LOCKHEED MARTIN

VOL. 27, NO. 1, January - March 2000

Service News

A SERVICE PUBLICATION OF LOCKHEED MARTIN AERONAUTICAL SYSTEMS SUPPORT COMPANY

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Service News
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LOCKHEED MARTIN AERONAUTICAL
SYSTEMS SUPPORT COMPANY

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Focal Point

Changing Times

Welcome to another issue of *Service News*. On behalf of everyone at Lockheed Martin, I would like to wish each of you a good and prosperous New Year. Many of you who are regular readers of this publication have been operating Hercules aircraft for decades. Stop for just a moment and remember what we used to think things would be like in the Year 2000. Thirty years ago, predictions for life in the Year 2000 contained wild images of frequent space travel and flying cars. As it turns out, many of the very same Hercules aircraft that were operational in 1970 are still the workhorses we rely upon today.


Jim Brandt

However, we cannot say that time has passed without major changes in technology. Computers have automated many of our everyday tasks and telecommunication advancements have made the world more accessible. New technology has also made possible the production of more powerful and fuel efficient engines. The C-130J is a good example of how technology has positively impacted the aircraft industry. Its glass cockpit and Mission Computer system would have seemed to be straight out of science fiction when many of you started flying the Hercules.

Changing times have also brought about changes in the way aircraft are operated. Over the years, average flight hours per year have risen and fallen and new aircraft missions have become operational. Some of the more unique Hercules missions have included the Commando Solo mission, the Fulton Recovery System, and the AC-130 Gunships to name a few.

...continued on Page 14

Front Cover: One of the new Maryland Air National Guard C-130J aircraft. Back Cover: A Royal Air Force C-130J aircraft at home in the United Kingdom. Front and Back Cover photographs by John Rossino.

Flight Instrumentation Test Set

by **Terri Lyde**
Senior Engineer
Electronic/Support Equipment

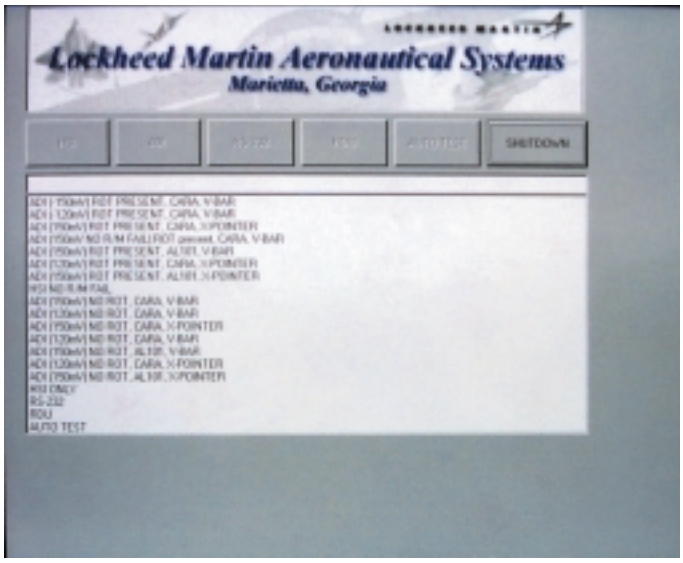
Cockpit instruments are such a vital part of flying. They display information such as speed, altitude, aircraft attitude, and the status of various systems on the plane. Other important instrument functions include displaying pertinent navigation information and radar data. Therefore, it is critical to keep these instruments in perfect operating condition.

To that end, Lockheed Martin's Electronic Support Department has created the Flight Instrumentation Test Set. This test set was designed to test the Electronic Flight Instrument (EFI) and Radar Display Unit (RDU) currently installed on many C-130 aircraft.

