LOCKHEED MARTIN

VOL. 26, NO. 4, October - December 1999

Service News

A SERVICE PUBLICATION OF LOCKHEED MARTIN AERONAUTICAL SYSTEMS SUPPORT COMPANY

Contents

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SYSTEMS SUPPORT COMPANY

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Focal Point

Committed to Customer Satisfaction

The C-130J will become operational with both the United Kingdom's Royal Air Force and the Royal Australian Air Force by the end of 1999. We are excited to see what we believe is the world's best airlifter begin its operational life. We are confident that the C-130J will significantly raise the standard by which airlifters are judged.

At Lockheed Martin, we are more committed than ever to our customers' operational success and our support role in achieving that goal with them. We have undertaken several initiatives to ensure that Hercules operators, including our new C-130J operators, will continue to experience an increasing level of support from us. As our customer, you have told us that support is very important. More than ever before, we are listening to you and structuring our business to be more responsive to your needs.

Gene Elmore

One of the areas in which we are striving for a higher degree of customer satisfaction with our new C-130J operators is aircraft deliveries. In an effort to streamline the delivery process and improve quality, we have a dedicated Delivery Team working on the Royal Air Force program. Before each airplane is delivered to the customer, it is thoroughly inspected by the Delivery Team and a functional check flight is performed by a Lockheed Martin flight crew. All discrepancies found by the Delivery Team are corrected before the customer performs the acceptance inspection. The Delivery Team works directly with the customer throughout the acceptance inspection to rapidly resolve discrepancies, obtain parts, answer questions, and provide any other assistance needed by the customer. By using the Delivery Team concept, we were able to deliver S/S 5478 to the United Kingdom's Defense Evaluation and Research Agency with only three minor discrepancies.

A team of engineers accompanied the recent delivery to the Royal Australian Air Force of their first C-130J to ensure a smooth transition. A team of Field Service Representatives is providing maintenance support to the U.S Air Force Operational Test & Evaluation effort at Edwards Air Force Base.

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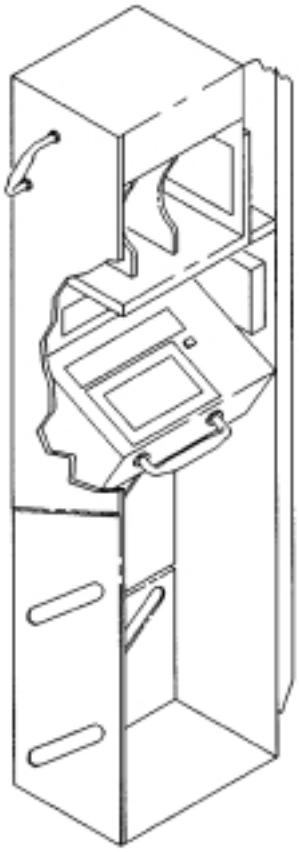
Front Cover: Royal Australian Air Force C-130 photographed by LACW Tricia Wiles, 86 Wing.
Back Cover: Royal Air Force C-130. Official Royal Air Force photograph.

Enhanced Cargo Handling System

by
Steven Judd
Lockheed Martin Aeronautical Systems
Flying Operations

Cargo handling - the lifeblood of a tactical airlift aircraft. The ability to quickly and safely handle cargo on the ground and to deliver airdrop platforms accurately and reliably is a necessity to Hercules crews. The Enhanced Cargo Handling System (ECHS) represents the first major improvement to the cargo compartment of the C-130/Hercules aircraft since the Brooks and Perkins dual rail system. The system represents substantial strides forward in the areas of airdrop accuracy, crew efficiency, and overall safety. This is accomplished through the use of a combination of new features and components that are detailed in this article.



The first part of the article examines the new components and how each one of them operates. The component descriptions are loosely arranged as they would be encountered as a person walks aft through the cargo compartment. The latter part of the article takes a close look at how the system works together to accomplish the various tasks necessary of any cargo handling system. These modes are presented in the same order as they appear across the top of the MENU page of the Multi Function Control Display.

MFCD & RECP

The primary loadmaster position is just forward of Fuselage Station (FS) 245 in the space previously occupied by the closet. The Multi Functional Control Display (MFCD) and the Ramp and Emergency Control Panel (RECP) are located at this position. The displays and controls face outboard. In addition to these two controls, the position includes a light and publication storage bins. The parachute initiation device (PID) manual release T-handle has been relocated within easy reach of the loadmaster position on the aft portion of the 245 bulkhead. Mechanical circuit breakers for the ECHS are located at the primary loadmaster station at the 245 bulkhead.

The MFCD provides all primary control and system status display for the ECHS. It is a full color, landscape

Left: The primary loadmaster position is in the location previously occupied by the closet just forward of the 245 bulkhead.
Bottom: The RECP is located just above the MFCD.

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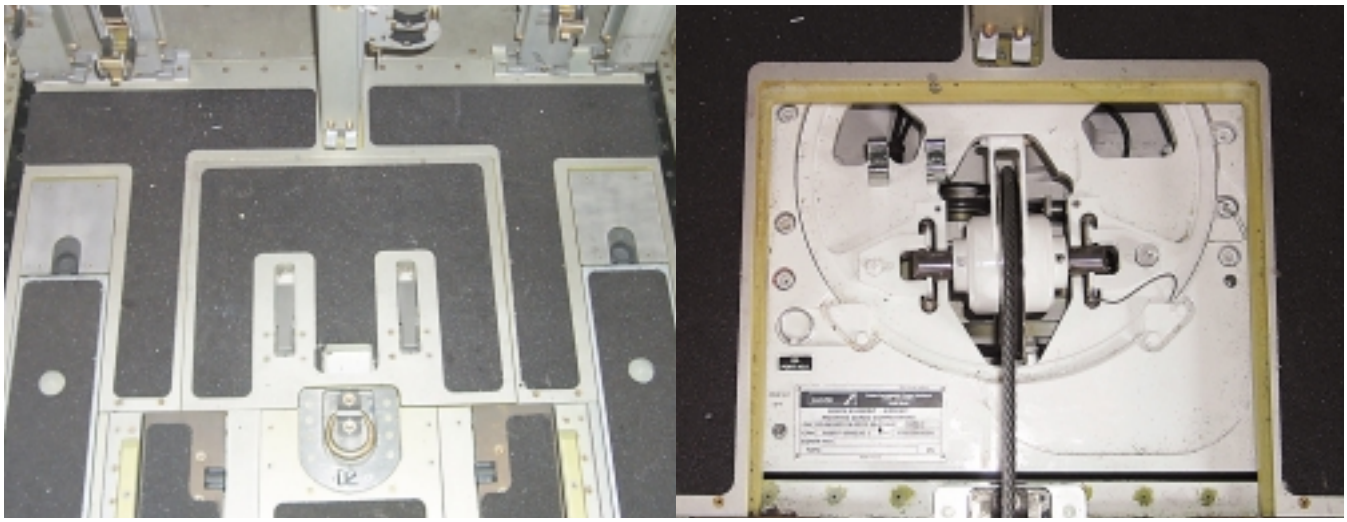

