NASA Facts

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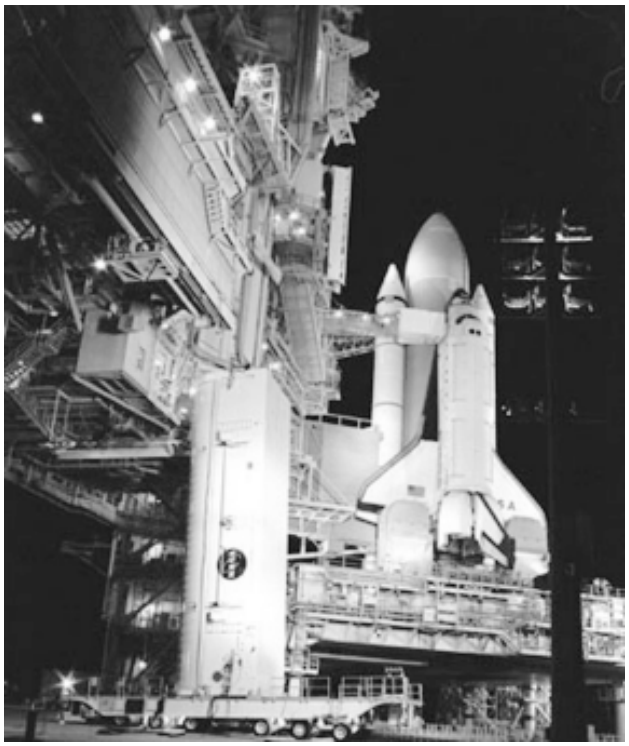
KSC Transporters

Transporters of several types are used throughout the Kennedy Space Center's (KSC) Launch Complex 39 Area to move orbiters, solid rocket motors, payloads and the Space Shuttles. The transporters first grew out of a need to move Project Apollo flight hardware and supporting structures, and later, the various elements supporting Space Shuttle launches. The oldest type currently still in use at KSC is the crawler transporter (photo below); the newest is the payload canister transporter. Each serves a unique purpose.

Crawler Transporter



Payload Canister Transporter

Solid Rocket Motor Transporter

Orbiter Transporter

Early Concepts

In 1961, President Kennedy set a national goal of making a manned landing on the moon before the end of the decade. The National Aeronautics and Space Administration was assigned the responsibility of accomplishing this awesome feat. At the time, neither the huge and extremely sophisticated flight hardware nor the supporting launch facilities existed.

While other NASA facilities tackled the job of designing and developing the Saturn V launch vehicle and the Apollo spacecraft for transporting three men to the moon, Kennedy Space Center began the design of the launch complex.

Heading the team at KSC was Dr. Kurt H. Debus, KSC director and rocketry pioneer with launch experience dating from the 1930s.

Because of the size and complications of handling the huge Saturn V rocket and the adverse environmental factors of wind, rain, highly corrosive salt air, electrical storms, and hurricanes that exist at KSC, Dr. Debus' team departed from the conventional methods of assembly and checkout of the launch vehicles at the launch pad. He decided that the Saturn V would be assembled and checked out in a Vehicle Assembly Building (VAB) and then transported to the launch pad on a mobile launch pad and tower.

Conveyance of the mobile launcher and Saturn V to the pad posed no small problem in the 1960s. The rocket and launcher would weigh 12 million pounds, and the distance would be 3.5 miles to Pad A and more than 4 miles to Pad B. In addition, a portable service tower would be required to be transported to the launch pads to service the Saturn V.

Three concepts of transporting the vehicle and launcher were proposed: a barge and canal system, a rail system, and a land transporter. The task of selecting one of these three systems and then transforming a concept into reality fell to D.D. Buchanan, chief of the launcher systems and umbilical tower design section.

After a year of study, in 1962 the cross-land tracked vehicle, or crawler transporter, was determined to be the most feasible conveyance.

Early concepts showed the transporter integral with the mobile launcher, but exposure to launch damage and possible long repair periods influenced the selection of a transporter that would be completely self-powered and separate from the structures. The transporter would be the largest land vehicle ever constructed, would weigh six million pounds, and would be capable of transporting the mobile launcher with an assembled Saturn V or the mobile service structure.

In July 1962, NASA approved the crawler transporter concept, and in March 1963, a contract was awarded to Marion Power and Shovel Co., Marion, Ohio, for the construction of two transporters.

Application to the Shuttle Program

Of credit to the individuals who designed the KSC crawler transporters is the fact they did not embark on exotic schemes that might have taken years to develop and would have cost many times more. Instead, they used existing and proven concepts that were modified and ingeniously applied to the Apollo program requirements.

