM orbit
- Ku Band failed.
- FD3: R-Bar Pitch Maneuver was performed. Four areas of interest were identified: 1) RSB Trailing Edge Tile, 2) FWD Gap Filter, 3) Port ET Door Tile Chip, 4) three closely grouped OMS POD tile damage sites. The Damage Assessment Team later cleared these areas for entry and MMT concurred no focus inspection required.
- Docking Contact occurred at 097:07:44:09Z
- ISS Hatch opened at 4:11 AM CDT April 7, 2010, welcomed by ISS crew.
- FD4: MPLM was grappled, unberthed, and installed on the Node 2 Nadir without issue.
- FD5: EVA 1: Mastracchio & Anderson remove old ATA and handover new ATA to SSRMS, retrieve JEM SEED, & R&R RGA. EVA1 duration 6:27.

**S131-E-010002 --- STS-131 & EXP 23 crews gather in ISS Kibo Lab STS-131 crew members pictured (light blue shirts) are CDR Poindexter, PLT Dutton; Anderson/MS, Mastrachio/MS, Metcalf-Lindenburger/MS, Wilson/MS, & Yamazaki/MS (JAXA). EXP 23 crew members are CDR Oleg Kotov (RSA), Mikhail Kornienko/FE (RSA), Alexander Skvortsov/FE (RSA); Soichi Noguchi/FE (JAXA), T.J. Creamer/FE (USA), & Tracy Caldwell Dyson/FE (USA).**

**STS131-S-050 --- NASA Commentator Mike Curie and astronaut Kathryn (Kay) Hire discuss launch in LCC Firing Room 4 at KSC.**

In JSC MCC, Carson Sparks/FDO (Flight Dynamics Officer) in foreground & Tom Schmidt/GPO (Guidance & Procedures Officer), in rear, working launch data updates one hour prior to launch.
**SPACE SHUTTLE MISSIONS SUMMARY**

**MISSION HIGHLIGHTS**

**EVENTS**

- FD8/EVA2: Mastracchio & Anderson had difficulty installing new ATA onto S1 truss due to sticky plungers on bolt 4. Numerous workarounds were employed and eventually the bolt did cooperate. Alignment of the bolts and soft dock mechanisms are orientation sensitive and the task took much more time than booked. Several tasks were not completed & were rescheduled to EVA 3. EVA2 duration 7:26.
- FD9/EVA3: Mastracchio & Anderson completed: S1 ATA Fluid connectors (from EVA 2), Retrieve A/L MMOD shields (from EVA 2), Old ATA transfer to the LMC in Shuttle payload bay (all 4 bolts were engaged, though the last bolt required extra time due to some alignment challenges), & S1 ATA FGB install. EVA3 duration (PET) 6:24.
- FD9; Monday, April 12th celebrated the 49th Anniversary of the Soviet cosmonaut, Yuri Gagarin, first human to orbit the earth in 1961 and the 29th Anniversary of the first U.S. Space Shuttle launch in 1981.
- Transfers:
  - 15,222 Lbs of hardware transferred to ISS (inside & out)
  - 12,060 Lbs of MPLM supplies & logistics transferred to ISS
  - 4,109 Lbs of MPLM supplies & logistics returned from ISS
  - 1,702 Lb Ammonia Tank Assembly (ATA) delivered to ISS
  - 1,295 Lb ATA (old) returned from ISS
  - 94.5 Lbs of O2 used to repress the stack
  - 1,460 Lbs middeck items delivered to ISS
  - 1,235 Lbs of middeck items returned from ISS to Discovery
  - 6,639 Lbs of total hardware returned aboard Discovery
  - 975 Lbs of water transferred to ISS
  - 806,282 Mass (Lbs) of ISS now in space
  - 96 Percentage complete of ISS assembly (pressurized volume)
- FD13: Undocked at 107:12:52:10Z
  - During entry comm blackout times were approx. 110/12:49:15 to 12:54:34 (~ 5.5 min). Early H/O to TDRS 46 was not an option as TDRS 46 stayed on a lower antenna. INCO prediction of LOS was in error due to DCL PAD error, noted in Significant Anomalies. Also, see Ascent/Entry Flight Techniques Panel #255 of April 30, 2010.

**FUEL CELL**

- First time four women in space shown in the Zvezda Service Module: clockwise from lower left: are Tracy Caldwell Dyson/FE EXP 23, Metcalf-Lindenburger/MS, Yamazaki/MS(JAXA), & Wilson/MS.

**PAYLOADS/EXPERIMENTS**

**PAYLOAD WEIGHTS**

**MISSILE WEIGTS**

**LAUNCH SITE, LIFTOFF TIME, CROSSRANGE**

**LANDING SITE, ABORT TIMES**

**LANDING TIMES, FLT DURATION, WINDS**

**THROTTLE PROFILE, ENG. S.N.**

**ORBIT, INC, HAHP, FSW, LANDING SITES, RUNWAY, CROSSRANGE, SSME-TL, NOM-ABORT EMERG, ADM, EMERG**

**CREW (7)**

**TITLE, NAMES & EVA’S**

**CONTINUED...**

AT LEFT:

- S131-E-008710 -- Mastracchio (left) & Anderson conduct 2nd EVA during which they unhooked and removed depleted ammonia tank and installed a 1,700-pound ammonia tank on ISS Starboard 1 truss. Crew had problems with bolting down the new ATA tank on S1. They eventually got all 4 bolts secured, however, the time required to do this resulted in several tasks dropping off this EVA.

- S131-E-009456 --- Mastracchio (right) & Anderson conduct 3rd & final session of EVA. Activities included fluid lines hookup of new 1,700-pound ammonia tank and prepared cables on the Zenith 1 truss for a spare Space to Ground Ku-Band antenna.

**CONTINUED...**

- FD13: Undocked at 107:12:52:10Z

- During entry comm blackout times were approx. 110/12:49:15 to 12:54:34 (~ 5.5 min). Early H/O to TDRS 46 was not an option as TDRS 46 stayed on a lower antenna. INCO prediction of LOS was in error due to DCL PAD error, noted in Significant Anomalies below. Also, see Ascent/Entry Flight Techniques Panel #255 of April 30, 2010.

**CONTINUED...**
SIGNIFICANT ANOMALIES:

**Orbiter:**
- CCTV Camera C zoom not functioning
- During STS-131, KU-BAND FAILED FROM POWER UP FOR BOTH COMMAND AND RADAR OPERATIONS.
- NRD-131-005, D-131-RPM-410-001: Debris Event During Asccent at 42sec Met from Port Upper SRB Trailing Edge. Tile has broken away, appears to be partial liberation. Visible Charring Along the Aft Edge.
- LRCS fuel helium ISO B valve slow to close during post wave off system reconfigure.
- FRCS fuel helium ISO A valve slow to close during post entry valve test.

**KSC:**
- STS-131 Post Launch Debris

**SRB:**
- Uploaded Accelerometer Data from the S/N 2000003 DAS showed 446 seconds of Preflight Testing Followed by the first 94 seconds of flight data.
- RSRM: None.

**SSME:**
- ME-2 HFTP 21 Degree Accel Disqualified at T+7:19 ET: None.

**MOD:**
- Incorrect Comm Predicts due to Pads Error

**Integration:**
- Base Flight Shield TPS Liberation
- Windows 5, 6 Missing/Protruding Ceramic Plugs
- Rudder Speedbrake TPS Liberation

Discovery’s planned approach and landing track across the continental U.S. Photo courtesy JSC/PAO.
**Brief Mission Summary:** The STS-132 (34th mission to ISS), dubbed “Finishing Touches” by PAO, main objectives were to conduct three EVA’s, deliver & install the 2nd Russian Mini-Research Module, a complement of batteries, a backup Ku-band antenna, and other ISS supplies. This was the last scheduled flight of Atlantis; however, Congress later approved one more flight, see STS-135.

**Launch Window:** Window open at 134:18:09:09Z and close at 134:18:25:10Z. Preferred Launch Time was 134:18:20:09Z (In-Plane Time) for a launch window of 5074.

**Launch Scrubs/Delays:** None.

**Launch Scrubs/Delays:** None. It’s a beautiful day in Florida to bid “Bon Voyage” to the good ship Atlantis on its sunset cruise. ‘*Kh' (Space Shuttle Program Public Affairs). Launch occurred on time at 134:18:20:09Z on Friday 05/14/10.

**TAL Weather:** Skysight Meteorology Group (SGM) reported a high pressure ridge provided benign weather at KSC for launch and RTLS. Things were trickier for TAL Sites with low pressure system resulting in breezy conditions at ZZA & MRN. By launch winds decreased below Flight Rule limits. At Istres rains remained outside of 20 NM watch area. Weather was “GO”.

**Flight Duration Changes:** None.

**PERFORMANCE ENHANCEMENTS:** Include the standard set plus: 1) PE Operational High Q - THIN/WAY, 2) OMS Assist, 3) a 52 nautical mile MECO, and 4) Del Psi

**LAUNCH WINDOW:** Window open at 134:18:15:09Z and close at 134:18:25:10Z. Preferred Launch Time was 134:18:20:09Z (In-Plane Time) for a launch window of 5074.

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**Flight Duration Changes:** None.
Space Shuttle Missions Summary

Overview:
- **STS-132/ULF4**
- Continued...

**Crew & EVAs**
- **Title Names & EVAs:**
  - MCC White Flight for (62)
  - Continued...
  - Mcc White Flight FC(62)

**Flight Directors & Shuttle**
- **AV:** Charlie Hobaugh
- **FD:** Mike Massimino
- **C:** Chris Ferguson
- **O:** Chris Ferguson
- **I:** Chris Ferguson
- **O2:** Stan Love
- **LD/O1:** Chris Ferguson
- **LD/O2:** Paul Fromm
- **Team 4:** Paul Fromm

**Launch Site:**
- **Date & Time:**
  - 6:02(P) 6:02(A)

**Landing Site & Aborts Times**
- **Site:**
  - SE TAL (ZZA 104)
  - Continued...

**Payloads & Experiments**
- **Name:**
  - Reisman, B.
  - Bowen, D.
  - Good, W.
  - Garrett, W.

**Eng. S.N.**
- **SN:** 146:12:48:19Z

**Profile:**
- **Duration:**
  - 11:18:27:59

**Wind:**
- **Kts:** 1:19 M:S

**Weather:**
- **KTS:** 8, 2 L
- **Off:** 146:12:48:72

**Tenth Shuttle Crew Member Replacement**
- **Planning:** Ginger Kerrick

**Mission Highlights**
- **Flight 1st:**
  - FD3: EVA2: Bowen & Good successfully completed all tasks: cleared cable from the Orbiter LDRI tilt axis, installed 4 new batteries in truss 3 old batteries into pallet, & stowed a temp. battery. EVA2 duration 7:09.

**Payloads:**
- **OLP:**
  - FD8: EVA 3: Good & Garrett activities included: completion of batteries R&R’s, P6 cleanup, & PDGF trial. EVA3 duration (PET) 6:46.

**Payloads/Experiments**
- **Title:**
  - Firsts/Lasts:
  - - Last scheduled flight of Atlantis.
  - - The Mini Research Module 1 (MRM1), aka Rassvet, is first & only major piece of Russian H/W that U.S. hauled to ISS.
  - - First evaluation of Commercial Compression Garments to prevent post-spaceflight Orthostatic Intolerance.

**Crew:**
- **Date:**
  - 2010-05-16

**Events:**
- **End:**
  - Docking Contact occurred at 134:14:28:25Z resulted in a 125.1 by 85.2 NM orbit.

**Payloads:**
- **OLP:**
  - FD3: EVA Pitch Maneuver was performed.
  - - Docking Contact occurred at 134:14:28:25Z.
  - - Hard Dock, hooks closed, occurred at 134:14:40:49Z.

