National Aeronautics and Space Administration

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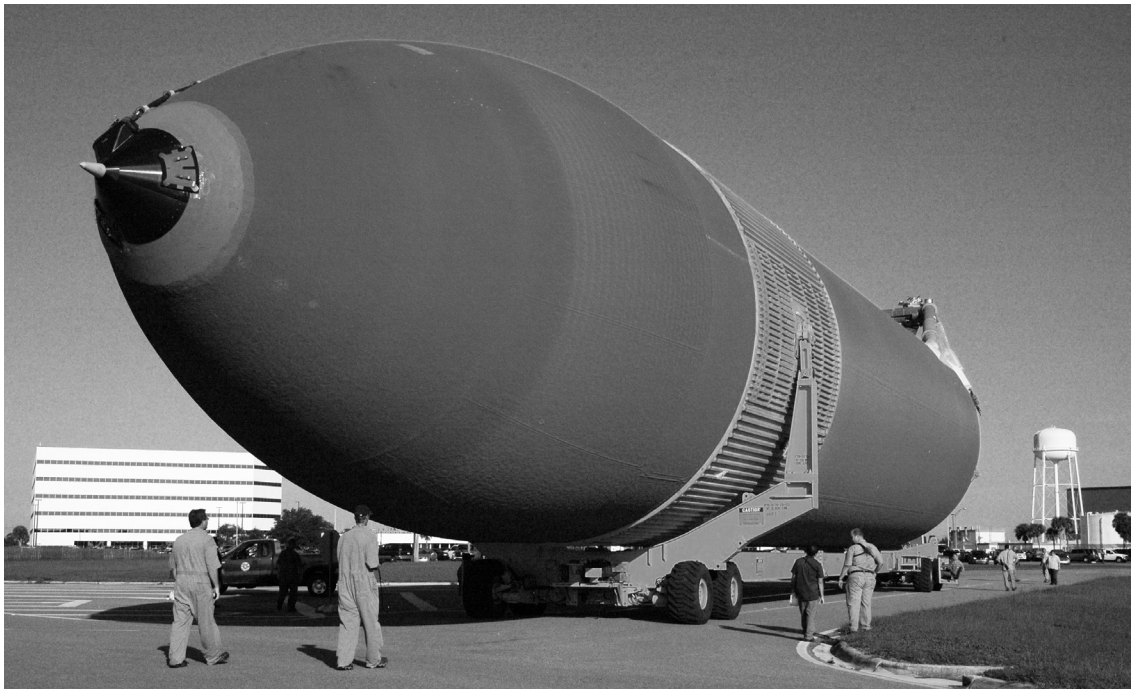
# Space Shuttle External Tank ET-120, STS-120

The Space Shuttle Program remains committed to understanding external tank foam in order to more accurately assess potential risks and improve the space shuttle external tank. A number of improvements were made to the tank prior to the first Return to Flight mission, STS-114 (July 2005), and more were made before STS-121 (July 2006). While external tank foam loss can never be completely eliminated, the program continues to make tank improvements to minimize foam and ice loss by looking at areas where debris may be shed, prioritizing them and methodically eliminating them one at a time.

ET-120, which will fly on the STS-120 mission, was the first Return to Flight tank — the first tank to be modified with safety improvements mandated by the Columbia Accident Investigation Board. Those modifications included improvements to the forward bipod, liquid hydrogen tank/intertank flange and liquid oxygen feedline bellows. ET-120 was shipped by barge from the Michoud Assembly Facility in New Orleans Dec. 31, 2004, slated to fly on Discovery's STS-114 mission in July 2005. ET-120 was subjected to two tankings at the Kennedy Space Center, Fla., in preparation for launch of STS-114, with resulting thermal protection system (TPS) conditions typically reported and documented. ET-121 replaced ET-120 for the STS-114 mission due to diffuser and ECO sensor anomalies with ET-120.



**ET-120, which will fly on space shuttle mission STS-120, arrived at the Kennedy Space Center, Fla., July 30, from the Michoud Assembly Facility in New Orleans. The tank was moved into the Vehicle Assembly Building, where it was mated to the twin solid rocket boosters and orbiter Discovery. (Photo credit: NASA/KSC)**

ET-120 was returned to Michoud for post STS-114 TPS modifications and was used as a dissection test article during the STS-114 foam loss investigation. Foam loss events on the protuberance airloads (PAL) ramps and ice/frost ramps during STS-114 required that dissections be performed on ET-120 to further understand foam loss mechanisms. Dissections revealed TPS cracking conditions at the liquid hydrogen PAL ramp and liquid hydrogen ice/frost ramp locations. Other TPS applications considered "at risk" to the overall Space Shuttle Program for thermal cracking were removed from ET-120 and evaluated. All other dissected TPS applications were returned to flight-ready configuration. In addition to the TPS attention ET-120 received, other systems, such as structural, electrical and propulsion/mechanical subsystems went through a verification reassessment process.