Construction of the transporters as separate and independent of the mobile launch platform structures proved both prudent and visionary in light of future requirements of the transporters. Although modifications were necessary to support Shuttle operations, the transporters have truly become the workhorses of the Complex 39 area. They will continue to function well into the 21st century using the same basic design initiated in 1962.

Crawler Transporter

One of KSC two crawler transporters (CT) transports the Mobile Launcher Platform, with the assembled Space Shuttle aboard, between the refurbishment area, the VAB, and Complex 39 Launch Pads A and B. Normally, the CT lifts the mobile launcher from its parking site pedestals at the refurbishment area, carries it into the VAB, and lowers it onto the pedestals in the high bay.

When the Shuttle orbiter has been mated to the external tank and solid rocket boosters, the CT lifts the mobile launcher with the Shuttle, and carries it to the launch pad using a laser guidance system on the crawler and a leveling system. Once at the pad, the CT lowers the Shuttle-topped mobile launcher onto the pad pedestals. The CT then moves to a park site away from the pad to avoid possible damage from launch.

After the Shuttle is launched, the CT lifts the mobile launcher from the pad and returns it to the parking location for refurbishment.

The Crawler Transporter consists of these systems and subsystems:

AC Power System
DC Power System
Auxiliary Power System
Hydraulic System
Pneumatic System
Integrated Monitor and Control System
Jacking, Equalizing and Leveling System
Steering System
Engine Monitor System
DC Propel System
Fire Detection, Alarm and Protection System
Lubrication System
Instrumentation System

Crawler Transporter Facts

Height
Minimum (Cylinders retracted) ..... 20 Feet
Maximum (Cylinders extended) ..... 26 Feet
Size
Overall ..... 131 Feet Long / 113 Feet Wide
The four contact points (interface) the crawler makes to the MLP are arranged in a 90-foot square ——- (same as the base line on a major league baseball field).
Cylinders
Jacking Hydraulic (16 Each) ..... 20-Inch Diameter
Steering Hydraulic (16 Each) ..... 14.5-Inch Diameter
Guide Tube (4 Each) ..... 40-Inch Diameter
Weight
Overall ..... 5.5 Million Pounds
Chassis ..... 2.2 Million Pounds
(lifted by hydraulic system)
Speed
Loaded ..... 1 MPH
Unloaded ..... 2 MPH
Loads
Mobile Launcher Platform and
Space Shuttle ..... 12.0 Million Pounds
Mobile Launcher Platform ..... 8.8 Million Pounds

Additional Facts

Trucks
Traction Motors ..... 16 each (4 per truck)
375 H.P. each
Belts ..... 8 each (2 per truck)
Shoes ..... 57 per belts
8 belts, 456 shoes
Shoe Weights ..... 2,200 Pounds each
Hydraulic System
Overall Capacity ..... 3700-Gallon Capacity
Steering ..... 4 pumps, 35.5 GPM
@ 1200 RPM, per pump
Pressure ..... 0-5,200 PSI Maximum
Jacking, Equalizing, Leveling (JEL) ..... 8 pumps
Electrical System
DC Power System ..... For 16 traction motors
375 H.P.
Diesel Engines ..... Alco, 16 Cylinders
2 @ 2,750 H.P. each
Generators (DC) ..... 4 @1,000 KW each
AC Power System ..... Runs all onboard systems
Diesel Engines ..... White-Superior, 8 Cylinders,
2 @ 1,065 H.P. each, for A/C power
Generators ..... 2 @ 750 KW each
Diesel Fuel Capacity ..... 5,000 Gallons
Fuel Consumption ..... 42 Feet Per Gallon
(approximately 125.7 Gallons Per Mile)
Drive System Gear Ratio 168:1

Solid Rocket Motor (SRM) Transporters

The Solid Rocket Motor (SRM) Transporter moves the Space Shuttle SRM segments between the Rotation, Processing and Surge Facility (RPSF) and the storage buildings (Surge 1 and Surge 2) or the VAB. The SRM segments are delivered to the RPSF from Utah by railroad car where they are unloaded onto pallets.

The SRM Transporter moves under the pallet, lifting both the pallet and the segment. The transporter then moves the pallets and segments to either the Surge Facilities for storage or to the VAB transfer aisle for segment stacking. Four fueled segments are required for each of the two Solid Rocket Boosters used on each Shuttle flight.