**Payloads/Experiments**
- **OLP:**
  - FD4: EVA 1: Reisman & Bowen installed SGNIT & EOCT.

**Payloads/Experiments**
- **OLP:**
  - FD5: Russian MRM1 successfully unberthed and docked to ISS.

**Payloads/Experiments**
- **OLP:**
  - FD6: EVA2: Bowen & Good successfully completed all tasks: cleared cable from the Orbiter LDRI tilt axis, installed 4 new batteries in truss 3 old batteries into pallet, & stowed a temp. EVA2 duration 7:09.

**Payloads/Experiments**
- **OLP:**
  - FD6: EVA2: Bowen & Good successfully completed all tasks: cleared cable from the Orbiter LDRI tilt axis, installed 4 new batteries in truss 3 old batteries into pallet, & stowed a temp. EVA2 duration 7:09.

**Payloads/Experiments**
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**SPACE SHUTTLE MISSIONS SUMMARY**

**STS-132/ULF4**

<table>
<thead>
<tr>
<th>FLT NO.</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>CREW (7)</th>
<th>LANDNG SITE/ ORBITER, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDNG TIMES, ORBITER ABORT TIMES</th>
<th>ORBITER, LIT ABORT, CROSSRANGE</th>
<th>SRB ENG. S/N</th>
<th>ORBIT FLT DURATION, WINDS</th>
<th>THROTTLE PROFILE ENGINE S/N</th>
<th>AND ET INC</th>
<th>VP-RM</th>
<th>PAYLOAD WEIGHTS, FSW</th>
<th>PAYLOADS/ EXPERIMENTS</th>
<th>MISSION HIGHLIGHTS (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)</th>
</tr>
</thead>
</table>

**Continued…**

**DISTANCE:**
- 4,579,978 sm
- TOTAL SHUTTLE DISTANCE: 524,493,743 sm

**ISS023-E-047488** — In the grasp of ISS Canadarm2, Russian-built Mini-Research Module 1 (MRM-1) is moved for permanent attachment to ISS FGB. Named Rassvet, Russian for "dawn," the module is the second in a series of new pressurized cargo storage components for Russia. Rassvet also gives ISS an additional docking port.

**Mississippi Delta →**

**Oil Spill →**

**LEFT:** ISS023-E-032398 — Soichi Noguchi (JAXA) ISS EXP 23 FE, photographed the Mississippi Delta showing the BP oil slick in the Gulf of Mexico on May 4, 2010. Part of the river delta and nearby Louisiana coast appear dark in the sunglint. Location of oil rig is out of frame to the left. USGS Comment: "Worst oil spill in U.S. history."

**S132-E-006106** — Bowen during first EVA with Reisman (out of frame), continues construction and maintenance on the ISS, with battery replacements & installation of a 2nd Ku-band antenna.

**S132-E008900** — Good (foreground) & Reisman, are surrounded by ISS hardware during the flight's final EVA.

**Prominent Events:**

- Transfers:
  - 28,792 Lbs HW transferred to ISS (inside & out) includes:
    - MRM1 "Rassvet" - loaded (17,670 Lbs)
    - 7,573 Lbs ICC with supplies to ISS
    - 6,466 Lbs ICC with supplies from ISS
    - 42 Lbs Oxygen to ISS
    - 30 Lbs Oxygen to ISS (stack repress)
    - 10.5 Lbs Nitrogen to ISS
    - 1,325 Lbs water to ISS
  - 2,182 Lbs middeck items to ISS aboard Atlantis
  - 1,763 Lbs middeck items returned from ISS aboard Atlantis
  - 8,229 Lbs total HW returned aboard Atlantis includes ICC
  - 816,349 Mass (Lbs) of ISS now in space

- Undocked at 143:15:22:04Z:
  - During entry comm outage time due to blackout was extended to 146:12:32:00Z - 12:34:30Z (~ MET 01/16:12 - 16:14:30). SWV handover to TS-46 was not available as TS-46 was on a Lower Antenna resulting in plasma blackout. This was well advertised.

- ISS hardware during the flight's final EVA.
Atlantis was named after the primary research vessel for the Woods Hole Oceanographic Institute in Massachusetts from 1930 to 1966. The two-masted, 460-ton ketch was the first U.S. vessel to be used for oceanographic research. Such research was considered to be one of the last bastions of the sailing vessel as steam-and-diesel-powered vessels dominated. [From STS-132 Press Kit by PAO]

**Significant Anomalies:**

**Orbiter:**
- During Flight, a FES Shutdown Occurred While Operating on the Primary B Controller. Reference: MER-09
- KSC: - STS-132 Post Launch Debris

**SRB:**
- LEFT-HAND SRB FRUSTUM UPPER RIGHT BSM ROOM TEMPERATURE Vulcanization (RTV) 133 IS MISSING, MEASURING 5° LONG
- RSRM: None.

**SSME:**
- None.

**ET:**
- STS-132/ET-136 FOAM LOSS ON THE +Z SIDE OF THE INTERTANK
- MOD: None.
- Integration: - Unexpected Debris/Expected Debris Exceeding Mass Allowable Prior to Pad Clearance (Uplift Debris)
- Ice Observed on the T-0 Umbilical at Retraction

**Atlantis Tribute:** From Mike Leinbach/Launch Director/KSC

*Above Right: KSC-2010-4450 ([http://mediaarchive.ksc.nasa.gov/index.cfm](http://mediaarchive.ksc.nasa.gov/index.cfm)). This Tribute Display features Atlantis soaring above the earth. Atlantis flew seven missions to space station Mir. In addition to its many assembly, construction, and resupply missions to the International Space Station, Atlantis also flew the last Hubble Space Telescope servicing mission on STS-125. The planet Venus represents the Magellan probe deployed during STS-30, and the planet Jupiter represents the Galileo probe deployed during STS-34. Threaded through the design are the mission patches for each of Atlantis’ flights. The inset photos illustrate various aspects of space shuttle processing as well as significant achievements such as the “glass cockpit” and the first shuttle docking with Mir during STS-71. The inset photo in the upper left corner shows a rainbow over Atlantis on Pad A and Endeavour on Pad B. Endeavour was the assigned vehicle had Atlantis’ STS-125 mission needed rescue, and this was the last time both launch pads were occupied simultaneously. The stars in the background represent the many people who have worked with Atlantis and their contributions to the vehicle’s success.*

**Congress Allows Atlantis to Fly Again - See STS-135**

"Space Shuttle Atlantis comes home to the Kennedy Space Center for the final time, 25 years, 32 flights, and more than 120 million miles traveled; the legacy of Atlantis, now in the history books," Commentator Josh Byerly remarked from his console in Houston. NASA Photos courtesy: Susan Phipps Multimedia Librarian/AP3 JSC
Lonnie Schmitt - First “Century Club” Controller

(From: collectSPACE.com - Robert Pearlman) - CDR Ken Ham joined in with past and present members of MCC Thursday morning [May 20, 2010] to recognize Lonnie Schmitt as the first Flight Controller to reach his 100th shuttle mission. "This is truly a momentous occasion," radioed Ham from onboard Atlantis. "We were just kicking this around on the flight deck here between us who have spent a lot of time in MCC as Capcom and know a lot of the flight controllers and offhand, we can’t come up with any other individual that we know of that has been around as a flight controller since STS-1."
Missions Highlights:


- **Giant Crawler Carries Shuttle To Pad**: STS-133 rolls to PAD on 09/20/10 for first launch attempt - scrubbed on 10/29/10. The KSC crawler-transports (two) carried all Apollo Saturn V's and all Shuttle vehicles on the gravel path from the VAB to Launch Complex 39.

- **Brief Mission Summary**: The STS-133 (35th mission to ISS) delivered two key components to ISS – the Italian-built Permanent Multipurpose Module (PMM) and Express Logistics Carrier 4 (ELC4) – for spare parts and storage capacity. Also delivered was Robonaut 2, the first dexterous humanoid robot in space. This was the final flight of the most flown Orbiter, Discovery (39 flights) - The Beginning of the END!

- **Postponements**: - Baseline STS-133 to FDRD - launch date of 07/29/10 on 09/16/10 on 09/30/09. Adjustments needed for flight product planning. - Paused to 11/01/10 on 07/01/10. Slip was required to complete preparations of critical spares that will be launched in the Permanent Multi-Phase Module (PMM).

- **Launch Scrub**: - Launch scrubbed on 10/29/10 due to helium & nitrogen leaks discovered in the right OMS pod. Launch rescheduled for 11/02/10. On 10/30/10 launch rescheduled to 11/03/10 to allow additional time for reloading the helium tank after repair in the right OMS pod. Technical scrub.
- Launch scrubbed on 11/02/10 at L-1 MMT meeting due to problem with center SSME controller. Launch rescheduled for 11/04/10. Technical scrub.
- Launch scrubbed on 11/04/10 at tanking MMT meeting due to predictions of bad weather. Launch rescheduled for 11/05/10. Technical scrub.
- Launch scrubbed on Friday, 11/05/10 when a liquid hydrogen leak was detected about 6:30 a.m. CDT in the Ground Umbilical Carrier Plate (GUCP). Mike Moses, MMT Chair stated: "This is not a stranger to us -- we saw this on STS-119 and STS-127." A crack in the leak was detected on the flange of the ET intertub near the oxygen tank. To allow time for engineering analyses of these issues, for compatibility with on orbit sun angles, and for avoidance of other space traffic to/from ISS, the launch was reset for NET 11/30/10. Continued...
STS-133/ULF5
Continued…

Continued…

OV-103

Continued…

IRS
Crew - Charlie Hobaugh
Asc - Barry Wilmore (Wk)
C02 - Megan McArthur
Planning - Mike Massimino
Ent - Charlie Hobaugh
Terry Virts (Wk)
Team 4 - N/A

EXTERNAL TANK FOAM LOSS 3 min, 51 sec into Ascent
- No Severe Damage

DISCOVERY’S FINAL LIFT-OFF

STS133-S-039 (24 Feb. 2011)

PRCB Briefing Chart for ET-137 Intertank Stringer Crack Observation

External Tank Foam Loss 3 min, 51 sec into Ascent
- No Severe Damage

STT-133 / ET-137 Intertank Stringer Crack Observation

1st observation in history of program
- Design unchanged since SLIT (ET-96)

During your drain inspection a crack was noted on LoS Intertank Range Closeout
- Dissection of foam revealed a crack on each side of the stringer at 6:23:41.9 T, and a crack at the adjacent stringer 6:23:42.9 T
- Crack was unrepaired

DENS ALT
1266 FT

FLT DURATION
12:19:03:53

S/T
1290:04:07:04

CV-103
359 22 24:02

Continued…

LAUNCH SCREWS: (Continued)

On 11/18/10 launch rescheduled for NET 12/03/10 due to identified analysis and ET repairs required for safe launch. On 11/24/10 launch rescheduled to NET 12/17/10 to allow analysts additional time to determine likelihood of additional ET stringer cracks during ascent. “This is turning out to be a little more complicated from an analysis standpoint,” NASA’s associate administrator Bill Gerstenmaier. On 12/03/10 launch rescheduled to NET 02/03/11 to validate repairs and to support engineering analysis with instrumented ET Tanking Test. On 01/08/11 launch rescheduled to NET 02/24/11 to allow engineers additional time to assess new cracks resulting from tanking test. And, on 01/20/11 launch date was established as 02/24/11. This date allowed for completion of all stringer work. Technical scrub.


LAUNCH DELAYS: 2M57S due to Range Safety Control Command Computer anomaly. “We had about two seconds of hold time remaining, which is about one second more than Mike [Launch Director Leinbach] needed to get the job done, so we had plenty of margin,” quipped Launch Integration Mgr Mike Moses.

