

ADJUSTABLE CENTER OF GRAVITY LIFT FIXTURE SYSTEM DESIGN AND OPERATIONAL FEATURES

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ABSTRACT

Transportation of waste payload requires accurate placement of the payload in the shipping container. A typical payload for waste shipments is 14 drums assembled on a circular pallet in a two level stack of 7-packs of drums. The payload may also be in two standard waste boxes (SWB) with one SWB stacked on top of the other. Stacking a typical waste payload container into a payload assembly would require tedious and meticulous waste weight management at the shipper's site. This type of waste payload management would be required to ensure even weight distribution of the assembled payload so that the assembly of the SWB or Drums would be vertical (PLUMB) during insertion and removal from the close confines of the shipping container payload cavity.

A specially designed lift fixture system with remotely operated counterweights has been developed for waste shipping and receiving sites. The system balance weights are remotely positioned with the aid of level indicators and encoders such that the combination of payload assembly and lift fixture becomes balanced (plumb) as a unit to provide vertical alignment within the shipping container payload cavity. This lift fixture system is also used for removal and installation handling of the transportation package lids.

SYSTEM DESIGN AND OPERATIONAL FEATURES

The TRUPACT-II Adjustable Center of Gravity (ACG) Lift Fixture was designed to provide a means of remotely engaging and handling the TRUPACT-II fourteen drum payload and various components of the TRUPACT-II shipping container. The ACG Lift Fixture is equipped with an operator controlled center of gravity compensating system which ensures that the payload is handled in a non-tilted position to prevent possible damage to the payload or shipping container. The ACG Lift Fixture is designed to operate from a standard 110 VAC, 20 ampere power outlet and attach to the user's facility five ton overhead crane. The ACG Lift Fixture has a design lift load capacity of 10,000 pounds. The ACG Lift fixture consists of the following main components (Fig. 1):

- Lifting Beam Structure
- Lift Leg System
- Center of Gravity Compensating System
- Electrical Tilt Sensing System
- Electrical/ Control System

LIFTING BEAM STRUCTURE

The main lifting beam structure consists of three carbon steel beams extending radially from the crane hook interface, spaced 120 degrees apart. At the end of each of the beams is a revolving joint to which the linear actuator and lift leg attaches.

The shackle at the hook interface attaches to the ACG Lift Fixture through a spherical bearing. The spherical

bearing provides maximum freedom of movement of the ACG Lift Fixture at the crane hook interface.

LIFT LEG SYSTEM

The ACG Lift Fixture is supplied with two sets of detachable lift legs (long and short). The lift legs are attached to the rotating joint by a ball lock pin. The grappling end of the leg uses a quarter turn fastener concept for attaching to the lift receptacles on the transport container outer containment vessel (OVC) lid, inner containment vessel (ICV) lid, and payload pallet.

The long lift legs are installed into the Lift Fixture for handling of the pallet and payload. The long lift legs are equipped with a red stripe. The red stripe will be visible above the guide tubes when the lift leg is not properly seated in the pallet lift packets, and will not be visible above the guide tubes when the lift legs are properly seated in the pallet lift pockets.

The short lift legs are installed into the ACG Lift Fixture for handling of the OCV lid, and the long lift legs are installed for handling of the ICV lid and payload pallet.

CENTER OF GRAVITY COMPENSATING SYSTEM

The load compensating system which is incorporated in the lift fixture design can compensate for a limited unbalancing of the payloads as a result of uneven placement of heavier drums on one side of a TRUPACT-II pallet. The load compensating balance system is capable of balancing a loaded pallet and lift fixture assembly with a 3.6 inch center of gravity shift from the vertical centerline.