A recovery plan was presented and accepted by the Space Shuttle Program. The External Tank Project Office then initiated implementation of the plan to return the tank to flight status. The goal for the tank's TPS repairs was to maintain integrated debris risk at the same level or better than the existing configuration. ET-120 repair work began in October 2006 to support the August 2007 launch on need mission for Endeavour/STS-118 and the primary tank for Discovery/STS-120.

Work was completed and ET-120 was shipped by barge from the Michoud Assembly Facility on July 24, 2007, and arrived at the Kennedy Space Center, Fla., on July 29.

**A technician measures foam prior to removing it from ET-120's liquid hydrogen tank protuberance airloads (PAL) ramp in November 2005. Following STS-114, studies and testing determined that both the liquid oxygen and the liquid hydrogen PAL ramps could be removed from the external tank to minimize potential foam loss. The two PAL ramps, made entirely of foam, weighed almost 37 pounds. ET-119 was the first tank to fly without PAL ramps. (Photo credit: Lockheed Martin)**

**A technician torques bolt fasteners on the redesigned —Y bipod fitting on ET-120 at NASA's Michoud Assembly Facility in New Orleans in November 2004. The bipod redesign was one of the Return to Flight changes to the external tank to minimize potential debris by eliminating the large insulating foam covering the bipod area in favor of electric heaters. (Photo credit: Lockheed Martin)**

**ET-120, when it flies on Discovery on STS-120 differs from ET-120 for STS-114 in the following ways:**

- The Liquid Hydrogen Ice/Frost Ramps have been modified at 14 locations (stations Xt 1151-1980).
- The Liquid Oxygen Ice/Frost Ramps have been modified at four locations (stations Xt, 718, 760, 794 and 828).
  - ET-128, which will fly on STS-124 targeted to launch April 2008, will be the first tank to fly with all 17 liquid hydrogen ice/ frost ramps redesigned/reshaped.
- The Liquid Oxygen Feedline Brackets — As an interim measure before the new titanium bracket design flies on ET-128, four feedline brackets (stations 1129, 1623, 1377, and 1871) have been modified with a different foam configuration. BX foam and SLA were removed from the upper portion of the four brackets and resprayed with BX foam only and restored to approximately the original mold line. Bracket BX foam is about one-inch thick and the underlying SLA is about one-half-inch thick, but the SLA is denser, or heavier than the BX foam. Approximately five inches of TPS has been removed — about .12 pounds of TPS mass each bracket. Less foam on the brackets is acceptable for the shuttle's ascent; it is now known that SLA is not required on the brackets.
- Liquid Oxygen and Liquid Hydrogen PAL Ramps have been removed.
- Bipod Harness Modifications — Wire harness sealing/ bonding, flown as a Return to Flight modification on ET-119/STS-121 (second RTF flight), was performed to preclude a debris event similar to the one observed on STS-114. Voids within cabling and underneath the harnesses have the potential to cause cryoingestion and cryopumping failure. A process was developed to seal cables and bond harnesses with minimal defects.
- Intertank Acreage Machining/Venting — The area of vented intertank thermal protection system foam increased to reduce the potential for foam loss due to "popcorning," caused by air bubbles becoming trapped in foam and flaking off and falling away during heating and expansion during launch.
- Two ET Camera Antenna Replacements — Corrosion on antennas observed during visual inspection are believed to have been caused by either the tank's extended stay at the launch pad (STS-114) or exposure to moisture at the Michoud Assembly Facility. Two Liquid Oxygen Feedline Camera System antennas were removed and replaced with new nickel-plated antennas. TPS closeout material was reapplied in accordance with the existing verified and validated TPS application procedure.

**A technician at the Kennedy Space Center maps out the cutting area of the liquid oxygen (LO2) feedline bracket where foam insulation and super lightweight ablator, or SLA, cork insulation were removed. Foam insulation was then reapplied without the SLA. (Photo credit: NASA/KSC)**

**As an interim measure before the new titanium liquid oxygen (LO2) feedline bracket redesign flies on ET-128, four feedline brackets (stations 1129, 1623, 1377, and 1871) on ET-120 were modified with a different foam configuration at the Kennedy Space Center. (Photo credit: NASA/KSC)**


**Space Shuttle Discovery at Launch Pad 39A at the Kennedy Space Center, Fla.**
**(Photo credit: NASA/KSC)**

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FS–2007–10–133–MSFC
8–335179