



FACT SHEET SPACE SHUTTLE EXTERNAL TANK

- Program:** Space Shuttle External Tank
- Customer:** National Aeronautics and Space Administration (NASA)
George C. Marshall Space Flight Center
Huntsville, Alabama
- Contract:** Design, development, test and engineering, and production of the Space Shuttle External Tank, and facilities support at NASA's Michoud Assembly Facility.
- Company Role:** Lockheed Martin manufactures the External Tank at NASA's Michoud Assembly Facility in New Orleans, La. Michoud Operations employs 2,500 people to build the tank, which is the only major non-reusable element of the Space Shuttle. One tank is used for each launch.
- Contract Status:** Under existing contracts, Lockheed Martin will continue to produce External Tanks through 2010. Three test tanks and 122 flight tanks have been delivered to NASA.
- Description:** At 154 feet long and 27.6 feet in diameter, the External Tank is the largest element of the Space Shuttle and the structural backbone of the system. It is comprised of a forward liquid oxygen tank, an aft liquid hydrogen tank and a connecting intertank. The tank is made of aluminum and steel alloys and titanium. A spray-on foam insulation material approximately one inch thick is applied to the exterior of the entire External Tank, with 282 square feet of underlying ablators, to prevent ice build-up and to protect the tank from engine and aerodynamic heating.
- In 1979, NASA asked Lockheed Martin to trim at least 6,000 pounds from the External Tank, which weighed some 76,000 pounds. New fabricating techniques and material and design changes yielded a 10,000-pound weight savings and resulted in the first Lightweight Tank weighing 66,000 lbs. This translates to an almost equal payload increase for the shuttle. The seventh tank and all succeeding tanks through ET-94 are of the Lightweight configuration.
- Michoud Operations now builds the next generation of the External Tank, the Super Lightweight Tank, which weighs 58,500 pounds. Featuring design changes and an aluminum-lithium alloy and weighing some 7,500 lbs. less than the Lightweight Tank, the new Super Lightweight Tanks are vital for building and supplying the International Space Station. The first Super Lightweight Tank, ET-96, lifted off successfully on June 2, 1998, powering Shuttle mission STS-91 into space.

Tank Capacity: Total: 535,277 gallons
740,159 kg
1,610,000 lbs.

Liquid Oxygen: 145,138 gallons
625,850 kg
1,380,000 lbs.

Liquid Hydrogen: 390,139 gallons
104,308 kg
230,000 lbs.

Tank Size: Length: 153.8 feet 4,688.0 cm
Diameter: 27.6 feet 840.0 cm

Hydrogen Tank Length: 96.7 feet 2,947.0 cm
Oxygen Tank Length: 54.6 feet 1,664.0 cm

Intertank Length: 22.5 feet 686.0 cm

Lightweight Tank Weight: 66,000 lbs. empty 29,932 kg
1,676,000 lbs. loaded 760,091 kg

Super Lightweight Tank Weight: 58,500 lbs. empty 26,536 kg
1,668,500 lbs. loaded 756,832 kg

Propellant Flow: * Liquid Oxygen: 159,480 lbs./min. or 16,800 gal/min

* Liquid Hydrogen: 26,640 lbs./min. or 45,283 gal/min

*** Note:** Liquid Oxygen Weight = 71.1 lbs./cu ft.
Liquid Hydrogen Weight = 4.4 lbs./cu. ft.
Liquid Oxygen Temp. = -297 degrees F
Liquid Hydrogen Temp. = -423 degrees F

Nominal Separation: Altitude: 69 statute miles
60 nautical miles
111 kilometers

Downrange: 805 statute miles
700 nautical miles
1,297 kilometers

Operation: The External Tank supplies liquid propellants to the Orbiter through 17-inch diameter feedlines and absorbs tremendous thrust loads produced at launch by the Orbiter's three main engines and by the Solid Rocket Boosters. The tank empties in about 8½ minutes and then separates from the Orbiter. Almost all of the tank burns up during re-entry. Any debris that does not burn up falls into a predetermined area of the Pacific or Indian Ocean.

Past Performance: NASA has launched the Space Shuttle 121 times.

Launch dates: STS-1 4/12/81 ET-1
STS-2 11/12/81 ET-2

STS-3	3/22/82	ET-3
STS-4	6/27/82	ET-4
STS-5	11/11/82	ET-5
STS-6	4/04/83	ET-8
STS-7	6/18/83	ET-6
STS-8	8/30/83	ET-9
STS-9	11/28/83	ET-11
STS 41-B	2/03/84	ET-10
STS 41-C	4/06/84	ET-12
STS 41-D	8/30/84	ET-13
STS 41-G	10/05/84	ET-15
STS 51-A	11/08/84	ET-16
STS 51-C	1/24/85	ET-14
STS 51-D	4/12/85	ET-18
STS 51-B	4/29/85	ET-17
STS 51-G	6/17/85	ET-20
STS 51-F	7/29/85	ET-19
STS 51-I	8/27/85	ET-21
STS 51-J	10/03/85	ET-25
STS 61-A	10/30/85	ET-24
STS 61-B	11/26/85	ET-22
STS 61-C	1/12/86	ET-30
STS 51-L	1/28/86	ET-26
STS-26	9/29/88	ET-28
STS-27	12/02/88	ET-23
STS-29	3/13/89	ET-36
STS-30	5/04/89	ET-29
STS-28	8/08/89	ET-31
STS-34	10/18/89	ET-27
STS-33	11/22/89	ET-38
STS-32	1/09/90	ET-32
STS-36	2/28/90	ET-33
STS-31	4/24/90	ET-34
STS-41	10/06/90	ET-39
STS-38	11/15/90	ET-40
STS-35	12/02/90	ET-35
STS-37	4/05/91	ET-37
STS-39	4/28/91	ET-46
STS-40	6/05/91	ET-41
STS-43	8/02/91	ET-47
STS-48	9/12/91	ET-42
STS-44	11/24/91	ET-53
STS-42	1/22/92	ET-52
STS-45	3/24/92	ET-44
STS-49	5/07/92	ET-43
STS-50	6/25/92	ET-50
STS-46	7/31/92	ET-48
STS-47	9/12/92	ET-45
STS-52	10/22/92	ET-55
STS-53	12/02/92	ET-49
STS-54	1/13/93	ET-51
STS-56	4/08/93	ET-54
STS-55	4/26/93	ET-56
STS-57	6/21/93	ET-58
STS-51	9/12/93	ET-59
STS-58	10/18/93	ET-57
STS-61	12/02/93	ET-60
STS-60	2/03/94	ET-61