Independent AC gearmotors provide the revolving motion for the load compensating balance weights. Each

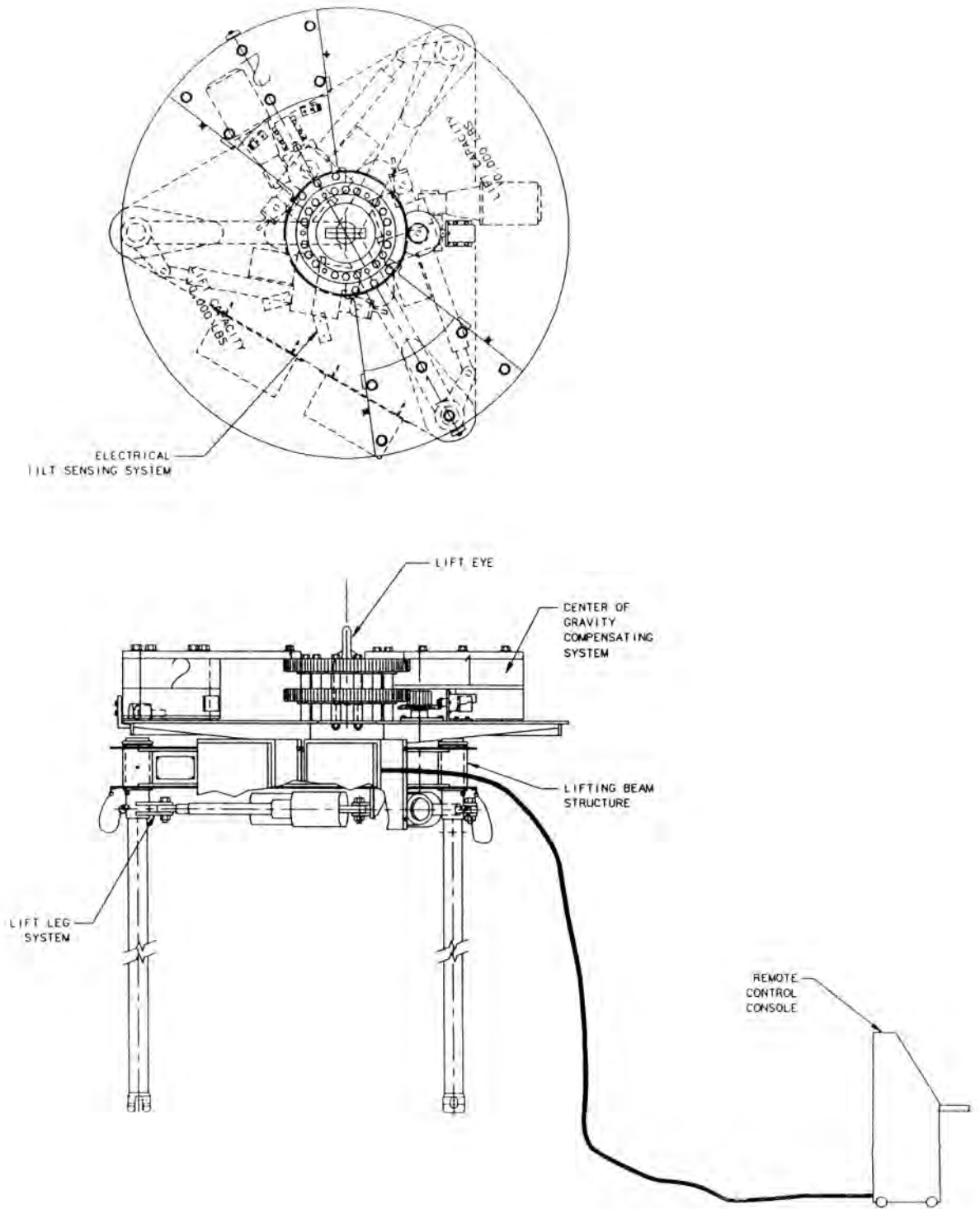


Fig. 1. Adjustable Center of Gravity Lift Fixture.

garmotor unit is protected against excessive drive load by means of a compact torque release clutch.