Left: The cargo winch is located under a cover plate in the forward cargo area.
Right: The cargo winch is shown in the deployed state.

orientation display that is fully readable in direct sunlight as well as Night Vision Imaging System (NVIS) compatible. The display has been specifically designed to be readable and useable in the low altitude environment of airdrop operations. The various modes of operation of the MFCD will be detailed later in this article.

The MFCD generates Caution, Advisory, and Warning System (CAWS) messages to alert the load crew of system failures and malfunctions. The system is designed so that the operator will be able to view the CAWS text concurrently with the cargo compartment graphic, giving clear system status assessment. All message text is generated by the MFCD software for display in the CAWS message areas. Selected messages will also provide "enables" for the master Advisory, Caution, and Warning System (ACAWS) message generation on the flight station. Messages are color coded to match the relative priority level. Advisories are displayed in green, cautions in yellow, and warnings in red. When a message becomes active, the alert is initially displayed and remains in inverse video, which varies with the color of the text. If more than one message has become active since the last CAWS selection, the most current will be at the top of the list, prioritized first by category (warning, caution, then advisory) and then within the categories. When the CAWS option select button is depressed, the CAWS page is displayed with the lower message area showing the CAWS messages. The CAWS messages are overlaid below the cargo compartment graphic.

The RECP is located directly above the MFCD. The RAMP/DOOR switch at the loadmaster position is available for use any time the flight station RAMP/DOOR switch on the Aerial Delivery Control Panel is in the OFF position and the aircraft is airborne. The loadmaster's RAMP/DOOR switch may be made operational on the ground if the weight on wheels switch is overridden by a selection from the Flight Station Avionics Management Unit. If the aircraft is pressurized and an attempt is made to open the ramp/door, a Flight Station ACAWS message will be generated and a CAWS message will be displayed on the MFCD alerting the operator that the aircraft is pressurized. If the toggle switch is held to the OPEN position for eight seconds, the ramp/door will open. During airdrops, the loadmaster is now the primary flight crewmember responsible for operation of the

Left: The control pendant for the cargo winch stowed in the forward cargo compartment.
Right: Up close photo of the control pendant

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Above and Right: The rollers are easily deployed by releasing the catch and then turning them over.

ramp/door. This conveniently located switch enables the loadmaster to accomplish this job in the safest manner possible. The logic for the cargo ramp/door operation resides in the Mission Computer (MC). The MFCD receives ramp/door command information via discrete inputs from the RECP. The MFCD then passes these commands to the MC via the MIL-STD-1553 data bus. The ramp and door design incorporated on the U.S. Government version of the C-130J allows operation at speeds up to 250 knots.

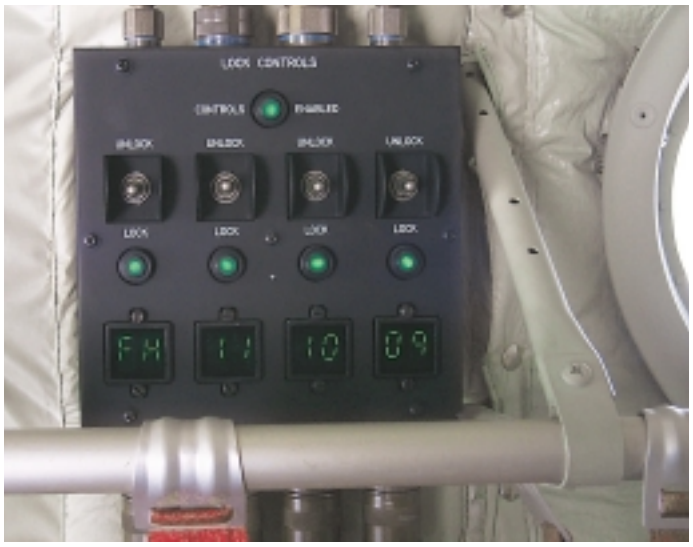
The contingency or alternate controls available on the RECP are Cargo Jettison, Towplate Release, Electric Lock Arming/Locking/Unlocking, Drogue Jettison, and Airdrop Hold. With the exception of the ramp/door operations, the RECP is used only for abnormal or emergency situations and/or during the failure of the MFCD, the MIL-STD-1553 data bus, or a power failure. Under normal circumstances, all of the previously mentioned systems are controlled by the MFCD.

Winch

The winch on the C-130J ECHS has been greatly improved over previous models. The winch is located between FS 257 and FS 277 and is embedded in the floor under a cover plate. With this system, the winch is always available, yet it does not take up valuable cargo space. The winch includes provisions for inspection of its lubrication level while installed. The components of the winch system are a control pendant, power cables, winch cable, sheave assembly, and a motor assembly.