The EFI and RDU are line-replaceable units built by Avionics Display Corp. (ADC). The RDU displays radar information from the Low Power Color Radar System in the form of Red, Green, and Blue video inputs with RS-170 timing. The EFI encompasses the functionality of the old Horizontal Situation Indicator (HSI) and the Attitude Direction Indicator (ADI). With inputs from the flight director, radio altimeter, navigation systems, and the aircraft attitude sensors, this instrument displays the following information:

Photos this page: Lockheed Martin Field Service Representative John DeLion demonstrates the Flight Instrumentation Test Set to TSgt. Jeff Cornwell of the North Carolina Air National Guard.

Figure 1. EFI Test Software menu.



- Glideslope deviation
- Localizer deviation
- Speed deviation
- Rate of turn
- Heading
- Bearing
- Heading and course set
- True airspeed
- Groundspeed
- Distance to go
- Static air temperature
- Radar altimeter
- Pitch and roll commands and attitudes
- System status information in the form of flags

The Flight Instrumentation Test Set has been designed to test the functionality of the EFI and RDU. Driven by user inputs for a graphical user interface, it simulates every input required of these units. Housed in a rugged, transportable case, the unit is easily transported to the repair shop or flight line where it is used to diagnose problems with the EFI and RDU.

The test set includes a display unit and a base unit. The display unit connects to the base unit, sending communication signals over a RS232 port and receiving power from the base unit. A hand-held mouse connects to the display and allows the user to make selections from the screen. The display unit is run by a 133 MHz Pentium processor running the Win95 operating system, and uses a solid state disk drive to store the necessary software. The base unit operates with a 100 MHz 486DX4 processor in a PC/104 form factor, and it connects to other PC/104 input/output and signal processing cards. Two additional circuit boards are used to complete the necessary signals needed.

Figure 2. HSI Test Screen.

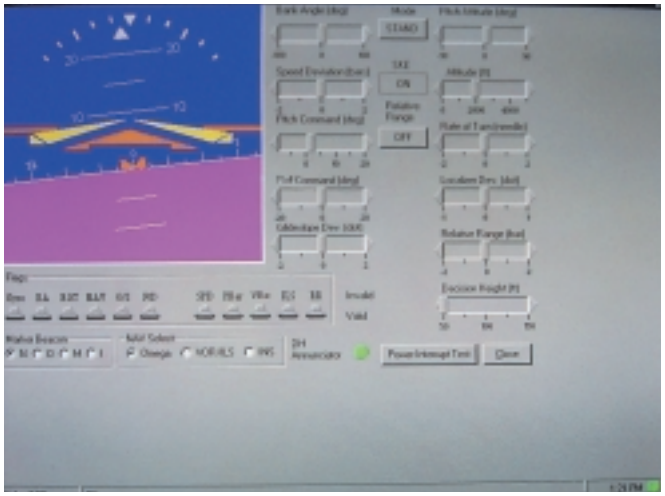


Figure 3. ADI Test Screen.

The user can choose one of two ways to test the EFI unit. The unit can be tested by stimulating all of the inputs individually and watching for the correct response or by running an automatic test. For the individual test, there are sixteen different ways in which the EFI unit can be configured, two of which are for an HSI and fourteen of which are for an ADI. These configurations are dependent on the aircraft version number. The user can also test the RS232 communication

Figure 4. Auto Test Screen

lines of the EFI for reversionary mode operation, and can do a power interrupt test which turns off the 28 V power supply to the EFI for approximately 50 milliseconds. This test allows the user to verify that the EFI continues to operate for power supply outages that last less than 50 milliseconds.

When power is applied to the test set, the computers boot up and the EFI test software is started. The user is presented with a menu of choices as shown in Figure 1. Options exist to test the RDU, to test the EFI's reversionary RS232 mode, to run the automatic test, and to test the ADI and HSI functions individually.