The relative position of both counter-balancing weights over the fixture platform is continuously detected by means of an encoder. The balance position output is absolute. Therefore, if power is lost to the ACG Lift Fixture, correct output is immediately available when power is restored.

ELECTRICAL TILT SENSING SYSTEM

The ACG Lift Fixture is equipped with two tilt sensors mounted at ninety degrees to each other, which provide an accurate indication of the tilt angle of the lift fixture. The electrical power to the tilt sensor is supplied from the console which also displays the tilt sensor's angular position on the digital display. The balance system accuracy is ± 0.5 degrees (30 ARC minutes of a degree) which is required to prevent scraping of the payload along the ICV wall during loading and unloading of a 14 drum pallet with the ACG Lift Fixture.

ELECTRICAL/CONTROL SYSTEM

A portable ACG Lift Fixture operator control console is supplied with the system. The minimum electrical power supply to the control console is 115 VAC, 60 Hz, 20 ampere.

Operator's coordination between the tilt sensor readout values and load balancing system is accomplished manually from the portable control console.

Remote engagement/disengagement of the lift legs to the lift receptacles on the lids or pallet is accomplished from a Remote Control Console. The operator is required to operate two controls (one with each hand) to activate the lift leg lock/unlock operation. The engaged or disengaged position of each lift leg is indicated by lighted indicators on the control console.

The three electrical actuators are simultaneously activated by operating two controls (one with each hand) requiring constant operator pressure for activation. Each of the actuators are independently deactivated by an actuator internal limit switch. Each of the lift leg position indicators are also independently activated by the actuator internal limit switch.

The control console is equipped with the following features (Fig. 2):

- Master on-off switch with indicator light
 - Grapple lock/unlock control with indicators
 - Grapple lock/unlock enable control
 - Tilt sensor readouts
 - Counter-balance weight position readouts
- Positioning controls for the counterbalance weights

Fig. 2: Adjustable Center of Gravity Lift Fixture Control Console

SYSTEM OPERATION

The ACG Lift Fixture is attached to the facility 5 ton overhead crane. The crane is moved directly above the lift fixture and the crane hook attaches to the shackle of the lift fixture at the hook assembly (Fig. 3). The electrical power control cables permanently attached to the lift fixture are connected to the portable control console's power outlet connection jack.

The 115 VAC 20 AMPS power supply cable from the facility is connected to the portable control console's power outlet connection jack.

Three previously inserted plastic shipping alignment tube guides are positioned into the slip sheets and the reinforcement pallet holes of the 14 drum payload. The guide tubes are used to position the lift leg receptacles into the pallet lift lugs.

The lift leg receptacles provide safe locking action in the event the actuators are accidentally actuated at the control console while the payload is in the lifted position.

By maneuvering the crane to the load pickup station the fixture is lowered into the 14 drum payload through the guide tubes until the receptacles of the three legs land and are inserted into the pallet lift lugs.

From the operator's console, the operator is required to operate two controls (one with each hand) to activate the lift leg lock/unlock operation. The lift lugs are rotated to the lock position by the three independent electrical actuators of the lift fixture. Three indicator lights will identify the engagement rotation of each of the three legs.

The load is lifted at this time not more than 1 inch above the floor and the tilt angle in two planes is monitored from the control console. The proper balancing/leveling correction is adjusted by actuating the garmotors to revolve the balancing weights in the same or opposite direction until the tilt angle in both planes indicates less than ± 0.5 degrees. The payload and pallet system is ready for further lifting and relocation outside the container at this time. Unloading is essentially the reverse operation of loading. For ICV handling, the lifting leg attachments shall still be used. For OCV lid lifting, the lifting legs shall be removed and replaced with the shorter lift legs, designed for lifting the OCV lid.

