

# NASA Facts

National Aeronautics and  
Space Administration

**John F. Kennedy Space Center**  
Kennedy Space Center, Florida 32899



FS-2002-08-009-KSC

## KSC Transporters



**T**ransporters 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 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; the newest is the payload canister transporter. Each serves a unique purpose.



Clockwise from far left:  
Payload Canister Transporter with canister at the pad;  
SRM Transporter with its cargo;  
Crawler Transporter on the crawlerway;  
Orbiter Transporter waiting for its cargo.



## 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 the 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.

With the advent of the Shuttle program, other transporters were needed to move the orbiters and payloads.

## Crawler Transporter

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

**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 that 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 ea) .....	20-inch diameter
Steering Hydraulic (16 ea) .....	14.5-inch diameter
Guide Tube (4 ea) .....	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 ea/4 per truck)	375 hp ea
Belts	8 ea (2 per truck)
Shoes (57 per belt/ 8 belts)	456 shoes
Shoe Weights	2,200 pounds ea

**Hydraulic System**

Overall Capacity	3700-gallon
Steering	4 pumps, 35.5 GPM @ 1200 RPM, per pump
Pressure	0-5,200 PSI maximum
Jacking, Equalizing, Leveling (JEL)	8 pumps

**Electrical System**

<u>DC Power System</u>	For 16 traction motors .....375 hp
Diesel Engines .....	Alco, 16 cylinders 2 @ 2,750 hp each
Generators (DC) .....	4 @ 1,000 kw each

<u>AC Power System</u>	Runs all onboard systems
Diesel Engines .....	White-Superior, 8 cylinders, 2 @ 1,065 hp 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	Lifting
Steering	Brake

Fire DC Power and Control  
 Communications Diesel Engine and Cooling  
 Pneumatic

### ***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) 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/8 feet in front/  
 16 feet 8 inches in middle  
 Height .....5 feet 3 inches minimum  
 to 7 feet 3 inches maximum  
 Engine .....335 hp, 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 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 pads. The transporter can carry the payload canister in either a horizontal or vertical configuration mode.

The transporter's 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 weight of 308,600 pounds when outfitted with the canister and 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. Because payload handling requires precise movements, the transporter has a creep mode that permits it to be propelled down to 0.25-inch per second or 0.014 mph. When moving between buildings or sites, the transporter uses a 340-horsepower turbo-charged diesel engine. Indoors, drive power relies on a 45-kilowatt, 480 VAC 3-phase electric motor to avoid exhausting hydrocarbons inside the clean room environment.

### ***Payload Canister Transporter Statistics***

Length ..... 65 feet  
 Width.....23 feet  
 Flatbed Height ..... Varies from 5 feet 3 inches  
 to 7 Feet +/- 3 inches  
 Weight, Unloaded .....230,000 pounds  
 Weight, Gross .....258,320 pounds  
 Speed, Unloaded .....10 mph  
 Speed, Fully Loaded .....5 mph  
 Creep Mode .....0.014mph  
 (or 0.25 of an inch per second)