LAUNCH INFORMATION

MISSE 1 and 2 were launched into low earth orbit aboard Space Shuttle Discovery (NASA orbiter vehicle designation OV-103) during mission STS-105 on August 10, 2001. The experiment packages were attached to the exterior of the International Space Station (ISS) by Astronaut Patrick G. Forrester during a space walk conducted on August 16, 2001.

PEC-1 was positioned on the lower portion of the ISS Airlock so that it would be exposed to the maximum amount of ultra-violet (UV) radiation and atomic oxidation (AO). PEC-2 was positioned on the side of the ISS Airlock to receive UV radiation, but a minimal amount of exposure to atomic oxygen.
MISSE 3 & 4 were launched by Space Shuttle Orbiter Discovery during mission STS-121 on 3 August 2006. Astronauts Williams and Reiter attached the experiments to the exterior of the International Space Station on August 3, 2006. MISSE 3 went on one of the high-pressure tanks around the crew lock, while MISSE 4 was installed on Quest’s Joint Airlock.

The original MISSE 6 launch target date was February 14, 2008 but after the delay of STS-122 the shuttle was launched at 2:28 am EST March 11, 2008 aboard space shuttle orbiter Endeavour (NASA orbiter vehicle designation OV-105). The mission designation was STS-123. Installation was attempted during the third EVA, however the case did not initially fit onto the bracket and installation was postponed. The MISSE 6 experiment was then installed successfully during the fifth EVA on March 22, 2008 by Astronauts Robert L. Behnken and Michael Foreman.
IN ORBIT OBSERVATIONS

Shuttle Astronauts visited the MISSE 1 & 2 experiments to make observations and to take photographs while they were in orbit. These Extra Vehicular Activities (EVA’s) were made to the experiments in September, October and December of 2001; February, April and October 2002; and March, April and August of 2003. The part identification markings included in the MISSE experiments were clearly visible in many of the photographs and appeared to be readable.
Shuttle Astronauts took snap shots of MISSE 3 & 4 after deployment and revisited the experiments and took additional photographs in December 2006 to assess their condition.

This image of the MISSE-3 Passive Experiment Container (PEC) was taken on December 18, 2006. At this point, MISSE-3 has been exposed to the space environment for approximately 4 months.

This photograph of MISSE 6 was taken immediately after being attached to an exterior truss segment on the Columbia External Payload Facility during STS-128. Other in flight photographs were taken on September 1, 2009. These photographs showed readable Data Matrix symbols in all positions.
The marked samples were removed from their trays and hand carried back to Huntsville, Alabama, where they were photographed and inspected prior to delivery to Intermec Technologies for mark quality verification testing. This activity was successfully completed on October 11, 2007.

MISSE 6 was retrieved from outside the European Space Agency's Columbus Laboratory by STS-128 astronauts Danny Olivas and Nicole Stott on Sep 1, 2009. The experiments were returned to Edwards Air Force Base, California on September 11, 2009 after two landing attempts at Kennedy Space Center were waved off. Discovery touched down at 20:53 EDT (00:53 UTC). Discovery began its trek back to KSC at daybreak on Sunday September 20, 2009, when the spacecraft departed Edwards Air Force Base in California atop the modified 747 carrier jet. The duo made refueling stops in Amarillo and Fort Worth, Texas, before heading to Barksdale Air Force Base in Louisiana for an overnight stay. Space shuttle Discovery completed its ferry flight across the country Monday, reaching the Kennedy Space Center just after 12 noon EDT on September 21, 2009.

The marked samples were hand carried to Sys-Tec Corporation for mark quality verification. This activity was completed on December 7, 2008.
MISSE 2, Tray 2, Top

D2 Holder

EOIM 10 Holder (Flipped Horizontally)
MISSE 4, Tray 2, Top

B9 Holder
RECOMMENDATIONS

The primary purpose for the MISSE marking tests is to define Data matrix symbol marking processes that will remain readable after exposure to low earth orbit environments. The initial MISSE marking tests clearly reflected that intrusive marking processes can be successfully used for this purpose. However, subsequent tests demonstrated that some additive marking processes will also satisfy the requirements. This was an unexpected result. Since additive markings present less risk and in many cases are most cost effective, Sys-Tec Corporation recommends that future additive markings tests be conducted to refine these processes and to test additional additive marking processes for future use. Proposed marking enhancements and recommendations for future testing are identified below:

1. Require the use of matte finish fluoropolymer clear coat to protect markings applied using Laser Bonding, Laser Coat and Remove, and Laser Coloring marking processes.

2. Require that markings applied to glass substrates using Laser Inducted Vapor Deposition (LIVD) process be applied to the interior (unexposed) side of the item.

3. Replace the electro-chemical coloring (AC current) process tested as part of this experiment with a deep electro-chemical etch process (DC current) to form a recessed marking that is enhanced using a coloring agent to improve contrast. This marking, protected with a matte finish fluoropolymer clear coat, will be more durable and easier to read.

4. Explore means to backfill dot peen markings to improve readability using hand-held readers.

5. Incorporate the following newly developed marking materials into future in-flight experiments.
   - Laser Bonding materials previous flown with a protective clear coat.
   - Advance Laser Bonding material developed by Ferro Corporation for use in high temperature (2000F) engine marking applications. Mark will be protected with Shield Products clear coated.
OVERVIEW OF MISSE CONSTRUCTION

(1) MATERIALS IN HOLDER
(2) HOLDERS IN TRAY
PEC CARRIER
(3) TRAY IN PEC
(4) PEC IN CARRIER
(5) PEC INSTALLED ON SHUTTLE BAY TRUSS
(6) PEC ATTACHED TO SPACE STATION