The control pendant is a hand held unit that is connected to the aircraft with either an 8-foot coiled cable that extends to 24 feet or a straight, non-coiled 60-foot cable. The control pendant contains WINCH ON/OFF and HI/LO switches and a variable displacement REEL IN/OUT thumbwheel. The HI/LO switch selects the high speed (40 feet per minute) or low speed (20 feet per minute) rate of reel out or reel in. The thumbwheel is spring loaded to the center (OFF) position and can be rotated 36 degrees to either side of

In this photo, the aft portion of the cargo compartment is configured with rollers and center vertical restraints.



The Pallet Lock Control Units are strategically located in the cargo compartment.

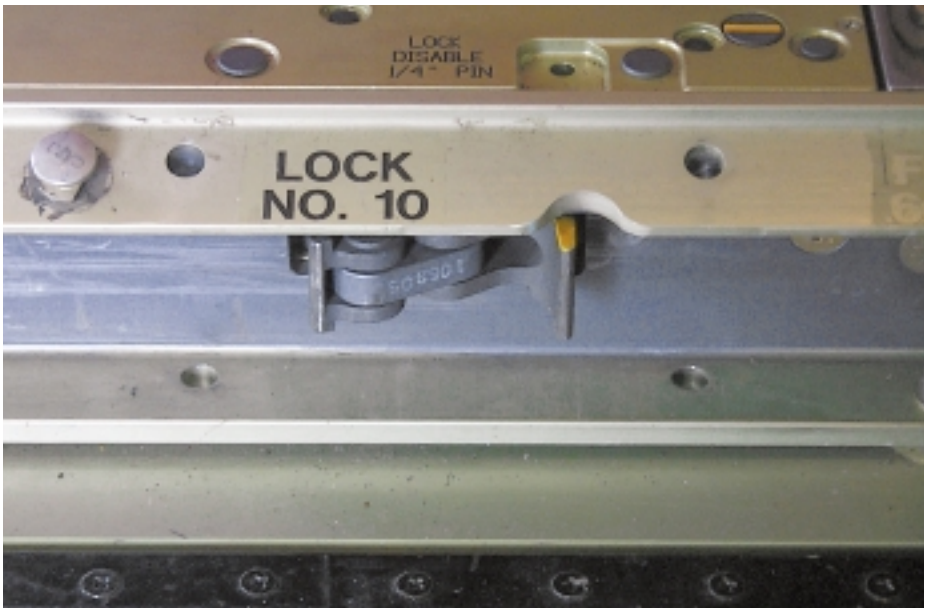
center. The control pendant also contains POWER ON and OVERTEMP indicator lights. The design of the control pendant allows very precise control of the winch. The control pendant can be installed at either a forward or aft position in the cargo compartment.

The winch assembly consists of cable travel limit switch, automatic load brake, cable storage drum and level wind assembly, cable traction system, traction drums, cable and hook assembly, sheave assembly, motor assembly, and gear train system. The winch is driven by four stages of spur reduction gears mounted on ball or roller bearings. The load tends to rotate the output shaft faster than the input shaft which causes the brake cams to increase the axial force on the brake disks. The brake will stop up to a 6,500 pound load (without slippage) within 10 linear feet of travel.

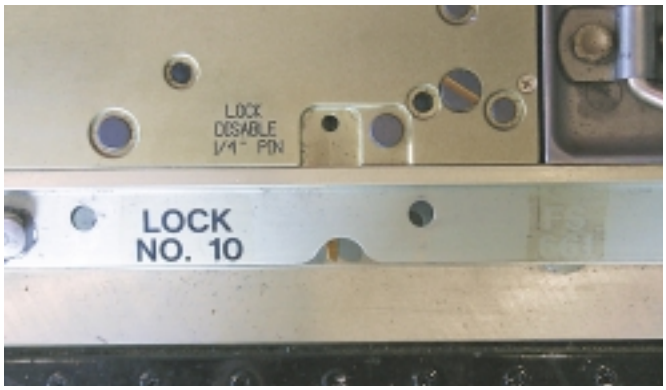
The motor assembly is a 270 VDC brushless motor. The design utilizes a conventional three phase induction motor stator and high energy magnets on the rotor. No brushes are required for this design since commutation is provided by the electronics. The dual traction drum drive system is utilized to provide a constant pull on the cable, regardless of how much cable is deployed.

The cable storage drums utilize a rebus form for the drum grooves with a riser from core layer to second layer and from second layer to third layer. The storage drum rotates and translates simultaneously using a ball spline and level screw system ensuring even layering of the cable on the storage drum. The storage drum will accept up to 200 feet of cable; C-130J aircraft have 150 feet of cable installed at the factory. A multi-disk slip clutch is integrated into the storage drum drive system. The slip clutch will produce a minimum back tension of 250 pounds, which is sufficient to prevent slippage of the cable on the traction drums.

The cable is dispersed from a single payout over a 6 inch diameter sheave that will swivel to deploy the cable horizontally in any direction for a full 360 degrees. The sheave is mounted to a turntable; a friction device holds the sheave at a selected heading. The



Above: A close view of an electronic lock in the locked position.
Below: There are eight vertical restraints located in the aft cargo area and sixteen on the ramp.



Top view of an electric lock.

In addition to the standard manual tool, a long reach tool is provided for manual actuation of the locks when the cargo compartment is full.

cable is 3/8 inch in diameter, has a breaking strength of 14,400 pounds, and is 150 feet in length (per MIL-C-1511). The hook incorporates a safety latch to prevent the load from becoming detached during loading/unloading operations.