To test the ADI or HSI functionality, the user chooses one of the configurations listed on the menu. Once a configuration has been chosen from the menu, the ADI or HSI test screen will appear as shown in Figures 2 and 3. The user interface includes ADI and HSI controls to mimic the HSI and the ADI. Approximately 90% of the functionality has been included in the user interface controls. The FLAGS section of the screen includes toggle switches to turn the various warning annunciators on and off. The scroll bars are used to change the analog and synchro inputs such as aircraft heading, glideslope deviation, and static air temperature. The turn dials are used to simulate knobs on the air-

Reversionary Mode

Reversionary Mode allows the pilot or copilot to use one EFI to display both ADI and HSI information. The pilot or copilot can toggle between an ADI display and an HSI display on one EFI. Normally, both the pilot and copilot have two separate sets of EFIs. One displays ADI information and the other displays HSI information. If the display processor is not operational on one EFI, the information going to that EFI can be transferred to the other EFI for display.

An up close view of the FITS display unit.

craft for Heading Set and Remote Course Set. The push-button controls are used to change different ADI and HSI modes such as NVIS, SKE, distance sources, etc. and to initiate a power interrupt test. The NAV select section is used to select different navigation modes.

The Automatic Test Function of the test set checks the EFI by sending maximum and minimum level voltages and currents to all of the inputs. The EFI responds to commands from the test set to send back all measured voltage and current levels. The two sets of data are compared; if they are within certain tolerances, the test passes. If not, the particular test that has failed is highlighted in red on the Automatic Test screen. This screen is shown in Figure 4. The items listed for the test are the pin numbers on the connectors and the signals corresponding to the pin numbers.

The RS232 Reversionary mode test checks the RS232 lines on the EFI used for Reversionary mode operation. The user performs this test by choosing it from the menu and then choosing to have the EFI display a pattern on its screen. The patterns include colors, flight instruments, an ADI, an HSI, and a HSI demo.

The Radar Display Unit test is performed by sending a Red, Green, and Blue (RGB) video pattern to the RDU. The RDU can only accept Red, Green, and Blue video inputs with RS-170 timing. The test set sends the RDU a color bar pattern to be displayed.

For further information concerning the Flight Instrument Test Set, PN ES125066-1, please contact:

Lockheed Martin Aeronautical Systems
Customer Supply Business Management
Department
D/65-14, Z/0577
Marietta, GA 30063-0577
Telephone: (770) 494-5238

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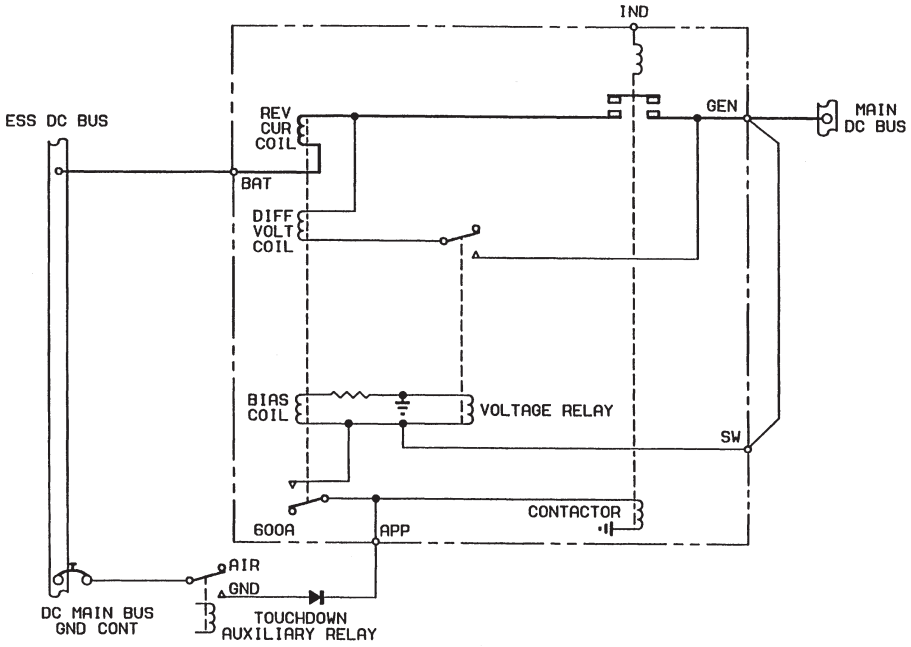
Reverse Current Cutout Relays

by **John DeLion**
Field Service Representative, Senior
C-130/Hercules Field Service

Reverse Current Cutout Relays (RCCRs) are designed to protect the power busses in the event of a power failure. These relays are utilized on C-130H and older aircraft and are located behind the pilot's and copilot's side and lower circuit breaker panels.