TAL WEATHER: Spaceflight Meteorology Group (SMG) reported high pressure across Spain and France for generally acceptable weather at the TAL sites. ZZA was selected as prime TAL site at crew briefing [however, earliest TAL call was based on MRN]. Winds were gusting to 30 kts prior to crew brief, but headwinds dropped within limits at time of briefing. Isolated showers in Eastern France were never a threat and strong winds at Istres weakened enough for forecast to be amended GO.

PERFORMANCE ENHANCEMENTS: Include the standard set plus: 1) PE Operational High Q -WIN/ FEB, 2) OMS Assist, 3) a 52 nautical mile MECO, & 4) Del Psi

FLIGHT DURATION CHANGES: Plus 1 day added for PMM outfitting was approved by MMT on FD 5. The IMMT/MMT added a 2nd extra day on FD 8 to allow the six member shuttle crew to further help unload the new PMM storage unit.

LAUNCH DIRECTORS:
LD/O1 - Steve Robinson
C02 - Megan McArthur
LD/O2 - Royce Renfrew
O1 - Hal Geltzeman
LD/C2 - Stan Love
O2- Ginger Kerrick
LD/C3 - Ricky Arnold
Team 4 - N/A

ISS
C1 - David Korth
LD/C2 - Royce Reinfred
O3 - Chris Edelen
Team 4 - Kwatsi Alibaruho

CAPCOMS:
SHUTTLE:
Asc - Richard Jones
LD/O1 - Bryan Lunney
C02 - Ginger Kerrick
LD/O2 - Stan Love
O3 - Rick LaBrode
Entry - Tony Caccaci
Team 4 & Prelaunch - Paul Dye

FCC:
O1 - Hal Geltzeman
LD/C2 - Stan Love
O3 - Ricky Arnold
Team 4 - N/A

SHUTTLE FLIGHT DIRECTORS:
LD/O1 - Steve Robinson
C02 - Megan McArthur
Planning - Mike Massimino
Ent - Charlie Hobaugh
Terry Virts (Wk)
Team 4 - N/A

SHUTTLE CAPCOMS:
Asc - Charlie Hobaugh
- Barry Wilmore (Wk)
C02 - Megan McArthur
Planning - Mike Massimino
Ent - Charlie Hobaugh
- Terry Virts (Wk)
Team 4 - N/A

The LMMT/MMT added a 2nd extra day on FD 8 to allow the six member shuttle crew to further help unload the new PMM storage unit.

EXTERNAL TANK FOAM LOSS 3 min, 51 sec into Ascent
- No Severe Damage

External Tank Foam Loss 3 min, 51 sec into Ascent
- No Severe Damage

MOD - John Mccullough
Entry - Tony Caccaci
LD/O1 - Bryan Lunney
C02 - Ginger Kerrick
LD/O2 - Stan Love
O3 - Rick LaBrode
Entry - Tony Caccaci
Team 4 & Prelaunch - Paul Dye

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ISS
C1 - David Korth
LD/C2 - Royce Reinfred
O3 - Chris Edelen
Team 4 - Kwatsi Alibaruho

Deadlock: (Continued)

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Continued…
ISS026-E-030282 (26 Feb. 2011) — Backdropped by a blue and white part of Earth, Discovery approaches ISS for its last visit.

S133-E-007808 — ISS’s Canadarm2 grasps the Italian-built Permanent Multipurpose Module (PMM) for transfer from Discovery’s payload bay to be permanently attached to the Unity node.

S133-E-008627 — In U.S. Lab Destiny, crews pose for a joint STS-133/Exp 26 group portrait. The STS-133 crew in red shirts (from left) are Stott, Drew, PLT Boe, CDR Lindsey, Barratt & Bowen. In dark blue Exp 26 crew, from left, are Paolo Nespoli/ESA, Oleg Skripochka/RSA, Dmitry Kondratyev/RSA (below), Alexander Y. Kaleri/RSA and CDR Scott Kelly and Cady Coleman (below).

Continued…

**FIRSTS/LASTS:**
- Last Flight of Discovery - 1st vehicle to be retired.
- Robonaut 2 is first dexterous humanoid robot in space
- First flight of SRB Thrust Vector Control (TVC) Auxiliary Power Unit (APU) Phase II fuel pump
- All six existing major spacecraft from Japan, Europe, Russia and the US that service ISS were simultaneously docked for first and last time. (Proposed Soyuz fly around of ISS for historic photo of the 6 vehicles - ruled out by Russia’s FSA as safety risk.)
- Last NASA module (Italian-built), the Permanent Multipurpose Module (PMM), a storage room, was attached to ISS.
- Steve Bowen is first NASA astronaut to fly on back-to-back Shuttle missions (see below).
- FD13: First “Live” Wakeup Call! Performed by Big Head Todd & the Monsters playing “Blue Sky” from MCC, Tuesday, March 8, at 3:23 a.m. CST.

11th SHUTTLE CREWMEMBER REPLACEMENT
- Tim Kopra (injury) was replaced by Bowen in Jan. 2011. (10th Shuttle crewmember replacement occurred on STS-132.)

NIGHT LAUNCH: N/A

RENDZVOUS: #80 Rendezvous and dock with ISS.

EVE NTS:
- FD1: OM52 ignition at 55:22:31:54Z resulted in a 125.5 by 84.9 NM orbit.
- FD2: No Focus Inspection required for TPS/RCC
- T1 maneuver at 57:16:33:24Z resulted in a 192.4 by 184.9 NM orbit.
- Docking Contact occurred at 057:19:14:18Z
- Reboost (26 mins) at 62:14:29:36Z resulted in a 194.6 by 184.8 NM orbit.
- FD5: EVA 1: Bowen & Drew completed all planned tasks: J612 extension cable install, Pump module retrieval from POA, Pump module install on ESP-2, CP3 camera wedge install, and Message in a Bottle Experiment. During pump installation task the cupola robotic workstation had a “loss of comm,” resulting in Bowen holding the 800 lb (but now weightless) pump for 25 min. He reported “I’m fine as long as it’s not too much longer.” Then added “How much longer?” Operations were transferred to the Lab robotics and task completed. EVA1 duration 6:34

Continued…

DISTANCE:
- 5,304,140 sm
- TOTAL CV-103 DISTANCE: 148,221,675 sm
- TOTAL SHUTTLE DISTANCE: 529,797,883 sm

**PAYLOADS/EXPERIMENTS:**
- Firsts/Lasts:
  - Last flight of Discovery - 1st vehicle to be retired.
  - Robonaut 2 is first dexterous humanoid robot in space
  - First flight of SRB Thrust Vector Control (TVC) Auxiliary Power Unit (APU) Phase II fuel pump
  - All six existing major spacecraft from Japan, Europe, Russia and the US that service ISS were simultaneously docked for first and last time. (Proposed Soyuz fly around of ISS for historic photo of the 6 vehicles - ruled out by Russia’s FSA as safety risk.)
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### SPACE SHUTTLE MISSIONS SUMMARY

**STS-133/ULF5**  
*Discovery departs ISS for last time!*

**DISCOVERY’S FLAWLESS FINALE**  
*MLGTD @ KSC March 09, 2011, 10:57:15 CST*

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<table>
<thead>
<tr>
<th>FLT</th>
<th>ORBITER</th>
<th>CREW (7)</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITE, ABORT TIMES</th>
<th>LANDING TIMES, FLIGHT DURATION, WINDS</th>
<th>SSME/RSRM</th>
<th>SRB</th>
<th>ORBIT</th>
<th>FSWS</th>
<th>PAYLOAD WEIGHTS</th>
<th>MISSION HIGHLIGHTS</th>
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<tr>
<th>EVENT (Continued)</th>
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<tbody>
<tr>
<td>FD5 MMT Decision: Based on FD2 inspection and RPM data, the TPS was cleared for entry per Flight Rule A2-142.</td>
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<tr>
<td>FD6: PMM, an extra storage room/closet, was installed and hatch opened.</td>
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<tr>
<td>Transfers: 31,459 Pounds of HW to ISS (inside &amp; out) 110 Pounds of Oxygen to ISS (Quest tanks) 72 Pounds of Oxygen to ISS (stack repress) 26 Pounds of Nitrogen to ISS 931 Pounds of water to ISS 2,031 Pounds of middeck items to ISS.</td>
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<td>ISS Mass in space 919,964 Pounds.</td>
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<td>FD12: Undock from ISS complete at 066:12:00:10Z.</td>
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<tr>
<td>FD14: During entry comm outage times due to blackout were: 1st outage 068:16:39:25Z. INCO cmds H/O from TDRS 174 prior to 1st roll reversal. MILA AOS at 68:16:45:00Z good return link and UHF.</td>
</tr>
</tbody>
</table>

**SIGNIFICANT ANOMALIES:**

- TPS Anomalies
- ATVC Ch 1 Power Supply Failed to Restart
- Ammonia Spray Boiler Sys B Unexpected Switchover
- KSC, RSRM, SSME, MOD, SRB - None.
- VIDEO FROM RH ET OBSERVATION CAMERA NOT RECORDED BY DAS DURING FLIGHT ET: (See Integration issues below)

---

**S133-E-007866 --- CDRs Scott Kelly (left) Exp 26 & Steve Lindsey STS-133 are shown in the hatch leading to the newly-installed PMM.**

**Discovery’s planned final approach and landing track to KSC. Chart courtesy Kyle Herring/JSC-PAO.**

**DISCOVERY’S FLAWLESS FINALE**

**MLGTD @ KSC March 09, 2011, 10:57:15 CST**

201103090001HQ. - Courtesy: Rob Navias/JSC-PAO
SPACE SHUTTLE MISSIONS SUMMARY

--- SOME OF THE OPERATIONS SUPPORT TEAM ---

JSC2011-E-021930 - STS-133 Lead FD Bryan Lunney monitors rendezvous data. His last flight.

Pat Ryan/PAO
Ginger Kerrick/FD O2


IN KSC LCC: ABOVE: NASA Ctr Directors: (lt to rt) are Patrick Scheurmann/Stennis, Bob Cabana/KSC, Mike Coats/JSC, & Robert Lightfoot/MSFC. BELOW: We have lift-off! (lt to rt) Stephanie Stilson/Discovery Flow Director, Charlie Blackell-Thompson/Lead Test Director, & Mike Leinbach/ Launch Director.
STS-133/ULF5 “A MIXTURE OF SADNESS AND PRIDE”

JSC Center Director: “I am proud to have been the Pilot on the first flight of Discovery in 1984. I also flew Discovery on my two missions as Commander.” - Mike Coats

Shuttle Program Manager/JSC: “Discovery’s landing yesterday was an outstanding end to an amazing mission. I was really struck by the ‘business as usual’ attitude of the dedicated team that takes care of our Orbiters. … To those team members that have flown their last flight with us – You should walk away with your head held very high. You have built and kept safe a unique capability in the most extreme of environments. I can only hope that others that come after us will look back at the Space Shuttle team and emulate the dedication, perseverance, and excellence that this team represents. If they do, we will have an outstanding human spaceflight program. For those team members remaining - Let’s go finish this program strong.” - John Shannon

STS-133 Crew: Nearing the end of the shuttle’s final mission, the crew sentiments were a mixture of sadness and pride. “When you look out the Cupola window, times like that, I really reflect on what a great vehicle it’s been – 39 missions, nearly one year on orbit, thinking about all the things the vehicle has done, it’s kind of bittersweet.” And later, “Houston for the last time, Wheels Stop!” - CDR Steve Lindsey.