The relative position of the weights can also be monitored from the proper instrument on the panel. The performance of this function is as follows:

The radial movement of each balancing weight is being detected by two independent encoders attached to the garmotor pinion which transmit absolute electrical signals

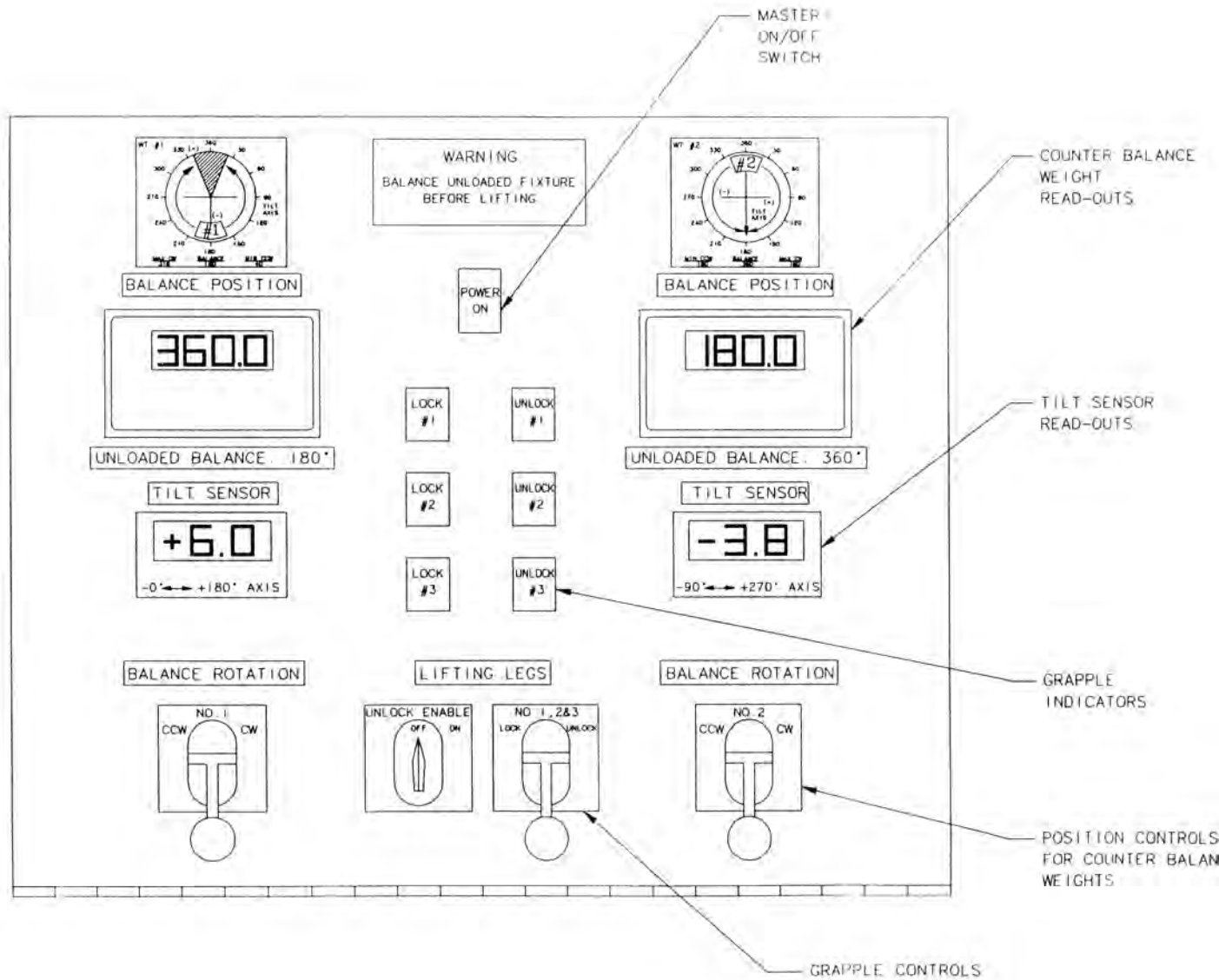


Fig. 2. Adjustable Center of Gravity Lift Fixture Control Console.

according to the angular position of the weights. The signal is then translated into the display angle on the instrument console. Fig. 3: Typical Handling Operation The ACG Lift Fixture provides a safe and efficient means of remotely lifting waste payloads. Additionally, the ACG Lift Fixture is equipped with an operator controlled center of gravity

compensating system which ensures that the payload is handled in a non-tilted position. This handling feature will prevent possible damage to the shipping container. Finally, the ACG Lift Fixture provides quick payload balancing, avoiding costly and tedious payload container weight management.