Each RCCR is made up of three individual relays. They are the voltage sensing, control, and current relays. The RCCR allows current in one direction as a normal relay, but opens the circuit with sufficient reverse current. Normal flow is from the generator (GEN) terminal to the battery (BAT) terminal.



RCCR (Main/Essential)

The reverse current characteristic varies with each type of relay. The accompanying table outlines the reverse current dropout amperage for the various RCCRs used on the Hercules.

The reverse current coil is a large metal bar wrapped by the bias and differential voltage coils. Under normal conditions, its field has little effect. If the voltage level at the BAT terminal becomes greater than the GEN terminal, the current reverses between the GEN and BAT terminals. The reverse current flow sets up a field opposite the bias field. This opposition will be great enough to force the bias contacts open. The circuit between the source and the load (GEN and BAT terminals) is opened.

Reverse Current Cutout Relay Fact Sheet

Part Number	NSN	Location	Current	Reverse Current Dropout
A700AQ4	2925-00-983-7521	TR Units & Busses	200 Amps	2 Amps to 9 Amps
AN3025-300	2925-00-555-5349	Batt & Isol Busses	300 Amps	9 Amps to 25 Amps
AN3025-600	2925-00-673-4564	Main & Ess Busses	600 Amps	18 Amps to 35 Amps

Opening the circuit stops the reverse current.

The switch (SW) terminal is the control for voltage sensing. It is normally directly jumpered to the GEN terminal. If the SW voltage is removed, the RCCR will open. When 28 volts DC (VDC) is applied to the SW terminal, the voltage sensing coils will close.