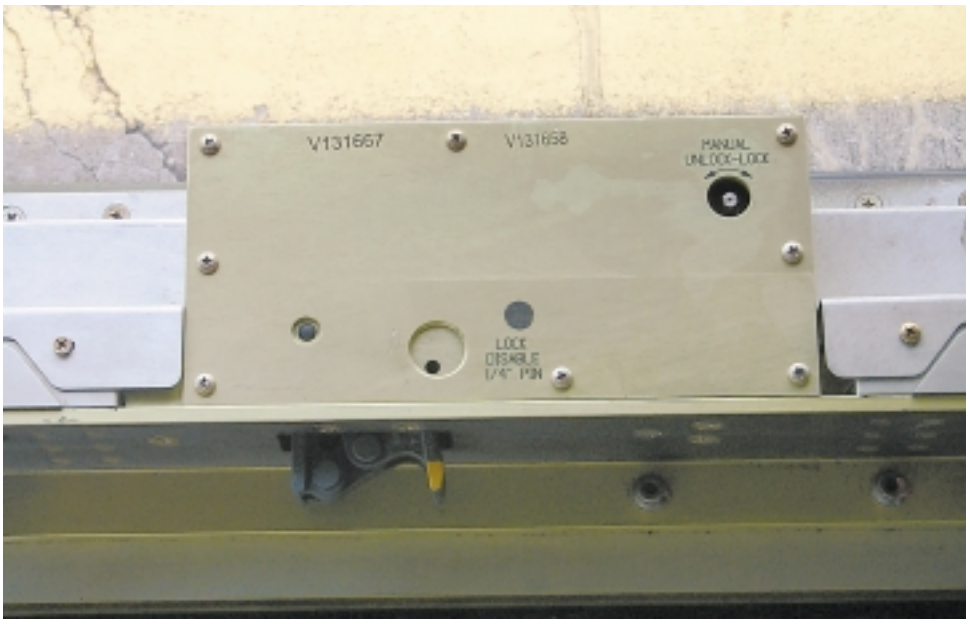
Low Profile Dual Rail System

The Low Profile Rail System consists of the following items: 24 Electric Locks, 24 Vertical Flanges, 7 Pallet Lock Control Units, Side Rails, Reversible Beveled Rollers, and 2 Pallet Stops.

There are 11 pairs of Electric Locks (ELs) that are located in the cargo compartment. A pair consists of a left hand EL and a right hand EL. The ELs can be controlled four different ways: the MFCD, the Pallet Lock Control Units (PLCUs), the RECP, and manually. The purpose of the ELs is to secure pallets or platforms during transport or airlift operations and electrically release selected platforms for airdrop missions. The 11 EL pairs have five different conditions: locked, unlocked, armed, in transit, and bypassed. The state of each individual lock is reported to the MFCD via the PLCU over the MIL-STD-1553 data bus. The ELs provide 26,900 pounds of forward restraint, 6,750 pounds of aft restraint in the locked position, and 3,350 pounds of aft restraint in the armed position. Each lock has two actuators, one that is used to lock and unlock the device and another that is used to remove a blocker which brings the device from a locked to an armed condition. The armed condition (locked and blocker removed) must be transited before a lock may be unlocked. When an EL is in the armed condition, piezoelectric sensors detect the aft force that is being exerted. At a predetermined force, the EL will electrically release the platform for airdrop, provided that a minimum predetermined force has been achieved. As a safety precaution, each lock is also designed to "duck-out" and release the airdrop platform if the force being applied to the EL exceeds the design parameters of the EL (approximately 3,500 pounds) and the lock has not electrically released. This is to prevent hung loads or structural failure of the aircraft. The mechanical "duck-out" feature is not available with the blocker in place.

There is one pair of ELs located on the ramp. The ramp ELs are used for logistics transport only and have a single actuator. They are controlled and monitored in the same manner as the cargo compartment locks. Since

Top view of an electric lock located on the ramp.



they are for logistics transport only, the ramp ELs do not arm, sense aft load, or "duck-out."

The purpose of the vertical restraints is to positively secure loads in the aft cargo and ramp areas where vertical restraint is not provided by the low profile rails. Improved vertical restraints for the C-130J have the capability to retract if contacted by a platform moving aft. There are eight restraints on the cargo floor located behind the aft most cargo EL (four on each side) and sixteen aft of the ramp hinge (eight on each side) for a total of twenty-four. Cargo floor restraints operate together via the MIL-STD-1553 data bus and may be actuated from either the associated PLCU or the MFCD. The same is also true for the ramp restraints. In contingency situations, the restraints are opened electrically in concert with arming the aft ELs from the RECP. The restraints are ganged into four groups, each group with its own actuator.

The Center Vertical Restraints are easily deployed as shown above.

The Pallet Lock Control Units (PLCUs) are remote terminals (RTs) on the 1553 data bus and are used to provide drive commands to the ELs, vertical restraints, and Towplate. They also monitor the status of these devices and transmit this data back to the MFCD over the bus. The PLCU also allows the load crew to operate the ELs and vertical restraints locally without the need to return to the loadmaster position until onload/offload is complete. There are seven PLCUs in the forward, mid, and aft cargo areas to provide for easy access. This feature of the ECHS represents a major safety and efficiency improvement from previous systems. The loadmaster can now directly monitor the loading crew throughout the onload/offload process.

One of the greatest time saving features of the ECHS is the reversible rollers. The system contains 32 permanently installed/stowed roller sections. There are 24 floor sections, 8 ramp roller sections, and 4 Container Delivery System (CDS) auxiliary rollers. The rollers offer the advantage of rapid configuration and convenient storage since they are stowed and deployed in the same location. During the time trial testing at Edwards Air Force Base, Lockheed Martin loadmasters were able to change from slick to roller configuration in approximately three minutes (one person working). The rollers are of a low profile design and offer an additional inch of clearance for cargo over the previous versions. They are also beveled for better item tracking.

CDS Center Vertical Restraint Rails

Another feature that greatly adds to the functionality of the new ECHS is the CDS Center Vertical Restraint Rails (CVRs). These CVRs are located in the main cargo floor at Butt Line 6 Left and Right. There are a total of 12 sections (6 left and 6 right). The rail sections are manually operated and flush mount in the floor when not in use. They are spring loaded to the stowed/deployed positions and have mechanical latches to secure them in stowed/deployed positions.