STS-62	3/04/94	ET-62
STS-59	4/09/94	ET-63
STS-65	7/08/94	ET-64
STS-64	9/09/94	ET-66
STS-68	9/30/94	ET-65
STS-66	11/03/94	ET-67
STS-63	2/01/95	ET-68
STS-67	3/02/95	ET-69
STS-71	6/27/95	ET-70
STS-70	7/13/95	ET-71
STS-69	9/07/95	ET-72
STS-73	10/20/95	ET-73
STS-74	11/12/95	ET-74
STS-72	1/11/96	ET-45
STS-75	2/22/96	ET-76
STS-76	3/21/96	ET-77
STS-77	5/19/96	ET-78
STS-78	6/20/96	ET-79
STS-79	9/16/96	ET-82
STS-80	11/17/96	ET-80
STS-81	1/12/97	ET-83
STS-82	2/11/97	ET-81
STS-83	4/04/97	ET-84
STS-84	5/15/97	ET-85
STS-94	7/01/97	ET-86
STS-85	8/07/97	ET-87
STS-86	9/25/97	ET-88
STS-87	11/19/97	ET-89
STS-89	1/22/98	ET-90
STS-90	4/17/98	ET-91
STS-91	6/02/98	ET-96
STS-95	10/29/98	ET-98
STS-88	12/04/98	ET-97
STS-96	5/27/99	ET-100
STS-93	7/23/99	ET-99
STS-103	12/19/99	ET-101
STS-99	2/11/00	ET-92
STS-101	5/19/00	ET-102
STS-106	9/08/00	ET-103
STS-92	10/11/00	ET-104
STS-97	11/30/00	ET-105
STS-98	2/07/01	ET-106
STS-102	3/08/01	ET-107
STS-100	4/19/01	ET-108
STS-104	7/12/01	ET-109
STS-105	8/10/01	ET-110
STS-108	12/5/01	ET-111
STS-109	3/1/02	ET-112
STS-110	4/8/02	ET-114
STS-111	6/5/02	ET-113
STS-112	10/7/02	ET-115
STS-113	11/23/02	ET-116
STS-107	1/16/03	ET-93
STS-114	7/26/05	ET-121
STS-121	7/4/06	ET-119
STS-115	9/9/06	ET-118
STS-116	12/9/06	ET-123
STS-117	6/8/07	ET-124

STS-118	8/8/07	ET-117
STS-120	10/23/07	ET-120
STS-122	2/7/08	ET-125
STS-123		ET-126

Lockheed Martin completed External Tank-126 on November 25, 2007, and delivered it on dock at Kennedy Space Center on November 30, 2007, for the STS-123 mission, the 122nd Space Shuttle flight.

The 25th mission, STS-51L (*Challenger*), launched January 28, 1986 and ended in failure 73 seconds after lift-off. The Rogers Commission's report on its investigation of the accident stated: "The Commission reviewed the External Tank's construction records, acceptance testing, pre-launch and flight data, and recovered hardware and found nothing relating to the External Tank that caused or contributed to the cause of the accident."

After a successful science mission, *Columbia* and her crew (STS-107) were lost during re-entry on February 1, 2003. The *Columbia* Accident Investigation Board (CAIB) concluded that *Columbia* re-entered Earth's atmosphere with a pre-existing breach in the leading edge of its left wing caused by a foam strike on ascent. The board stated, "We are convinced that the management practices overseeing the Space Shuttle Program were as much a cause of the accident as the foam that struck the left wing." The CAIB found no indications of negligence or faulty workmanship in the application of the External Tank Thermal Protection System.

Background: Lockheed Martin won a competitively bid contract in 1973 to design and build External Tanks at NASA's Michoud Assembly Facility in New Orleans. The facility has deep-water access, a necessity because of the requirement to transport the External Tanks to launch sites via ocean-going barge. The flight tanks are transported to KSC in Florida by the same ships that retrieve the Solid Rocket Boosters after they're jettisoned approximately 2¼ minutes into a Space Shuttle launch. The voyage from New Orleans, across the Gulf of Mexico, around the tip of Florida, up the Atlantic Ocean side of Florida and into the Banana River to KSC is approximately 900 miles and takes five days.

Milestones: Lockheed Martin Space Systems – Michoud Operations delivered the first External Tank for tests (the main propulsion test article) to NASA on September 7, 1977. Michoud delivered the ET for the first shuttle flight to NASA on June 29, 1979.

The first unpainted tank launched as part of the STS-3 mission on March 22, 1982. The first Lightweight Tank launched on the STS-6 mission on April 4, 1983. The final Heavyweight Tank launched with STS-7 on June 18, 1983. The first Super Lightweight Tank launched on STS-91 on June 2, 1998.