Lead Flight Director/JSC: “Discovery represents the ingenuity, creativity and diligence of the teams who originally designed and built Discovery and also the teams who operated and evolved the capabilities of Discovery across three decades. Discovery evolved from a short duration LEO delivery vehicle to a much more capable delivery and service spacecraft staying on orbit more than twice as long as originally intended. The engineering teams and operations teams expanded Discovery’s capabilities well beyond the original designers intentions enabling scientists to learn more and more about the world and universe around us.” - Bryan Lunney/Onyx Flight

NASA Assoc. Admin. for Space Ops: “I don’t really know what to say other than to thank the Discovery team. I think of all the processing work, the folks throughout the history of this vehicle back to Downey and Palmdale who gave us a phenomenal vehicle. It’s legacy is the future with station in great shape and that’s only possible because Discovery performed so well. That extra work sets up so well for the research period aboard station.” - Gerst

DISCOVERY NOW HEADS TO THE SMITHSONIAN NATIONAL AIR AND SPACE MUSEUM’s UDVAR-HAZY CENTER IN CHANTILLY, VA.

Shuttle Legacy Mural - Hanging in LCC Firing Room at KSC

KSC-2010-4453 (http://mediaarchive.ksc.nasa.gov/index.cfm). This Tribute Display features Discovery demonstrating the renowned Rendezvous Pitch Maneuver on approach to the International Space Station (ISS) during STS-114. Having accumulated the most space shuttle flights, Discovery’s 39 mission patches are shown encircling the vehicle. The background image was taken from the Hubble Space Telescope, which was launched aboard Discovery on STS-31 and serviced by Discovery on STS-82 and STS-103. The prominent American flag and eagle represent Discovery’s two “Return to Flight” missions, STS-26 and STS-114, and symbolize Discovery’s heroic role in returning American astronauts to spaceflight. Discovery’s significant accomplishments include the first female Shuttle pilot (Eileen Collins on STS-63), John Glenn’s legendary STS-95 mission, and the celebration of the 100th space shuttle mission with STS-92. In addition, Discovery supported numerous DOD programs, satellite deploy/repair missions, and 13 flights for construction and operation of the ISS.
Brief Mission Summary: The STS-134 (36th mission to ISS) delivered the $2 billion Alpha Magnetic Spectrometer-2 (AMS-02) to the ISS. AMS-02 is a particle physics detector designed to search for dark matter and for antimatter (first discovered by British physicist Paul Dirac in 1920’s) in the universe. MIT Prof. Sam Ting is the AMS Principal Investigator. ISS spare parts and a suite of DoD Experiments were also delivered to orbit. Four EVA’s were conducted for ISS maintenance and the Orbiter OBUS was transferred to ISS as a permanent fixture. This was the final flight of Endeavour (25 flights).

STS WD
OFF: 263 days+ 69 Non-work days + 17 holidays + 2 safety days VAR: 9 +1C (Continuingly) day + 1Wk
PAD A: 53+14C
Total Work Days = 325 (OFF processing occurred over a total time period of 371 days)

POSTPONEMENTS:
- Baseline STS-134 to KFD - launch date of 07/29/10 on 06/30/09.
- Pd: to 11/26/10 on 07/01/10. Delayed to late November after a decision to replace the magnet at the heart of the AMS-02. Pd: to 04/19/11 on 01/26/11. This date was driven by the launch pad turnaround time required after STS-133 launch.
- Pd: to 04/29/11 on 04/04/11 due to conflicts with Russian Progress vehicle flight to ISS.
- Pd: to 02/26/11 on 01/26/11. A late-November/early December launch was ruled out because of conflicts with other planned station launches. Temperature constraints related to the station’s orbit prevented a launch in January and range conflicts with other unmanned missions pushed the approved launch date to Feb. 26.
- Pd: to NET 04/01/11 on 12/03/10 due to STS-133 slip for ET stringer problems.
- Pd: to 04/19/11 on 02/26/11. This date was driven by the launch pad turnaround time required after STS-133 launch.
- Pd: to 04/29/11 on 04/04/11 due to conflicts with Russian Progress vehicle flight to ISS.

LAUNCH SCRUBS: Launch scrubbed on 04/29/11 due to failed APFU fuel line heater. Launch rescheduled for NET 05/02/11. On 05/02/11 launch was initially rescheduled to NET 05/08/11, then later to 05/10/11 to allow time to R&R faulty Load Control Assembly (LCA) box. On 05/06/11 managers announced earliest launch date was now 05/11/11 pending resolution of additional electrical testing. Mike Moses at 05/09/11 Press Brief: “Our confidence to fly is we’ve done functional on all the components and know we have good power to those heaters and they’re performing just fine. … we have confidence in launching Monday the 16th at 8:56 am EDT.” Technical scrub.

Continued…
**SPACE SHUTTLE MISSIONS SUMMARY**

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<td>CV-105</td>
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</tbody>
</table>

**CAPCOMS**
- **SHUTTLE**
  - Ascent: Barry Wilmore
  - Entry: Tony Ceccacci
- **ISS**
  - O1: Robby Ayhurst
  - O2: Steve Robinson
  - O3: Dina Contella
  - O4: Rick LaBrode

**FLIGHT DURATION CHANGES**
- **LASTS/MOSTS**
  - Last flight of Endeavour
  - Last flight controlled from JSC MCC renamed for Dr. Christopher C. Kraft, Jr. on April 14, 2011.

**PERFORMANCE ENHANCEMENTS**
- Include the standard set plus: 1) PE Operational High Q - TRN/APR, 2) OMS Assist, 3) a 52 nautical mile MECO, & 4) Del Psi

**FIRSTS/LASTS/MOSTS**
- First flight controlled from JSC MCC renamed for Dr. Christopher C. Kraft, Jr. on April 14, 2011.
- First Papal call to space. On Saturday, May 21, 2011 Pope Benedict XVI commended crews for their courage and blessed...to ISS.
- Most time in space by an American: Mike Fincke surpassed Peggy Whitson’s record of 377 cumulative days finishing with 382 days

**FLIGHT DURATION**
- 15:17:38.22
- 9712 FT

**LANDING**
- FLN: 05-02-04
- STS: 05-02
- VIII: 04-02-04
- CV-105
- CV-106
- 206-03-17:45

**ABOVE: Jsc2011e036650 -- STS-134 was first flight controlled from JSC Mission Control Center after it was renamed in honor of Christopher C. Kraft, Jr. on April 14, 2011.**

**BELOW: Jsc2011e036646 -- Chris speaks at the ceremony. He was NASA’s 1st Flight Director for manned spaceflight. He served on all Mercury & several Gemini flights, was one of the designers & implementers of the MCC, and was JSC Center Director from 1972 to 1982. Call Name - Red Flight.**

**TOP LEFT:** MIT Professor Sam Ting the Principal Investigator for the $2 Billion AMS-02 in search of cosmic dark matter & antimatter. (AMS-01 was flown & tested on STS-91.)

**TOP RIGHT:** S134-E- 7189 - AMS In the grasp of the Orbiter’s robotic Canadarm for transfer to ISS.
**SPACE SHUTTLE MISSIONS SUMMARY**

**MISSION HIGHLIGHTS**

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<tr>
<th>FLT NO.</th>
<th>ORBITER</th>
<th>CREW</th>
<th>TITLE, NAMES &amp; EVAS</th>
<th>LAUNCH SITE, LIFTOFF TIME, CROSSRANGE</th>
<th>LANDING SITES, ABORT TIMES</th>
<th>LANDING TIMES FLT DURATION, WINDS</th>
<th>SSME-TL NOM-ABORT EMERG</th>
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**Crew “Star Trek” Connection**

**S134-E-009265 -- EVA-1 Feustel (rt) & Chamitoff (lt)**

**VIP**

CDR Mark Kelly’s wife & U.S. Representative Gabrielle Giffords severely wounded in a shooting at a public event in Tucson, Arizona on Jan. 8, 2011, was able to attend the launch.

**EVE NTS:**

- FD1: OMS2 ignition at 136:13:33:25Z resulted in a 175.9 by 124.7 NM orbit.
- FD2: RCC surveys showed some areas of concern. Focus Inspection required on FD6
- T1 maneuver at 136:07:38:13Z resulted in a 186.1 by 182.8 NM orbit.
- Docking Contact occurred at 138:10:13:52Z
- Hard Dock, hooks closed, occurred at 138:10:25:15Z
- ISS Hatch opened at 6:38 AM CDT May 18, 2011.
- FD4: AMS handed off from Shuttle arm to ISS arm and installed on ISS. Scientists immediately began detecting “thousands and thousands” of subatomic particles from deep space.
- FD5: DAT team cleared ascent RCC damage, but recommended a Focused Inspection of area between MLGD & ET door. MMT approved for FD6
- FD6: EVA 1: Feustel & Chamitoff completed installation & retrieval of MISSE experiments, & installations of: S3 CETA light, SARJ cover 7, P3/P4 ammonia jumper on ISS. Chamitoff’s ppCO2 sensor dropped out during EWC antenna task. Flight rule required termination of the EVA. EVA1 duration 6:19
- FD6: Focused Inspection was completed. DAT team analysis using these images cleared TPS for safe entry.
- FD7: EVA 2: Feustel & Fincke completed all tasks, however, duration was 1:30 longer than planned due to H/W issues. During port SARJ lube task some loose bolts prevented removal of 2 covers & reinstallation of another. Also, after filling P6 truss PVTCS one ammonia flake was seen near Fincke’s suit. Inspections revealed no visible contamination. Other tasks included SPDM LEE lube & S1 Radiator Sluice Beam installation. EVA2 duration 8:07.
- FD8: GMT 143/21:35 Soyuz TMA-20 undocking from ISS & imagery operations of Shuttle docked to ISS.
- FD10: EVA3: Feustel & Fincke completed all tasks for servicing of ISS, including cables for the power system & completion of work on a wireless communications system. EVA3 duration 8:54.
- FD10 the OBSS will be left behind to serve as an extension for station use if needed in the future.

**Last Shuttle Crew EVA May 25, 2011**

**ISS027-E-035698 --- Crews STS-134 (in Black) & EXP 27 (in Blue) pose in ISS Kibo: lt to rt (front row) are Paolo Nespoli/ESA, CDR Dmitry Kondratyev/RSA, CDR Kelly & Vittori/ESA; and (back row), Cady Coleman, Andrey Borisenko/RSA, Alexander Samokutyaev/RSA, Ron Garan, Fincke, Feustel/ESA, Chamitoff & PLT Johnson.**

**S134-E-009647 -- EVA 4 Chamitoff (Above)**

**S134-E-009631 -- EVA 4 Fincke (Below)**

**Continued…**
FD 7: JSC2011-E-046603 (21 May 2011) --- This overall view of the space shuttle FCR in the Christopher C. Kraft, Jr. Mission Control Center was taken during a special call from Pope Benedict XVI (upper left) in the Vatican to the STS-134 and Expedition 27 crews (center screen) on the ISS.


"...I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth."

And ending with... “We have a long way to go in this space race. But this is the new ocean, and I believe that the United States must sail on it and be in a position second to none.”

America has sailed this ocean for the past 50 years, and grabbed the lead on July 20, 1969. The question now is: will she still be the lead ship on this ocean for the next 50 years?
----- SALUTE TO ENDEAVOUR AND ITS FLIGHT CREW -----

ABOVE: STS134-070 (1 June 2011) --- After 19 years of service, xenon lights illuminate Endeavour’s drag chute during it’s last landing & Shuttle’s last night landing.

BELOW: 201106010004hq (1 June 2011) --- Crew poses in front of Endeavour post-landing: (Lt to Rt) Vittori, Johnson, CDR Kelly, Fincke, Chamitoff, & Feustel.