The CVRs provide 2g vertical and lateral restraint for A-22 containers. The restraints accommodate CDS skid board dimensions of 48x48 inch, 48x96 inch, and 48x53.5 inch (turned 90 degrees). CVRs must be deployed sequentially from aft to forward. Personnel can deploy only the required sections allowing for the installation of a buffer stop assembly forward and flexible use of floor space forward of the CDS (with no CVR channel) for cargo pallets, airdrop platforms, or general loaded cargo.

Towplate

The imbedded Towplate is utilized during Heavy Equipment airdrops to tow a drogue parachute behind the aircraft in order to provide positive extraction at the Computed Air Release Point (CARP). The drogue parachute is installed in the Parachute Initiation Device (PID) with the drogue line attached to the drogue link portion of the towlink. The other side of the towlink is attached to the extraction parachute bridle. The towlink is locked in the Towplate until "Green Light" when an

electrical signal is sent to the Towplate to release the towlink. This initiates a force transfer to the extraction system that extracts the airdrop load. The towlink is a two-piece link to accommodate Drogue Jettison in case of a parachute malfunction or "no-drop." Jettison is accomplished by electrically releasing the drogue link portion of the towlink, leaving the remainder of the towlink locked in the Towplate, thus preventing force transfer and leaving the heavy equipment load in the aircraft. After a drogue jettison, another drogue parachute may be installed in the PID and the airdrop continued.

The Towplate assembly is located on the aircraft cargo ramp between tie down rings D-28 and D-29. The Towplate is mounted flush with the cargo ramp floor and protected by a cover plate. The cargo handling system provides power and control for primary release, backup release, and drogue jettison. An electrical actuator is used for the primary release of the towlink. A second, identical "hard-wired" actuator is provided for backup release of the towlink. Emergency controls for the Towplate are located on the RECP. The two hard-wired, guarded Towplate switches are the Drogue Jettison switch and the Towlink Release switch. These two switches, since they are hard-wired directly to the Towplate, do not require the support of the MFCD to operate.

MFCD Modes

The next part of this article will focus on the various modes available to the loadmaster at the MFCD.

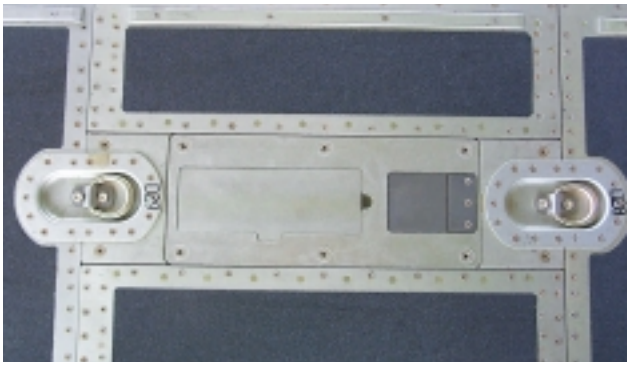
MENU

The MENU page displays the cargo compartment graphic as well as any CAWS messages that are appropriate. Pressing any of the assigned Option Select Buttons (OSBs) will drive the screen to the relevant page. The MENU page allows access to most other pages in the MFCD. In addition, the page displays the current ECHS status. It is anticipated that this page will be displayed any time the MFCD is not being used.

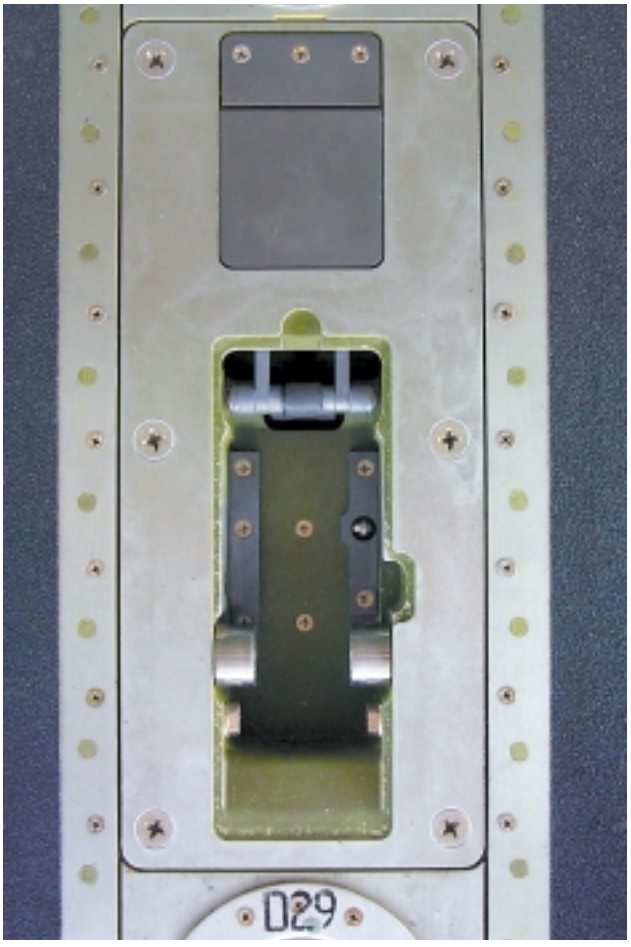
ONLOAD

To prepare the cargo compartment for onloading, all ELs and vertical restraints aft of any currently loaded pallets should be unlocked (for the purpose of onloading, individual locks and vertical restraints are treated in the same manner). The PLCUs can be enabled from the PLCU sub-menu on the LOCK CONTROL page. This will allow the load crew to control the ELs locally using the PLCUs located at seven different sidewall stations in the cargo compartment. After the ELs and vertical restraints have been unlocked, normal onload procedures have the load crew load all cargo scheduled for that mission, securing each pallet at the local PLCU. This allows the loadmaster to secure all cargo quickly and safely in the cargo compartment without leaving pallets unsecured by returning to the MFCD. After all the cargo has been loaded, the loadmaster will return to the loadmaster position.

In order for later operations to be performed on specif-



Above: The Towplate is located beneath a cover plate on the ramp.
Below: The Towplate with the cover removed.