The Solid Rocket Motor Transporter consists of these systems:

Drive System
Lifting System
Steering System
Brake System
Fire System
DC Power and Control System
Communications System
Diesel Engine and Cooling System
Pneumatic System

SRM Transporter Statistics

Capacity ..... 414,096 Pounds
Dead Weight ..... 204,800 Pounds
Gross Weight ..... 618,940 Pounds
Number of Wheel Sets 12
Tires 48
Axle Load Capacity ..... 70,480 Pounds
Number Of Drive Axles 6
Number Of Brake Axles 6
Tractive Power ..... 70,925 Pounds
Max. Gradient Ability Laden, Approx. 6%
Max. Crawl Speed, Unladen, Approx. ..... 6.4 MPH
Engine ..... Cummins Diesel, Type NTA-855 C 400 Water Cooled
Height Of Lowered Platform ..... 63 Inches
Lifting Stroke ..... 27-9/16 Inches
Axle Load Compensation ..... +/- 13-25/32 Inches
Platform Size ..... 612 X 239-3/8 Inches
Outside Turning Radius, Approx. ..... 40 Feet

Orbiter Transporter System

The Orbiter Transporter System (OTS) (seen below) is used to transport the Space Shuttle orbiters from the Orbiter Processing Facility (OPF) to the VAB, prior to mating the orbiter with the external tank and solid rocket boosters.

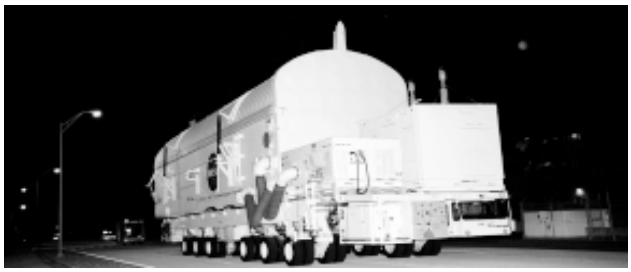
Since its arrival at KSC from Vandenberg Air Force Base, Calif., in 1989, the OTS has carried nearly every orbiter to the VAB for mating operations.

Orbiter Transporter Statistics

Length ..... 106 Feet 6 Inches
Width ..... 20 Feet at rear
16 Feet 8 Inches in middle
8 Feet at front
Height ..... 5 Feet 3 Inches minimum
to 7 Feet 3 Inches maximum
Engine ..... 335 H.P. V12, Air Cooled
Wheels 76
Turning Radius ..... 66 Feet
Weight-Empty ..... 167,000 Pounds
Weight-Gross ..... 327,000 Pounds
Speed Unloaded ..... 13 MPH
Max Speed Loaded ..... 5 MPH

Payload Canister Transporter

Two payload canister transporters are used to move the payload canisters and their associated hardware throughout KSC. The original transporters were replaced in January 2000, manufactured by KAMAG Transporttechnik, GmbH, of Ulm, Germany. Each transporter (see below) is a 12-bogie wheel, 24-tire, self-propelled vehicle designed to operate between and within space shuttle payload processing buildings, such as the Vertical Processing Facility, the OPF and the launch pads. The transporter can carry the payload canister in either horizontal or vertical configuration modes.



The transporter wheels are independently steerable, permitting it to move forward, backward, sideways, or diagonally, and to turn on its own axis like a carousel. It is equipped with pneumatic actuated braking and hydrostatic leveling and drive systems. It is steered from a 2-seat operator cab mounted at one end.

A transporter minus the canister weighs 136,600 pounds. It has a gross vehicular weight of 308,600 pounds when outfitted with the canister with payloads riding atop, 527 gallons of diesel fuel and with the environmental control system, fluids and gas service, electrical power system, and instrumentation and communication system modules aboard. Because payload handling requires precise manuevering, the transporter has a creep mode that permits it to be propelled down to 0.25 inches per second or 0.014 mph. When operating between buildings or sites, the transporter uses a 340-horsepower turbocharged diesel engine. Indoors, drive power relies on a 45-kilowatt, 480 VAC 3 electric motor to avoid exhausting hydrocarbons inside the clean room environment.

Payload Canister Transporter Statistics

Length ..... 65 Feet
Width ..... 22 Feet
Flatbed Height ..... 5 Feet 3 Inches minimum
to 7 Feet +/- 3 Inches maximum
Weight, Unloaded ..... 136,600 Pounds
Weight, Gross ..... 308,600 Pounds
Speed, Unloaded ..... 10 MPH
Speed, Fully Loaded ..... 5 MPH
Creep Mode ..... 0.014 MPH
or 0.25 inch per second