FD 8: iss027e036679 (May 23, 2011) ---- One of first legacy photos taken from Soyuz TMA-20 of a Shuttle (Endeavour, left of center) docked to ISS.
STL-134/ULF7 ---- SALUTE TO ENDEAVOUR AND SOME OF ITS OPERATIONS SUPPORT TEAM ----

**Shuttle Legacy Mural - Hanging in LCC Firing Room at KSC**

**ENDEAVOUR: From Mike Leinbach/Launch Director/KSC**

KSC-2010-4454 (http://mediaarchive.ksc.nasa.gov/index.cfm). This Tribute Display features Endeavour soaring into orbit above the sailing vessel HMS Endeavour for which the orbiter was named. The Cupola, delivered to the International Space Station by Endeavour on STS-130, is shown framing various images of Endeavour. The images represent the phases of mission processing and execution for the Space Shuttle Program. The first ever use of a drag chute during orbiter landing (STS-49) is depicted in the top window and moving clockwise the images symbolize the following: Rollout to the Pad, Ferry Flight return to Kennedy Space Center, Orbiter Processing Facility Roll-in, Docking at the International Space Station, and Lifting Operations for Orbiter Mate in the Vehicle Assembly Building. The background image was captured by the Hubble Space Telescope and signifies the first servicing mission which was performed by the Endeavour crew on STS-61. Crew-designed patches from Endeavour’s maiden voyage through her final mission are shown ascending toward the stars.
ATLANTIS COMING HOME TO KSC

An unprecedented view, as seen by the ISS Exp 28 crew, of Space Shuttle Atlantis on its way home with its plasma trail generated during the heat of entry. Airglow over Earth and stars can be seen in the background.

(ISS028-E-018214)
### SPACE SHUTTLE MISSIONS SUMMARY

#### STS-135/ULF7

**Crew**
- Chris Ferguson (Flt 3 - STS-115, STS-126)
- Doug Hurley (Flt 2 - STS-127)
- Sandy Magnus (Flt 1 - STS-112, STS-119)

**Launch Site, Lift-off Time**
- KSC 39A: 11:26:46 EDT (P)

**Landing Site**
- KSC W/D: 202:08:49:04Z

**Payloads**
- CPL-US: KSC 39A: 51.6%

**Mission Highlights**
- POST OMS-2: 124.3x84.9 NM
- DEORBIT BURN: 109/104.5

**Final Flight Details**
- Final flight of SHUTTLE
- Last flight
- DELAYED: None.

**Launch Scrubs/Delays**
- Postponements: Baselined STS-135 to FDRD - Revised STS-335 rescue mission

**Post-landing Sites**
- KSC 15

**Evacuation/Aborts**
- No SS EVAs were scheduled for this flight. (There was an ISS Crew EVA by Michael Fossum & Ronald Garan during this mission for a duration of 6:31 hr:min)

**Final Lift-off**
- At 11:29 a.m. (EDT) on July 8, 2011 (STS-135 - S-103)

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**Image Text:**

The “Katrina Tank” recovered from Hurricane Katrina and is ready to fly. (Courtesy Lockheed Martin – Michoud)
Continued…

**SPACE SHUTTLE MISSIONS SUMMARY**

<table>
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**MISSION HIGHLIGHTS** (LAUNCH SCRUBS/DELAYS, TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.)

Continued…

**FLIGHT DURATION CHANGES**: On FD4, MMT agreed to add 1 day to mission, stating: "Additional mission content would benefit ISS transfer and utilization.”

**FIRSTS/LASTS/MOSTS**:
- Last flight of Atlantis & Space Shuttle Program.
- Sandra Magnus is “Last Woman to Blast Off” in Space Shuttle.
- First iPhone launched into space to run an experimental app designed by Odyssey Space Research.

**RENDZEVOUS #:81** Rendezvous and dock with ISS.

**EVE NTS:**
- FD1: CMS2 ignition at 189:16:06:43Z resulted in a 124.3 by 84.9 NM orbit.
- FD2: Wakeup: “Viva la Vida” by Coldplay for Doug Hurley (w/greeting from MSFC employees) - RCC survey data collected for DAT.  Go to MMT on FD4.
- FD8: GPC 2 was reconfigured as SM GPC. - FD 10: GPC 4 reconfigured to SM and treated as fully functional for Entry.

**ISS028-E-015565 Atlantis as seen from ISS brings supplies & spare parts to ISS packed in MPLM at rear of P/L Bay. Last flight of the “Banana Truck”! [Atlantis was happily called the “Banana Truck” on STS-71 by Cosmonaut Strehalov, see page 2-84.]**
**SPACE SHUTTLE MISSIONS SUMMARY**

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**FLT DURATION**: 12:18:27:56  
**S/T**: 1318:16:13:22  
**OV-104**: 125,935,769 sm  
**TOTAL SHUTTLE DISTANCE**: 541,592,966 sm

**ISS028-E-017042**: Sandy Magnus/ MS enjoys view in the panoramic Cupola, an ISS addition since her last visit.

**SIGNIFICANT ANOMALIES**:  
*Orbiter*:  
- WLEIDS SENSOR UNIT 1111 DROPPED OUT OF OOM PREMATURELY  
- WLEIDS SENSOR UNIT 1098 HAD COMMUNICATION DROP OUTS  
- GPC 4 (SM) AR5450  
- DEP-S, RSSRM, SSM, ET, Integration & MOD: None.

**S135-E-006297**: Chris Ferguson, left, and Doug Hurley are pictured at the Commander’s Station and Pilot’s Station, respectively.

**S135-E-007515**: With his feet secured on a restraint on the ISS robotic arm or Canadarm2, Ron Garan/ Exp 28 Flight Engineer, carries the pump module.

**S135-E-007457**: Rex Walheim, Mission Specialist, works on the aft flight deck of Space Shuttle Atlantis.

**S135-E-007637**: Close-up of Mike Fossum/ Exp 28 Flight Engineer, as he participates in the July 12 six and a half hour spacewalk on ISS.

**S135-E-007457**: Continued...

**ISS TAL WEATHER, ASCENT I-LOADS, FIRSTS, SIGNIFICANT ANOMALIES, ETC.**

**S135-E-011914**: A Shuttle Goodbye to ISS

**A Shutter Goodbye to ISS**
“God Bless America” sung by the unmistakable Kate Smith signaled the start of landing prep. FD Paul Dye, CapCom Shannon Lucid (in rear center) and the rest of the team in the CCK MCC MOCR stood during the song, which was played for the crew and all those who have worked for the Space Shuttle Program. (From PAO)

Entry Flight Control Team in Shuttle FCR in CCK MCC. FD Tony Ceccacci (center front) holds STS-135 mission logo. (JSC2011-E-067253)

Seated on INCO console with Atlantis model is a bouquet of roses sent once again by the Shelton & Murphy families of North Texas. See history of “MCC Roses” given on flight STS-119/14A (page 2-203). (JSC2011-E-063867)

ROSES FOR CCK MCC

FINAL LANDING at 5:57 a.m. (EDT) July 21, 2011

Space Shuttle’s Last Landing Path (From PAO)

ATLANTIS STAYS AT KSC

CDR Ferguson has a big smile for the thermal tiles (JSC2011-E-067990)
--- SALUTE ---

JSC2011-E-067473 -- In MOCR in CCK MCC
Michael Lopez-Algeria (left) Director/Flight Crew
Ops for ISS shakes hands with Ascent FD Richard
Jones. In middle (l to r) are Paul Hill/ Director/MOD, John Mccullough/Chief FD Office &
Norm Knight/Dep Ch FD Office.

JSC2011-E-070840 -- STS-135 Ascent flight control team and
flight crew (black shirts) in shuttle flight control room in the
CCK MCC. Flight Director Richard Jones (left) and CDR Chris
Ferguson, STS-135 Commander, hold the mission logo.

JSC2011-E-064806 -- STS-135 Shuttle & ISS FD’s in the
shuttle FCR in CCK MCC at JSC. From left (front row) are
Tony Ceccacci, Courtenay McMillan, Chris Edelen, Kwatsi
Alibaruho, Gary Horlacher, and Rick LaBrode. Back row are
Paul Dye, Royce Renfrew, Richard Jones and Jerry Jason.

JSC2011-E-062692 -- STS-135 Orbit 1
FCT group portrait. Flight Director Kwatsi
Alibaruho (center) stands on the front row.

JSC2011-E-063635 -- STS-135 Orbit 2
FCT group portrait. Flight Director Rick
LaBrode holds the STS-135 mission logo.

JSC2011-E-064789 -- STS-135 Orbit 3
FCT group portrait. FD Paul Dye is in
front near Shuttle model & MCC Roses.

JSC2011-E-063846 -- Shannon Lucid,
STS-135 Planning Shift CAPCOM. She
was one of NASA’s first six women
astronauts.
On behalf of the Astronaut Office...

Now that Atlantis and the final Shuttle crew have safely returned to planet Earth, we are all feeling the finality of 30 years of Space Shuttle flights. ... While the Shuttle is an incredible, one-of-a-kind flying machine, the most important thing that this program has given us is wrapped up in all the people and expertise that turned a concept into something real. ... We are exceptionally honored to have flown with all of you as part of the Shuttle Program, and look forward to the continuation of our journey on board the International Space Station and beyond.

Peggy A. Whitson
STS-111/Exp 5/STS-113, ISS Exp 16 CDR
Chief, Astronaut Office

On behalf of the Astronaut Office...

ST3-135 crew left this plaque in the cockpit of Atlantis as a tribute to all of the people who have worked on the Space Shuttle Program.
A LARGE WELCOME HOME & A SUPER WELL DONE!

ABOVE: (JSC2011-E-068785) --- A large crowd welcomes home the crew of STS-135 on July 22, 2011 at Ellington Field near JSC. AT RIGHT: (JSC2011-E-070276) --- JSC Director Michael L. Coats (left), Houston Mayor Annise Parker, U.S. Senator Kay Bailey Hutchison (R.-Texas) and STS-135 Commander Chris Ferguson enjoy the crew return ceremony. Poster reads: “HOUSTON! Always the first word in Space. Thank You!” The Mayor was also presented a flown flag by the STS-135 crew.

NOTES: From STS-135 (ULF7) Post Landing News Conference - July 21, 2011 (From PAO)

Gerst – I really want to thank the Space Shuttle team and Program for today and the entire history of the Program. I can’t say enough about meeting the challenges and finishing strong. Today they met all the objectives. I’d also like to thank the nation for supporting this vehicle. It is a true marvel and allowed us to do amazing things. It’s going to allow us to move forward and utilize the station and commercial cargo providers come online later this year. We need to go forward and explore. I recognize that change is very hard, but huge improvement comes from change, so this team can accomplish great things in the future. I wish them the best. They will be successful in the future.

Moses – It’s been a heck of a day and heck of a Program. I’m representing a team across the country today and the vehicle performed perfectly. The team here and in Houston are world class. The Marshall team put together a propulsion system that also finished strong. It’s been a nice ride.

Cabana – It is great to have Atlantis home to stay after this mission. I can’t say enough about the teams here at KSC and how they performed the last few flights. The folks that knew they were going to be out of work performed flawlessly and were dedicated to what they were doing. That is what they do. I am proud to be part of this program. We’ve achieved the goal of flying out the shuttle safely and we’ll celebrate what we’ve accomplished over the last 30 years. But when that’s done, we’ll move on to the future.

Leinbach – Thanks to the KSC workforce. I’ve worked here all my career – 27 years. They did their job just like always. The workers here and across the country that dedicated their lives to this are my friends and I wish them well. I want to thank the press as well. You guys have been good friends of the space program as well. It was a good day. Mission complete and we’re looking forward to new challenges.
Space Shuttle’s “Final Four” stand prominently in front of Atlantis after landing at KSC. From right, are CDR Chris Ferguson, PLT Doug Hurley; Sandy Magnus/MS and Rex Walheim/MS.

STS135-S-214 (21 July 2011) -- Space Shuttle’s “Final Four” stand proudly in front of Atlantis after landing at KSC. From right, are CDR Chris Ferguson, PLT Doug Hurley; Sandy Magnus/MS and Rex Walheim/MS.