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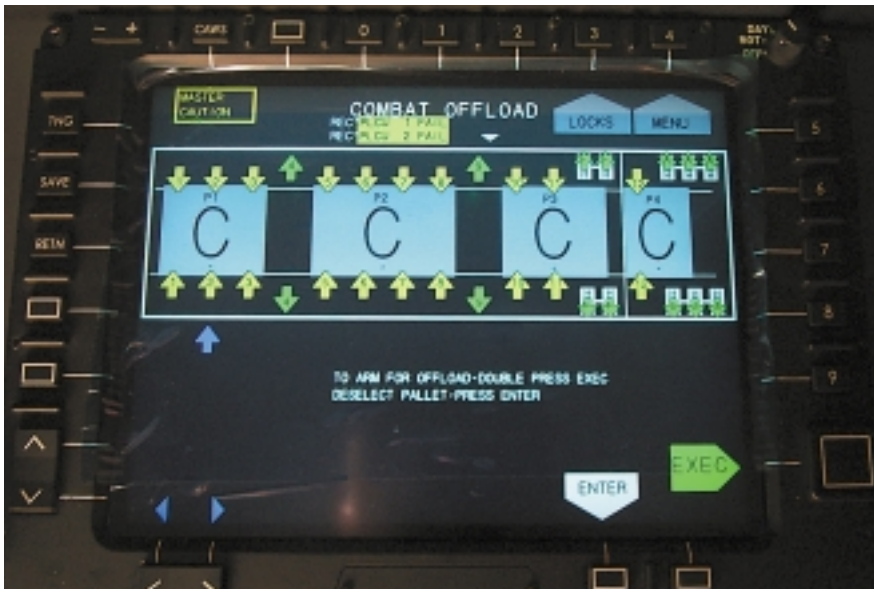

The Combat Offload page as displayed on the MFCD.

ic pallets within the aircraft, the loadmaster will assign pairs of ELs to individual pallets. This enables the loadmaster to perform operations (such as offload, combat offload, jettison, airdrop) on a single pallet or group of pallets depending on mission requirements or emergency procedures. This is accomplished by selecting the ONLOAD page from the MFCD MENU page.

Once the ONLOAD page is displayed, the MFCD prompts the loadmaster to assign the first and last lock positions to individual pallets. Once the information for all of the pallets has been entered and executed, the ONLOAD page may be exited. If it becomes necessary to exit the ONLOAD page prior to all of the information being entered, the ONLOAD page will retain information on the pallets that have been completely entered. The locks must be selected in ascending order (front to rear) when assigning ELs to pallets or platforms. To correct an error or make a change after programming is complete, simply return to the ONLOAD page and make the changes. A pallet may never be programmed to extend from the cargo floor to the ramp.

OFFLOAD

During normal logistical offloads, the load crew will unlock the ELs and vertical restraints using the PLCUs. They may be operated locally at the PLCUs, provided the PLCUs have been enabled from the LOCK CONTROL page. After an offload using this procedure is complete, the loadmaster will return to the loadmaster position and select the pallets that have been offloaded by using the OFFLOAD page on the MFCD.

COMBAT OFFLOAD

The ECHS has the capability of offloading single, multiple or married pallets, and airdrop platforms without the use of material handling equipment. Any number of pallets may be offloaded at a given time with combat offloading procedures. During developmental testing at Edwards Air Force Base, Lockheed Martin flight crews successfully combat offloaded six pallets from a C-130J with a nosewheel start to nosewheel stop distance of only 146 feet.

When the COMBAT OFFLOAD page is selected, the display directs the loadmaster to select the pallet or pallets to be offloaded. Pallets to be combat offloaded are selected beginning with the aft most pallet. After a pallet is selected, a large “C” appears on the pallet. At the appropriate time, the system is armed for combat

The Airdrop Program page as displayed on the MFCD.

The Airdrop page as displayed on the MFCD.

offload causing the following items to occur:

1. All ELs and vertical restraints aft of the aft most pallet will unlock.

2. All ELs between pallets to be offloaded will unlock.

3. All ELs actively engaged in pallets to be combat offloaded will be armed unless the pallet is on the ramp, in which case the the ramp ELs remain locked until offload is actually executed.

(**Note:** The ECHS allows combat offload of the pallet that is located on the ramp.)

If any EL or vertical restraint fails to unlock, the pallets designated for combat offload will not arm. Any bypassed ELs must be positioned correctly via the LOCK CONTROL page or manually, and pinned. After the ARM command is given, all affected ELs and vertical restraints have three seconds to reach their commanded state (at which time the lock actuators will discontinue driving to prevent motor burnout). If an EL or vertical restraint has not reached its commanded state within three seconds, an appropriate CAWS message will occur. After three seconds, the ECHS inhibits the combat offload pallets to be armed if any of the locks have not reached their commanded state.

When these conditions are met, the loadmaster is given the option to begin combat offload. When the command to begin combat offload is given, the MFCD will command the release of the aft most selected pallet. As soon as the ELs in the aft most pallet are released, the set of ELs assigned to the next aft most pallet will be commanded to release. This continues until all pallets selected for combat offloading have been released. All non-selected pallets remain locked throughout the combat offloading procedure. In the event the offloading must be discontinued, the loadmaster may select LOCK ALL LOCKS on the RECP. This will lock all ELs and vertical restraints and capture any pallets that have not exited the aircraft.

AIRDROP PROGRAM

After the pallets have been assigned to ELs (the terms pallet and platform are interchangeable for the purposes of this article), the MFCD may be programmed for airdrop. The programming may be completed at any

The Jettison page as displayed on the MFCD.

time during ground or air operations. The ECHS allows the loadmaster to program for Low Velocity Airdrop (LVAD), and training (SATB) drops.

Once a platform has been selected to be be programmed for airdrop, a program pop up screen is displayed. The following information is entered into the airdrop program pop up screen for each of the platforms to be airdropped:

1. EXTRACTION CHUTE SIZE - Extraction parachute size can either be one of the preprogrammed sizes (15, 22, 28, 2/28, 3/28) or a user entered size.

