

Payload Ground Handling—Space Shuttle

A Payload Ground Handling Mechanism is used to transfer payloads from a transportation canister on the ground and installs them into the shuttle orbiter on the launch pad.

Although it may look like a giant forklift, the motion controllers, drives and motors used to maneuver the load must be extremely precise, reliable and rugged. Very tight tolerances must be met while moving an extremely large, fragile, high value load.

This system, located in the cleanroom environment of the payload change-out area of the launch pad, also provides access to the orbiter mid-body for repairs and testing.



After successful payload installation, shuttle is ready for launch.

Application Highlights

During a lengthy downtime, the main drive wheel bushings of the mechanism deteriorated causing a swinging, pendulum-like motion of the entire structure.

Mechanical fixes were time consuming and would have delayed launches. ORMEC's multi-axis controller was used to efficiently control drive shaft wind-up by applying preload and monitoring position feedback from wheel mounted encoders prior to initiating the main drive wheel rotation. This eliminates the initial jerk as wheel bearing friction is overcome.

Productivity in Motion

- Payload transfer time decreased from 16 hours to 4 hours, 300% improvement in efficiency due to use of servo controls instead of mechanical drive trains.
- Reduced risk of damaging flight hardware due to system precision and reliability.
- Accuracy of motion controlled by the joystick is to one thousandth of an inch.
- A safety system monitors all user inputs and motor functions. A shut-down sequence executed when erroneous movement is sensed.



The operator commands movement determined by an observer's measured clearances.



Operator Interface

- Ease of operation with joystick and touch screen.
- Series of emergency stop pendants are able to halt motion from 24 different locations.
- Electric motors controlled from a touch screen where commands are chosen from user selected list of speeds and directions.

ORMEC Equipment

Multi-axis ORMEC Controllers

- Motion control and PLC functions with high performance computing capability.
- High speed drive based I/O with microsecond position capture servo updates.
- Sub millisecond programmable limit switch outputs.
- Drive fault protection circuits, watchdog timers and integrated diagnostics for fail-safe operation.

ORMEC Servo Drives

- High bandwidth control with high resolution motor feedback, for quick and accurate torque, velocity and position control.
- Programmable drive real-time software configuration tools.

ORMEC AC Servo Motors

- High performance, reliable with low maintenance.
- Large library of standard motors and a custom motor wizard for non-standard motor configuration.

Communication Interfaces

- ModBus/TCP to supervisory software on a PC.

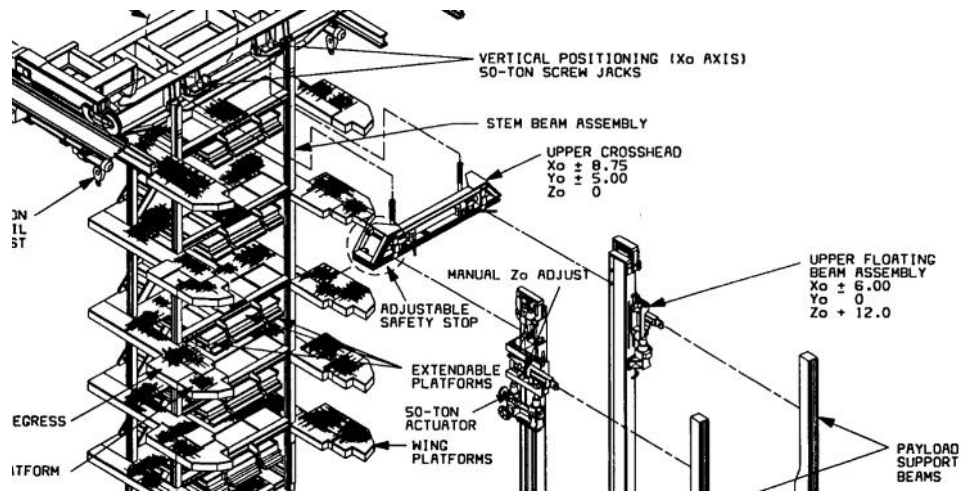
Operator consoles

Touch screen monitors

- Easy-to-use.
- Efficient commands and concise status displays.
- Joystick control for precise maneuvers.

Pendant stations

- Safety system consists of 24 remotely located emergency stop pendants.



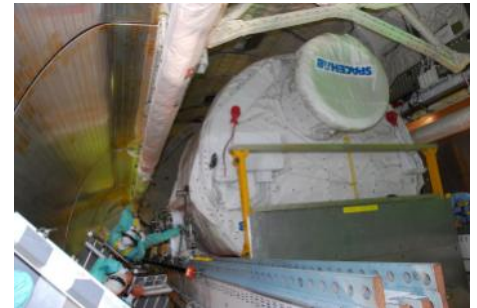
This drawing illustrates some of the many axes that are controlled with ORMEC controllers, motors and drives.

Mechanism movements

- Within the ground handling mechanism 14 axes of motion are controlled.

Special considerations

- Installed in Class 1, Div 2 environment.
- Rugged, reliable equipment withstands high vibration conditions experienced during the shuttle launch.



Extremely precise movements are required as the payload is guided during the last eight inches of its journey.

A critical part of the payload installation occurs during the final stage of mating. One motor drives the entire structure to about four feet of the mating position. The entire structure is then slowly moved to within eight inches of the final position. Four motors run a follower/pacer profile for precise positioning for the final transfer step.

The motion control experts at ORMEC have a wealth of experience providing motion control solutions for the aerospace industry. As your automation partner, we offer a comprehensive range of automation integration and project management services.

For more information please contact us by phone (585) 385-3520 or email us at sale@ormec.com

**Photos courtesy United Space Alliance and NASA.*