Passed U.S. Senate on July 13, 2011


Passed U.S. Senate on July 13, 2011

At Left:

Safely Home... Mission Accomplished!

"What a privilege to be on the scene for the last Apollo splashdown AND the last Space Shuttle landing ... and, what a privilege for each of us to have been associated with such talented and dedicated people ..."

Milt Heflin
Apollo Recovery Engineer- Primary Recovery Ship for Apollo 8, 10, 16, 17, Skylab 2,3,4, & ASTP
Space Shuttle EPS, Thermal, EGIL, EECOM & Flight Director
JSC Associate Director (Technical)

[That’s Milt with “hands on hips”. Yes, he was there & there. Well Done!]

Where will they go?

Announced April 12, 2011:

OV-101 Enterprise Test Vehicle - To New York City's Intrepid Museum
OV-103 Discovery - To Smithsonian National Air & Space Museum in Chantilly, Virginia
OV-104 Atlantis - To Kennedy Space Center, Florida
OV-105 Endeavour - To California Science Center in Los Angeles

No, they are not rolling out for launch! Discovery & Endeavour are rolling to storage locations at KSC where they will remain until ready for transport to museums, see below.

(Photo from Herring/PAO)
A summary table of weight data for each shuttle element and payloads for each mission is provided herein. The data for flights STS-1 through STS-57 was extracted from the SODB, Volume II. Effective with STS-51, the SODB data was no longer updated as flown. Therefore, the data has been obtained from the Day-of-Launch (DOL) Trajectory Design Data Package (TDDP), with Mach 3 EOM (End of Mission) and Landing Weights/CG’s from the Postflight Prop 30 Reports. The Performance Margin data was extracted from the RI/Boeing Postflight Trajectory Reconstruction Reports.

Starting with STS-75, the Shuttle Program agreed to a 900-lb Ascent Performance Margin (APM) gain for all missions. STS-75 and STS-76 have 900 lbs of inert weight adjustment (-450 lbs inert weight discrepancy adjustment and -450 lbs performance discrepancy adjustment, which were subtracted from the STS Operator Chargeable Cargo). Effective with STS-77, the -450 lbs was subtracted from the STS Operator Chargeable Cargo and the -450 lbs performance discrepancy is included in the MPS Prop Inventory. Effective with STS-79, the performance adjustment was changed to -200 lbs which is subtracted from the STS Operations Chargeable Cargo. Finally, beginning with STS-97 the TDDP included an item for “RECONSTRUCTED ASCENT PERFORMANCE COLLECTOR” in the “Shuttle Total Weight at SRB Ignition”.

The P/L Deployed Weights for MIR flights reflect the weights of hardware transferred to the MIR (does not include consumables transferred to MIR). DOD mission weight data was not available for this document.
## APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY

(SOURCES: SODB, VOL II Thru STS-57 & DOL TDDP for STS-51 and Beyond)

| FLIGHT  | TAIL NO/ OV. | WO CONS | NON PROP CONS | OMS PROP | RCS PROP | ORBITER TOTAL | ORBITER TOTALS | CARGO | CARGO TOTAL | CARGO WEIGHT | ACCUMUL WGT | ORBITER TOTALS | ORBITER TOTALS | SHUTTLE TOTAL | WEIGHT AT LANDING |
|---------|--------------|---------|---------------|----------|----------|---------------|----------------|--------|-------------|---------------|-------------|----------------|----------------|---------------|----------------|----------------|
| STS-1   | 102 (1)      | 172425  | 5197          | 18408    | 2461     | 5371          | 208437         | 0      | 0           | 0             | 10823       | 219620         | 208415         | 1664455       | 1295940        | 195943        |
| STS-2   | 102 (2)      | 175211  | 5922          | 18011    | 2469     | 5383          | 212161         | 0      | 0           | 0             | 10823       | 219620         | 208415         | 1664455       | 1295940        | 195943        |
| STS-3   | 103 (3)      | 175374  | 6560          | 17919    | 2446     | 5384          | 212846         | 0      | 0           | 0             | 22710       | 222985         | 651244         | 1643507       | 1298669        | 207073        |
| STS-4   | 104 (4)      | 175581  | 6588          | 22155    | 2446     | 5344          | 217280         | 0      | 0           | 0             | 1844        | 214727         | 897969         | 1644745       | 1298213        | 209141        |
| STS-5   | 102 (5)      | 176729  | 5507          | 19804    | 2448     | 5379          | 215033         | 0      | 0           | 0             | 1078        | 21455          | 75802          | 1644995       | 1298256        | 204263        |
| STS-6   | 105 (6)      | 172837  | 5364          | 10924    | 1964     | 50099         | 209597         | 0      | 0           | 0             | 220246      | 2431223        | 1532225        | 1644495       | 1298213        | 190627        |
| STS-7   | 109 (7)      | 172822  | 5415          | 21015    | 2449     | 5372          | 212239         | 0      | 0           | 0             | 3942        | 243639         | 1585843        | 1646431       | 1295695        | 204340        |
| STS-8   | 109 (8)      | 172879  | 5363          | 22011    | 2456     | 4962          | 212837         | 0      | 0           | 0             | 5166        | 227365         | 1813208        | 1656386       | 1297016        | 204141        |
| STS-9   | 102 (9)      | 173969  | 6184          | 16000    | 2446     | 5384          | 214549         | 0      | 0           | 0             | 33264       | 243781         | 2049001        | 1662238       | 1298367        | 220288        |
| STS-11  | 103 (1)      | 173041  | 6210          | 24704    | 2446     | 4970          | 216537         | 0      | 0           | 0             | 2981        | 228310         | 2203109        | 1662570       | 1295659        | 201529        |
| STS-14-C| 109 (5)      | 173207  | 5285          | 25096    | 2449     | 5012          | 216215         | 0      | 0           | 0             | 41          | 254481         | 2528267        | 1661790       | 1298028        | 197170        |
| STS-15  | 103 (1)      | 173911  | 5748          | 23864    | 2446     | 216105        | 30086          | 0      | 0           | 0             | 1170        | 263261         | 246093         | 1662823       | 1296101        | 202317        |
| STS-16  | 103 (6)      | 175411  | 6236          | 23086    | 24458    | 4950          | 219305         | 0      | 0           | 0             | 657         | 243642         | 3001525        | 1662451       | 1296571        | 208239        |
| STS-17  | 103 (7)      | 174036  | 6311          | 25107    | 24470    | 19016         | 227645         | 0      | 0           | 0             | 2381        | 247014         | 3248653        | 1662369       | 1299428        | 207983        |
| STS-18  | 103 (8)      | 174756  | 5372          | 25064    | 2446     | 5371          | 218303         | 0      | 0           | 0             | 1755        | 420089         | 1661338        | 1293021       | 4514313        | 216894        |

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**APPENDIX A** - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY

**SOURCES:** SODB, VOL II Thru STS-57 & DOL TDDP for STS-51 and Beyond
<p>| FLIGHT       | TAIL NO. | ORBITER NO. | ORBITER | CARGO | ORBITER TOTALS | SHAFT | ET TOTAL | SHUTTLE TOTAL | RESID MARG | ORBITER AT | ORDERER AT | WO CONS. | ORBITER PROP. | ORBITER TOTAL | Shaft | ET TOTAL | Shaft | ET TOTAL | SHAFT | ET TOTAL |
|-------------|----------|-------------|---------|-------|----------------|-------|----------|--------------|------------|-------------|------------|-----------|-----------|---------|----------------|----------------|-------|----------|-------|----------|-------|----------|
| STS-35      | 102      | 184580      | 7156    | 19339 | 22322         | 4971  | 22344    | 0             | 0           | 0           | 0           | 1792     | 0          | 25969    | 25969  | 217760  | 25969 | 217760  | 0     | 217760  |
| STS-37      | 100 (8)  | 177763      | 5739    | 20053 | 1835    | 4971   | 215167   | 34442          | 1615        | 0           | 743         | 0          | 36800     | 3761    | 40561   | 34964 | 3761    | 0     | 3761    |
| STS-39      | 103 (9)  | 179611      | 6257    | 22553 | 2451    | 4974   | 221012   | 8270           | 16046        | 0           | 494         | 0          | 21413     | 36542   | 26294   | 55400 | 36403   | 0     | 36403   |
| STS-40      | 102 (11) | 185755      | 7111    | 13625 | 1919    | 4968   | 218184   | 0              | 0            | 0           | 187         | 0          | 28114     | 5593    | 3770    | 55040 | 48420   | 0     | 48420   |
| STS-43      | 104 (9)  | 177623      | 6245    | 14126 | 1860    | 4972   | 209992   | 37575           | 8500         | 0           | 991         | 0          | 46712     | 2613    | 49352   | 58805 | 491607  | 0     | 491607  |
| STS-48      | 103 (13) | 178149      | 5466    | 22643 | 2061    | 4971   | 216564   | 13468          | 4425         | 0           | 609         | 0          | 971        | 24133   | 27690   | 19995 | 19995   | 0     | 19995   |
| STS-44      | 104 (12) | 177916      | 6245    | 16390 | 9876    | 4974   | 212586   | 37588           | 5809         | 0           | 1240        | 0          | 46373     | 25964   | 47235   | 63999 | 501415  | 0     | 501415  |
| STS-42      | 105 (14) | 178203      | 6341    | 14469 | 1908    | 4974   | 211062   | 0              | 0            | 0           | 220         | 0          | 28689     | 3701    | 32364   | 63999 | 530075  | 0     | 530075  |
| STS-44 (11) | 177432    | 6337      | 16894  | 2180  | 4970    | 213279 | 0        | 15538           | 0            | 0           | 2145        | 0          | 17683     | 2855    | 20341   | 63999 | 497581  | 0     | 497581  |
| STS-49      | 105 (11) | 180161      | 6199    | 19916 | 2448    | 4974   | 218859   | 23346          | 8766         | 0           | 697         | 0          | 32609     | 4635    | 37444   | 66333 | 558221  | 0     | 558221  |
| STS-48 (12) | 186622    | 9760      | 16830  | 9013  | 4974    | 225218 | 0        | 21216           | 0            | 0           | 2179        | 0          | 24305     | 8142    | 32447   | 66333 | 581526  | 0     | 581526  |
| STS-46 (13) | 178089    | 6380      | 24887  | 2451  | 4968   | 221941 | 0        | 14685           | 1396         | 0           | 2107        | 0          | 28656     | 5475    | 34060   | 67328 | 598724  | 0     | 598724  |
| STS-47 (2)  | 179161    | 6286      | 14559  | 1917  | 4979    | 212038 | 0        | 26247           | 0            | 0           | 1845        | 0          | 28092     | 4388    | 32480   | 67328 | 626816  | 0     | 626816  |
| STS-52      | 102 (13) | 188650      | 7127    | 17398 | 2163    | 4974   | 223478   | 55770          | 12475         | 0           | 2080        | 0          | 20132     | 6720    | 26662   | 67855 | 641371  | 0     | 641371  |
| STS-53      | 103 (15) | 179035      | 5874    | 18600 | 912     | 4964   | 215551   | 20789           | 4299         | 0           | 1030        | 0          | 26118     | 1918    | 28316   | 69960 | 646700  | 0     | 646700  |
| STS-54      | 105 (3)  | 178558      | 5895    | 14278 | 1925    | 4980   | 210802   | 37497           | 7991         | 0           | 1052        | 0          | 46540     | 2498    | 49039   | 73101 | 657430  | 0     | 657430  |
| STS-55      | 106 (16) | 179811      | 6287    | 15278 | 2456    | 4967   | 216223   | 0              | 12568         | 2840         | 0           | 1031        | 0          | 16439    | 4561   | 21003  | 73101 | 669342  | 0     | 669342  |
| STS-57      | 104 (7)  | 186929      | 7345    | 15687 | 1928    | 4972   | 226220   | 0              | 0              | 0           | 2282        | 0          | 26681     | 6901    | 33416   | 73101 | 6901    | 0     | 6901    |
| STS-59      | 107 (4)  | 179410      | 6412    | 25147 | 2450    | 4969   | 223554   | 132             | 1824         | 0           | 9424        | 0          | 19630     | 9489    | 29119   | 73233 | 715721  | 0     | 715721  |</p>
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*NOTE: DEPLOYED, NON-DEPLOYED, AND DEPLOYED/RETRIEVED REFLECT ACTUALS, E.G., WSF WAS NOT DEPLOYED AND RETRIEVED ON STS-60; TSS WAS LEFT IN SPACE ON STS-75.*

APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY (SOURCES: SODB, VOL. II Thru STS-57 & DOL TPDP for STS-51 and Beyond)
APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY

Page A-6

(SOURCES: SODB, VOL II Thru STS-57 & DOL TDDP for STS-51 and Beyond)

ORBITER

CARGO

NONTAIL
FLIGHT

W/O

NO.
OV-

PROP

FLIGHT PAYLOAD WEIGHTS
OMS

RCS PROP

CONS
CONS.