2. TOWPLATE - This is a Yes/No option with No being the default. If a sequential airdrop is planned, only the aft platform will be annotated with the TOWPLATE information.

3. SEQUENTIAL - This is another Yes/No option with No being the default.

4. WEIGHT - Weight of the platform.

5. AIRSPEED - A numeric value for the airspeed may be entered here, or it may be left blank. If no numeric value is entered, then AUTO will be displayed for airspeed, indicating that the MFCD will use the airspeed data from the Mission Computer.

As the situation dictates, the AIRDROP PROGRAM page may be exited by returning to either the MENU page or the LOCK CONTROL page. The ECHS will not allow selection of the platform on the AIRDROP page until appropriate onload programming for that platform is complete. All platforms need not be programmed prior to the airdrop, but the aft most platform (including any platforms to be dropped sequentially with it) must be completely programmed for the airdrop to take place. Subsequent platforms may be programmed any time prior to execution of the airdrop pass that is associated with those platforms.

AIRDROP

After the platforms have been programmed for airdrop on the AIRDROP PROGRAM page, they may be selected for airdrop. Once the AIRDROP page is displayed, the appropriate airdrop scenario may be selected. The following sections will address each specific scenario; however, a discussion of EL design and operations as it pertains to airdrop accuracy and safety will be of great help in understanding the ECHS airdrop mission goals.

EL DESIGN IN THE AIRDROP SCENARIO

As previously discussed, each EL has an internal piezoelectric load sensor capable of detecting an applied load in the aft direction. During the ONLOAD page programming, pairs of ELs are assigned to individual platforms, enabling specific control of each platform for the purposes of onload, offload, jettison, and airdrop. For the purpose of this discussion, assume that an airdrop platform has been assigned to EL pairs 8 & 9. Four individual ELs are now engaged in this platform. When a given load is applied to the platform from an extraction parachute, the loads are transferred to the MFCD and the four EL loads are summed to obtain total parachute force. Based on ballistics programmed into the MFCD and data the loadmaster inputs on the AIRDROP PROGRAM page, the ELs will release the platform at a given force. If an EL is inoperative and has been bypassed or simply unlocked from the LOCK CONTROL page, the other ELs assigned to the platform will sum the forces and still attain increased precision over mechanical systems. The ELs also have the capability to “duck-out” at a predetermined force if the EL for some reason does not release electrically, provided the EL is in the ARM position. This design feature will eliminate the possibility of a hung load due to an EL or MFCD failure. Control of the ELs from the RECP is also possible for airdrop, but not recommended during normal airdrop missions. Control of the ELs from the RECP does not provide a summing of forces for electric release, so only the “duck-out” feature is available in this situation.

HEAVY EQUIPMENT (TOWPLATE)

The information concerning the use of the Towplate during an airdrop is entered in the AIRDROP PROGRAM page. Based on the information entered in that page, the MFCD will treat the airdrop as a Towplate drop and the logic will proceed as such. This may be changed only by returning to the AIRDROP PROGRAMM page and changing the data.

When the AIRDROP page is selected, the cargo compartment graphic is displayed. Once the CNI-SP CARP countdown starts, the MFCD will display, on the AIRDROP page, the time to go in a box labeled CARP COUNTDOWN. When the CARP COUNTDOWN reaches green light, the graphic showing the CARP COUNTDOWN is removed from the page.

The MFCD automatically selects the aft most platform (or platforms for sequential platforms) and the loadmaster is given the option to arm the airdrop. When this

option is given, all of the affected ELs will be displayed on the cargo compartment graphic in yellow. For the system to arm for airdrop, the following conditions must be met:

1. All ELs aft of the airdrop platform are unlocked or bypassed.

2. All vertical restraints are unlocked.

3. All ELs associated with the platforms to be airdropped are either armed, unlocked, or bypassed.

4. A successful self test has been completed for the PID, Towplate, and associated software.

5. All required platforms have been successfully programmed.

6. The AIRDROP HOLD switch on the RECP must be in the OFF position.

If the AIRDROP HOLD switch on the RECP has been placed in HOLD, the word "HOLD" will be displayed above and below the Towplate icon on the cargo compartment graphic. All associated platforms, ELs, vertical restraints, and the Towplate will be green when arming occurs. All ELs and vertical restraints aft of the platform(s) are now depicted as being clear of the side rails. These design features allow for a quick scan to determine system status during increasing crew workload.

At this time, the system is waiting for the command to commence the airdrop. The command to commence may come from three different sources:

1. The Mission Computer "green light" command during an autodrop.

2. Flight Station activation of the CHUTE RELEASE and JUMP (green light) buttons respectively.

3. Loadmaster position activation of the manual release T handle to release drogue parachute and release of Towplate via the RECP.

Once the command to commence the airdrop is given, the PID is activated and "DROGUE RELEASED" appears on the MFCD. At green light, the Towplate is released, the message "TOWLINK RELEASED" is displayed on the MFCD, and Towplate icon disappears from the display.

HEAVY EQUIPMENT (NO TOWPLATE)

As with the Towplate drop, a "no Towplate" drop is not an option on the AIRDROP page, rather it is a default based upon the information entered in the AIRDROP PROGRAM page. A "no Towplate" drop is very similar to a Towplate drop except that once the command to commence the airdrop is given, the extraction parachute is deployed and the platform is released.

Training

The ECHS training program is a state-of-the-art interactive system, allowing training to take place on the ground as well as in the air. The training program may be selected from the MENU page while accessing the ONLOAD page.

The training system behaves in exactly the same manner as an actual airdrop or logistical mission, except for the color of platform when armed for airdrop. Onload, offload, jettison, airdrop program, and airdrop can all be accomplished using "ghost" pallets/platforms (ghost pallets/platforms do not really exist). The ghost pallets/platforms can be easily distinguished from actual platforms by their color and the annotation of "TNG" at the bottom of the platform. Training platforms may also be intermixed with actual platforms. For instance, an aircrew may elect to make two practice drops over a drop zone prior to the actual drop.