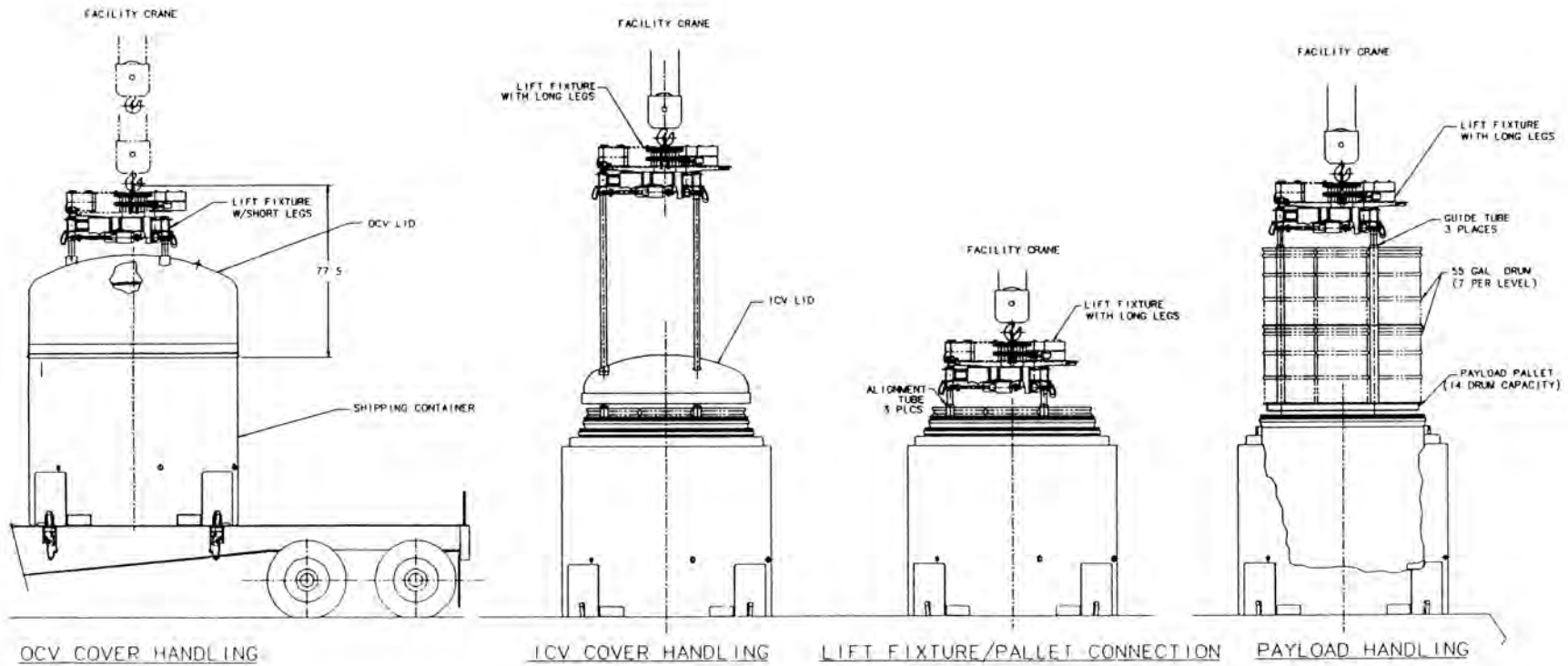


Fig. 3. Typical Handling Operation.