@
SRB
IGN

PROP
FWD

AFT

FLIGHT

ACCUMULATED

ORB

WT

TOTAL

PRI

DPLY

@
SRB

DPLY/
NON-

AND
RETR

IGN

DPLY

RETR
ONLY

MID-

CHARGE-

DECK

ABLE
PYLD/
STS

CARGO

PYLD

TOTAL

DPLY/
NON-

WT

ACCUM

ORBITER

ORBITER

ET

SRB

SHUTTLE

MARG

AT

AT

TOTAL

TOTAL

TOTAL

FINAL

MACH 3 EOM

LANDING

CARGO

@

@

WT @

@

LEFT

@

TDDP

TOTAL

SRB
IGN

ORBIT
INSERT

ORBIT
INSERT

SRB
IGN

&
RIGHT

SRB
IGN

&
RECON

WT

X CG

WT

X CG

DPLY

0
736
760 14152 24605 818721
104 180112 7216 21664 2451 4976 221585 2814
(16)
10578
10453
1065306
STS-77 105 180204 7235 19483 2453 4976 219518 1104 1837
0
866 27393 35205 819825
(11)
23586 1820
7812
1089758
STS-78 102 188422 10876 13227 1940 4979 224611
0
0
0
2066 23666 31854 819825
(20)
21598
8188
1113422
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2126 718 19039 27812 822995
STS-79 104 180241 7286 21473 2450 4971 221598 3170
(17)
15151
8773
1129291
STS-80 102 187805 9760 20528 2451 4975 230676
0
12524
0
1109 21208 31111 822995
(21)
7575 12427
9903
1137975
STS-81 104 180533 7284 21574 2452 4978 221988 4019
0
2842 810 19321 28149 827014
(18)
14492
8828
1153277
0
6638 512 17374 24891 833955
STS-82 103 182897 6572 25010 2448 4971 227065 6941
(22)
9921
7517
1163710
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2020 25556 34373 833955
STS-83 102 187924 10876 15000 1912 4970 225849
(22)
23536
8817
1189266
STS-84 104 179665 7163 21674 2455 4973 221097 3902
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8854
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(23)
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8791
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STS-85 103 181354 7072 17089 2450 4978 218082
(23)
15666 7587
6977
1247831
STS-86 104 180477 7283 21682 2451 4975 222037 6058
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1262812
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2973
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10098
1374160
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335 1122 30986 37731 877846
STS-88 105 182065 6997 24612 2451 4971 226265 26791
(13)
3073
6745
1378355
STS-96 103 183197 7174 25007 2450 4977 227974 4228
0
213 1034 22707 33808 882074
(26)
17994
11101
1397383
*
NOTE: STS-91 WAS FIRST FLIGHT OF SLWT, 59212 LBS. STS-95 WAS SECOND FLIGHT OF SLWT, 59942 LBS.
STS-76

PERF

ORBITER TOTALS

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2311537 254753 243818 16459137 1664470 1300764 4519162 5381 222399
1299175
8528
2343391 256495 245723 16704860 1664859 1297868 4517477 3683 229134
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2371203 249440 241776 16946636 1664353 1297828 4510469
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1296568
4306
STS-88 WAS THIRD FLIGHT OF SLWT, 59137 LBS. STS-89 ET WEIGHED 66353 LBS.

1082.8 211805 1084.5
1080.5 222276 1082.0
1081.9 228986 1083.4
1081.3 215904 1083.0
1079.1 227670 1080.6
1081.4 215337 1083.1
1077.8 213869 1079.6
1078.5 235421 1080.0
1081.0 216021 1082.6
1078.4 230773 1080.1
1082.0 221264 1083.6
1081.3 215303 1083.0
1081.0 232849 1082.6
1086.5 217422 1088.2
1080.3 232979 1081.9
1079.5 226872 1081.1
1076.8 228388 1079.5
1084.3 201492 1086.2
1080.2 222299 1081.8


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**APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY**

(SOURCES: SODB, VOL II Thru STS-57 & DOL TDPD for STS-51 and Beyond)

* Beginning with STS-97 the TDPD included an item for "RECONSTRUCTED ASCENT PERFORMANCE COLLECTOR" in the "Shuttle Total Weight at SRB Ignition".

** WT & CARGO ARE AT EI AND EI+15 MINUTES.
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**APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY**

(SOURCES: SODB, VOL II Thru STS-57 & DOL TDDP for STS-51 and Beyond)
## APPENDIX A - SPACE SHUTTLE FLIGHT WEIGHT SUMMARY

(SOURCES: SODB, VOL II Thru STS-57 & DOL TDDP for STS-51 and Beyond)

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<td>STS-135 104 (33)</td>
<td>184276</td>
<td>7072</td>
<td>24861</td>
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</table>

*Reconstruction analysis was not available (N/A) for STS-135 due to lack of funding.
The authors would like to acknowledge the following individuals for their contributions to the preparation of this book. Data Sources are also provided.

**ACKNOWLEDGEMENTS - LEGLER INFORMAL BOOK**

To: Brewster H. Shaw, while COO of United Space Alliance, for his sponsorship of Legler’s informal book.

To: Mary C. Thomas/DA8 for her dedicated services as Book Manager for Revisions and Change Notices to Bob Legler’s informal book through flight STS-115.

To: Karen J. Chisholm/DA8 for her dedicated services as editor and typist for Revisions and Change Notices to Bob Legler’s informal book through flight STS-115.

To: All those who helped Bob Legler gather data through flight STS-115.

**DATA SOURCES - LEGLER INFORMAL BOOK**

This document provides “as flown” operational mission data and has been compiled from many sources including the following:
- Flight Logs
- Flight Rules
- Flight Anomaly Logs
- MOD Post-Flight Reports (Ascent, On-Orbit and Descent)
- Post Flight Analysis of MPS propellants
- FDRD - Flight Definition Requirements Document
- FRD - Flight Requirements Document
- SODB - Shuttle Operational Data Book
- MER (Mission Evaluation Room) Shuttle Flight Data.
  - Orbit Distance traveled is taken from the PAO Mission Statistics.

**ACKNOWLEDGEMENTS - BENNETT (STS-116 Through STS-135)**

To: James M. Heflin/AB111, Associate Center Director Technical, for his leadership role to publish the informal “Legler Book” as an official NASA Technical Memorandum.

To: USA’s continued sponsorship to finalize the NASA Technical Memorandum.

To: Michael Curie, NASA HQs PAO Specialist & Commentator for his many responses to requests for information from Floyd Bennett.

To: M. Cathleen (Cat) Buehrer/DA32 (REDE CRITIQUE NSS JV) for her invaluable tutorial assistance and knowledge provided to Floyd Bennett for navigating through Microsoft Word software for preparation of this final book.

To: Edward P. Gonzalez/DM321 and John A. Fields/ DM111 for excellent technical review.

To: Dale H. Ward/IS4 (Tessada) and Sharon Hecht/IS4 (DB Consulting Group, Inc.) for their excellent editorial comments and final document preparation.

**DATA SOURCES - FOR BENNETT**

And finally, thanks to all the Data Source Contributors who helped Floyd Bennett find his way to the correct mission data for flights STS-116 through STS-135.

See the listing to follow:
This listing provides the data sources and Point(s) of Contact (POC’s) used in preparing the portion of the Space Shuttle Mission Summary Book for missions STS-116 through STS-135. My thanks to all these contributors and many others who helped this author find his way to the correct mission data.

Floyd V. Bennett

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## APPENDIX B - ACKNOWLEDGEMENTS AND DATA SOURCES (Continued)

### COLUMN 3: CREW SIZE: TITLE, NAMES, AND EVA'S

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### COLUMN 4: LAUNCH SITE, LIFTOFF TIME, LANDING SITES, ABORT TIMES

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## COLUMN 5: LANDING SITE/RUNWAY, CROSSRANGE, LANDING TIMES, FLIGHT DURATION, WINDS

### ALL ITEMS EXCEPT

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### ENTRIES LISTED BELOW:

POC: Barbara Schill (USA) & Chris Re (USA), Chris Lessman (USA), Rosalyn Mark

### LANDING EVENTS

- **Time of Landing**
  - Ascent/Descent Flight Design, POC: Lessmann, Christopher F. (USA)
- **Site (#)**
  - Site (#) refers to # of landings at a site, calculated from previous landing at that site
- **Surface (#)**
  - Surface (#) refers to # of landings on surface from previous landings on same surface
- **Landing Day of Week (#)**
  - (D) refers to # of landings on that particular weekday, calculated from landings on same weekday
- **Landing Date (#)**
  - (D) refers to # of landings in a particular calendar month, calculated from landings in the same calendar month

### DEORBIT BURN

GMT (e.g., 051:12:59:52.0Z)-DM Trajectory Server - Legler Report, POC's: Propst, Carolyn A. (USA) & Deboeck, Toni F (USA)

### ORBIT DIR

(D) refers to # of landings from the same direction, calculated from # of last mission at same direction

### TIME OF EVENTS DURING LANDING


### ROLLOUT

- **Distance (ft)**
  - Calculated: wheels stop position - MLGTD position
- **Time (sec)**
  - Calculated: wheels stop GMT - MLGTD GMT

### WINDS: OFFICIAL and DENS ALT (ft)

- Spaceflight Meteorology Post Flight Mission Summary, POC: Oram, Timothy D. (JSC-WS8) [NOAA]

### FLT DURATION

- **S/T**
  - Shuttle total flight time, calculated: mission duration + sum of previous missions
- **OV-XXX**
  - Total flight time for specific orbiter vehicle, calculated: mission duration + sum of previous missions

### DISTANCE

- Statute miles traveled this mission: PAO Missions Stats Report, POC: Herring, Kyle J. (JSC-AP311)