The MFCD will simulate a load force on the ELs during the airdrop sequence to get the ELs to release in the same way as an actual drop. The PID, Towplate, ELs, and vertical restraints will all actuate as required for a given airdrop scenario.

Contingency Airdrops

The capability exists for accomplishing an airdrop after a partial or total failure of the ECHS. A contingency airdrop would consist of a manual release of the drogue parachute, a release of the towlink using the TOWPLATE RELEASE switch on the RECP (if applicable), and a mechanical duck-out of the appropriate ELs after they have been armed electrically with the RECP JETTISON switches or manually at the lock. Although not as precise as the release with a fully operating ECHS, the contingency airdrop procedure will yield roughly the same accuracy as the system operating on earlier model C-130 aircraft.

Jettison

In the event of an inflight emergency, it may become necessary to jettison pallets to increase the performance of the airplane, remove unsafe cargo, or to ensure a safe landing configuration.

The JETTISON page may be selected from the MENU page. As each pallet to be jettisoned is selected, a “J” will appear inside the pallet on the cargo compartment graphic. If all pallets are to be jettisoned, all may be selected at once. Selected pallets are then armed for jettison. Once the command to jettison is executed, the ELs will unlock in sequence, beginning with the aft most pallet to be jettisoned.

In the event the MFCD is inoperable, the RECP may be used to jettison cargo.

Lock Control

The LOCK CONTROL page allows the operator to lock, unlock, arm, or bypass an individual EL, pairs of ELs, EL pairs aft of programmed pallets, or all ELs and vertical restraints in the cargo compartment. The LOCK CONTROL page is used in normal operations to enable the PLCUs for onload and offload operations. The LOCK CONTROL page has priority over all other pages with the exception of the JETTISON page. Any inputs to the LOCK CONTROL page will have no effect on the operation of the RECP.

Lock Calibration

The LOCK CONTROL page also provides the function of lock calibration. Initial calibration of an EL may be accomplished during bench testing. Lock calibration is accomplished by placing a known force to a lock, reading the force, and assigning a corrected value to the lock, if necessary. Only one lock may be calibrated at a time, and the lock calibration function of the ECHS is only selectable during ground operations.

Summary

A design goal of the ECHS is to increase airdrop accuracy by controlling variables within the system that until now could not be controlled. In order to achieve airdrop accuracy, two conditions must be met:

1. Place the aircraft at a precise point (3 dimension), at the proper airspeed, and on the proper course.

2. Release the load precisely at that point.

The first design goal is addressed on the C-130J through a combination of increased navigational accuracy using the autopilot and Embedded GPS/INS and crew updates. Additionally, airdrop precision in adverse weather is accomplished with the use of the improved low power color radar featuring monopulse stabilized doppler beam sharpening. The ability to release the load at precisely the point is addressed by the ECHS. CARP computations are handled by the CNI-SP and take into account airspeed, mean effective wind, drop altitude, and parachute ballistics.

In addition to airdrop accuracy, safety and efficiency have both been greatly improved by the ECHS. Safety has been enhanced by the fact that the locks can now be controlled locally through the PLCUs, ensuring the loadmaster can remain with the load during the onload/offload process.

Efficiency has been enhanced in several areas. The reversible rollers cut the time to reconfigure the cargo compartment to just a few minutes. The CDS center vertical restraint rails reduce the time to configure the cargo compartment for CDS. The winch and Towplate are now stored in the floor beneath protective covers so that they are more accessible and easier to use. All of these features combine with the MFCD modes to form one of the most advanced, user friendly, and safe cargo handling systems ever installed in a transport aircraft.

❑

Long Pod APU Modification with ECS Systems Upgrade

by
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Lockheed Martin Aeronautical Systems incorporates many improvements into the baseline Hercules design which can be adapted for retrofit on in-service aircraft. One such modification, applicable to C-130B, E, and early H models, is the installation of an upgraded Auxiliary Power Unit (APU) and Environmental Control Systems (ECS). Lockheed Martin and Sogerma are teamed for this kit which helps reduce the cost and provides Lockheed Martin with a working partner in Europe.

This modification replaces the Gas Turbine Compressor/Air Turbine Motor (GTC/ATM) and 20 KVA generator. The new APU drives a 40 KVA generator that doubles the electrical power and is the same generator as installed on the main engines. Also, increased bleed air capacity is available for air conditioning during preflight ground operations. In addition to providing a more reliable APU that is identical to later C-130H production, the same is done to the ECS of both the flight deck and cargo compartment. The earlier C-130 aircraft, prior to Serial Number 4653, have different units installed in the flight deck and in the cargo compartment. With this modification, the new refrigeration units are the same at both locations and excess flight deck air conditioning capacity can be diverted to the cargo compartment, when required.

Some of the added benefits of this APU upgrade include:

- ◆ Inflight starts of the APU are possible with the new upgraded system.
- ◆ Commonality with the later model C-130H APU configuration.
- ◆ A single shaft gas turbine power section.
- ◆ Precise temperature control.
- ◆ Improved APU starting and operating response.
- ◆ More durable materials used in components which increases the service life of parts.
- ◆ Mean Time Between Failure (MTBF) is greatly improved.

The modification includes the structural modification to the main landing gear pods to increase their length 20 inches forward. This makes them identical in size and shape to the main landing gear pods installed on the later model C-130H aircraft.

This kit can be broken out to install the APU only. With this option, only the left main landing gear pod is modified. This results in a much less expensive kit that can be upgraded later to include the refrigeration as required. ❑

...continued from Focal Point

In addition to the efforts with the C-130J customers, we are also working with operators of older model Hercules aircraft to ensure seamless support. At this time, we are actively implementing changes to enhance this relationship. Through our use of these and other innovative concepts, we plan to continue our course toward higher quality and greater customer satisfaction.

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