### TOTAL SHUTTLE DISTANCE

- Calculated: distance traveled this mission + sum of previous missions
  - PAO Missions Stats Report, POC: Herring, Kyle J. (JSC-AP311)
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   (#) refers to # of flights flown - calculated from last flight of that FSW version |
| **COLUMN 11: PAYLOAD WEIGHTS; PAYLOADS, EXPERIMENTS** |                                                                              |
| PAYLOAD WEIGHTS                 | Day of Launch (DOL) Trajectory Design Data Package (TDDP), POC: Bhula, Jayantilal (Jay) (USA) |
| TOTAL, MIDDECK, DEPLOYED, and NON-DEPLOYED |                                                                              |
| SHUTTLEACCUMULATED WEIGHTS     | Calculated (summed) from previous missions                                   |
| DEPLOYED, NON-DEPLOYED, and CARGO TOTAL |                                                                              |
| PERFORMANCE MARGIN (LBS)       | Day of Launch (DOL) Trajectory Design Data Package (TDDP), POC’s: Bhula, Jayantilal (Jay) (USA) |
| FPR and FUEL BIAS, FINAL TDDP  | Provided by Mike , L. Scott/USA/FDD POC                                     |
| RECON                           | STS-XXX Ascent Performance Trajectory Reconstruction, POC:Steven P. Brod/Boeing |
| ASSIGNEDS                       | FDRD: [https://sspweb.jsc.nasa.gov/webdata/pdcweb/07700.htm](https://sspweb.jsc.nasa.gov/webdata/pdcweb/07700.htm) |
| PAYLOADS: PLB and MIDDECK # CRYO TANK SETS STS OPERATOR SELECTIONS |                                                                              |
| RMS (#)                         | -# of flights RMS flown - calculated from previous missions with RMS        |
## APPENDIX B - ACKNOWLEDGEMENTS AND DATA SOURCES (Continued)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DATA SOURCES</th>
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<tbody>
<tr>
<td><strong>COLUMN 12: MISSION HIGHLIGHTS</strong></td>
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MMT Minutes: [https://sspweb.jsc.nasa.gov/mmt/](https://sspweb.jsc.nasa.gov/mmt/) |
| **KSC W/D (Work Days)** | KSC Milestone Interface Chart, POC: Overton, Thomas L. (KSC) [ASRC AEROSPACE] & Clark D. Ford (KSC PHO00) |
| **LAUNCH POSTPONEMENTS** | SSPO PRCB Directives: [https://sspweb.jsc.nasa.gov/meeting/mtgdata.cfm](https://sspweb.jsc.nasa.gov/meeting/mtgdata.cfm) |
| **LAUNCH SCRBUS** | MMT Minutes: [https://sspweb.jsc.nasa.gov/mmt/](https://sspweb.jsc.nasa.gov/mmt/) |
| **LAUNCH WINDOW** | Real-time Data, POC: Sparks, Carson W. (JSC-DM) [USA] |
| **LAUNCH DELAYS** | MMT Minutes: [https://sspweb.jsc.nasa.gov/mmt/](https://sspweb.jsc.nasa.gov/mmt/) |
| **TAL WEATHER** | Spaceflight Meteorology Group Post Mission Summary,  
POC: Oram, Timothy D. (JSC-WS8) [NOAA] |
| **PERFORMANCE ENHANCEMENTS** | Day of Launch (DOL) Trajectory Design Data Package (TDDP), POC: Bhula, Jayantilal (Jay) (USA) |
| **FLIGHT DURATION CHANGES/LANDING** | MMT Minutes: [https://sspweb.jsc.nasa.gov/mmt/](https://sspweb.jsc.nasa.gov/mmt/)  
Spaceflight Meteorology Group Post Mission Summary, POC: Oram, Timothy D. (JSC-WS8) [NOAA] |
Flight Readiness Reviews: [https://sspweb.jsc.nasa.gov/webdata/launch/](https://sspweb.jsc.nasa.gov/webdata/launch/) |
| **NIGHT LAUNCH (#)** | Number of night launches, calculated from previous night launch mission |
| **NIGHT LANDING (Site, #)** | Number of night landings at specified site, calculated from previous night landing mission at that site |
| **RENEZVOUS** | Number of rendezvous missions, calculated from previous rendezvous mission |

Continued…
APPENDIX B - ACKNOWLEDGEMENTS AND DATA SOURCES (Continued)

ITEM | DATA SOURCES
--- | ---
COLUMN 12 MISSION HIGHLIGHTS (Continued)

EVENTS
- Time of on-orbit maneuver events (OMS 2, IT, etc.)
  DM Trajectory Server - Legler Report, POC’s: Propst, Carolyn A. (USA) and Deboeck, Toni F (USA)
- Time of docking/undocking events
  APDS sensor Data from the ODRC, POC: Dake, Janna J., Murphy, Rachel & Haskovec, Doug (JSC-DS421)
- Time of ISS hatch opening and crew welcome
- EVA descriptions and durations
  Post flight EVA notes (provided by DX POC)
- Transfers (hardware and consumables weights)
  STS-XXX Final Customer Support Room (CSR) Report and STS-XXX Mission by the Numbers (provided by MO POC’s)

SIGNIFICANT ANOMALIES
PCASS In-flight Anomalies: [https://usa93.usa-spaceops.com:4443/adamvweb/ifa_ifa_search2.wp_execfind](https://usa93.usa-spaceops.com:4443/adamvweb/ifa_ifa_search2.wp_execfind)

ENTRY BLACKOUT
INCO Electronic Flight Log (Provided by DS POC Steve Sides & Mark Williamson)

WEIGHT SUMMARY
All entries except entries below:
- Day of Launch (DOL) Trajectory Design Data Package (TDDP): POC: Bhula, Jayantilal (Jay)/USA
- Orbiter Tail No.
  FDRD: [https://sspweb.jsc.nasa.gov/webdata/pdcweb/07700.htm](https://sspweb.jsc.nasa.gov/webdata/pdcweb/07700.htm)
- Shuttle /PL Accumulated WTs
  Calculated from previous missions
- Weight at Orbit Insertion
  Ascent Post Flight Data (provided by Gonzalez, Edward P./JSC-DM)
- Performance Margin
  Final TDDP Provided by Mike L. Scott/USA/FDD POC
  STS-XXX Ascent Performance Trajectory Reconstruction (Kristin Smaltz & Stephen Brod/Boeing)
- Orbiter weight at Mach 3 EOM and at Landing
  IDP Cycle/Prop30 Aerosciences Report (provided by Barbara Shill & Rosalyn Mark/USA/FDD/SDM)

PHOTOS (All Missions)
Identified by NASA Number, unless otherwise noted. POC: Jody Russell/JSC-AP (Tessada)
This appendix provides the JSC Flight Director Log initially compiled and kept updated by Bob Legler, “History Flight”. Since his death the log has been maintained by the Flight Director Office staff. This is a listing of Flight Directors beginning with Christopher C. Kraft, Jr. “Red Flight” in 1960 with Project Mercury flights, and ending with the completion of the Space Shuttle Program in 2011.

Note: Names listed in blue denote photo available from electronic copy by “control-hold-click”.

APPENDIX C - FLIGHT DIRECTOR LOG
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* Second generation FDs, #4 Glynn Lunney and #54 Bryan Lunney

NOTE: There were two additional individuals that were selected as flight directors but elected to not continue: Rick Fitts and Michele Brekke. Continued…
HONORARY FLIGHT DIRECTORS

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<td>Scarlet Flight</td>
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THE FLIGHT DIRECTOR OFFICE: “Provides leadership and direction for conducting human space flight operation. Our mission is to ensure excellence in mission operations for Human Space Flight.” (DA8 Home Page)
IN MEMORIAM

Bob Legler, the originator of the informal Space Shuttle Missions Summary Book, was born a natural Corn Husker and lived a full life. His true love was serving his country in the US Coast Guard, Merchant Marines, United Nations, US Army, and the NASA Space Programs as an aerospace engineer. As one of a handful of people to ever support the Mercury, Gemini, Apollo, Skylab, Space Shuttle, and International Space Station missions, Bob was an icon to his peers. He spent 44 years in this noble endeavor called manned space flight. In the memorial service for Bob, Milt Heflin, JSC Associate Director and former JSC Chief Flight Director, provided the following insight:

“Bob was about making things happen, no matter what his position or rank, in whatever the enterprise was at that time…it might have been dodging bullets and bombs while establishing communication systems for United Nations outposts in crazy places…it might have been while riding the Coastal Sentry Quebec Tracking ship in the Indian Ocean…watching over the Lunar Module electrical power system or the operation of the Apollo Telescope Mount…serving as a SPAN Manager in the MCC (where a lot of really good stories were told during crew sleep)…or even while serving as the Chairman of the Annual FOD Chili Cook-off or his beloved Chairmanship of the Apollo Flight Operations Association [for reunions]…in each case he gave of himself so that the “mission,” no matter what it was, could be successful…Bob might not have been the most efficient chairman…story telling could get in the way from time to time…but he made up for it by being a catalyst, causing the team to rise to the occasion…

(Continued)
And, we all know quite well his love of capturing the history of manned space flight...Apollo reunions and producing the Space Shuttle Missions Summary Book are two of his legacies...events and things with Bob's hands that were done for the enjoyment of all...he took great pride in keeping the “official” Flight Director Log, a listing of those that have served as a Flight Director in Mission Control...the Log today lists 69 Flight Directors beginning with Red Flight, Chris Kraft...even I had a hard time in convincing Bob that I would not abuse my electronic copy of this list, if he would just send it to me...this list also contains the names of only five individuals designated as an Honorary Flight Director...Bob is number 5, known as ‘History Flight,’ given that honor upon his retirement...”

From Randy Stone, former JSC Chief Flight Director and former JSC Deputy Director: “Bob mentored all of the new Flight Controller’s with his wisdom, knowledge, but more importantly his passion for human space flight.”

Others commented: “Bob was a walking encyclopedia of space knowledge and also had a great sense of humor.” “Bob was a rarity in the annuals of human space flight – a joyful cheerleader [with] unabashed love of the space program.” “I could always rely on Bob for hard to find info. His enthusiasm for his work was obvious.” “Bob was good natured and enjoyed a good joke, even if it was on him. I love Bob and will miss him.”

And, shortly before Bob died, he received the following note from Bob Cabana, KSC Center Director and former Astronaut: “Bob, I look forward to your Summary Shuttle Book after the last [final] Shuttle mission. I think it’s the only way I’m ever going to remember what missions I CAPCOM’ed on and who was on console with me.”

The detail, the accuracy, the completeness of this Space Shuttle Missions Summary Book are a testament to Bob Legler’s “passion and knowledge” for human space flight. We will finish this book for him with the same dedication.

Floyd Bennett
Friend & Colleague
After Bob Legler's death in 2007, Floyd Bennett asked for and was given the task of completing Bob Legler's Space Shuttle Missions Summary Book, beginning with flight STS-116 and ending with the final Space Shuttle Mission. He was a friend and colleague of Bob's during the Apollo and Space Shuttle Programs. He also worked with Bob as a member of the Apollo Flight Operations Association for reunion events and was a co-author of Bob’s 35th [and last] Apollo Anniversary Reunion Book.

Floyd has 57 years of technical and managerial experience in the field of Aerospace Engineering. After graduation from Virginia Tech University in 1954, he joined the National Advisory Committee for Aeronautics (which became NASA in 1958) at Langley Research Center in Hampton, VA. As a research engineer he published several NACA/NASA Technical Reports on aircraft aeroelasticity. In 1962 he transferred with the Space Task Group to the Manned Spacecraft Center (now Johnson Space Center) in Houston, TX. Here he performed and managed analyses for manned spaceflight in engineering development, mission planning, flight operations, systems integration, and finally as a Space Shuttle Missions historian.

He performed key roles during the Apollo Program in establishing the Lunar Module Spacecraft landing and ascent operational trajectory strategies, lunar landing site selection, mission planning and real-time mission support for all Apollo manned lunar landing missions. During the Space Shuttle Program he performed a key role in systems integration for establishing program control of vehicle weight and performance for initial Space Shuttle manned development flights.

After NASA retirement in 1982 he continued making contributions in Space Shuttle Systems Integration for resolution of Payload, SSME, and Orbiter technical issues while working for three different NASA contractors, retiring from United Space Alliance in 2006.

Floyd is an Associate Fellow & Emeritus Lifetime Member American Institute of Aeronautics & Astronautics. He has received numerous NASA and USA awards for exceptional service during the Apollo and Space Shuttle Programs including an Apollo 15 Astronaut's Lunar Landmark named "Bennett Hill".