By applying 28 VDC to the APP terminal, the RCCR will act as a normal relay. ❒

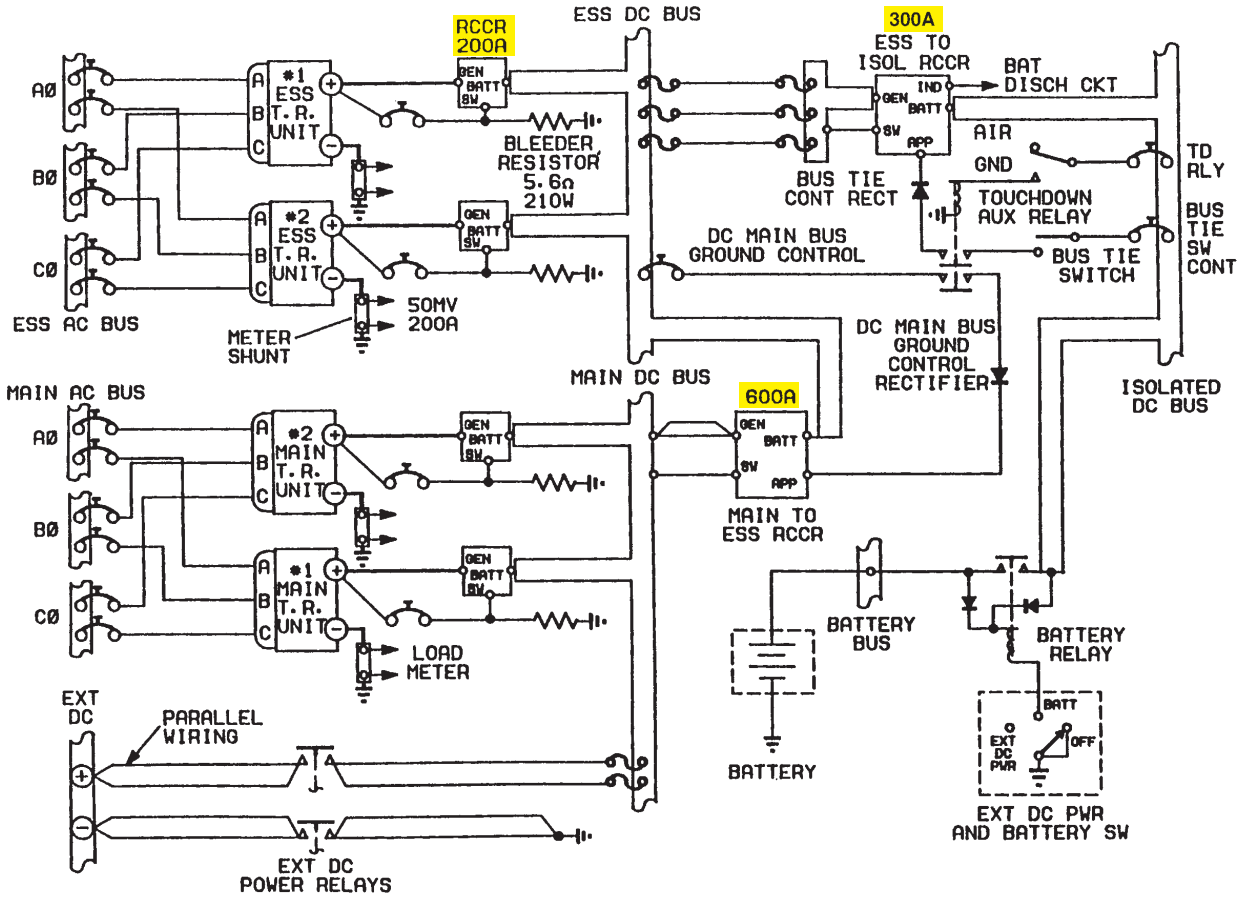
RCCR Case Study

A recent incident involved a very intermittent failure of the essential (ESS) to isolated (ISO) DC bus tie system to tie. In this instance, the failure would only occur once out of every 10 or so times that the Bus Tie Switch was actuated. The problem had been occurring for some time and the flight crew refused to accept the aircraft until this problem was corrected.

Both the ESS to ISOL RCCR and the bus tie control rectifier had been replaced previously; however, the problem continued intermittently. It was noted that during the intermittent failures, approximately 9 VDC was present on the GEN terminal of the RCCR. The application of 28 VDC through the Bus Tie Switch and the control rectifier to the APP terminal allows the busses to tie. While performing a visual inspection of the associated components in the aircraft, it was found that the bus tie control rectifier was physically partially shorted to ground. The short overheated the rectifier resulting in its failure.

The aircraft was returned to service by removing the short, replacing the bus tie control rectifier, and replacing the ESS to ISOL RCCR.

DC Power Supply Schematic



Hercules Support Center

The Hercules Support Center has been discussed several times in recent issues of *Service News*. As we continue to refine the concept, we are making incremental changes so that we may better serve you, our customer.

The goal of the Hercules Support Center is to provide all-up support for Hercules operators all the time. To that end, the Support Center is available to you 24 hours per day, seven days per week.

The Support Center personnel are organized around particular areas of expertise on the Hercules aircraft. The primary disciplines are Powerplants, Avionics/Electrical, Structures, and Systems. Each of these areas is manned by one or more career professionals who is an expert in the field. In addition to a wealth of personal experience, personnel in the Support Center have various tools and resources at their disposal to better support the customer. These tools include a complete Technical Library as well as access to engineering, design, and installation drawings. All of the resources of Lockheed Martin are available to the Support Center staff including Engineering, Safety, Flight Operations, etc.

Hercules Support Center

Telephone:	770-431-6569 (24 hours)
Facsimile:	770-431-6556
E-mail:	hercules.support@lmco.com
Web Site:	http://www.lmassc.com

Please address all technical inquiries to the attention of Dan Miller.

Postal: LMASSC
2251 Lake Park Drive
Smyrna, GA 30080-7605
USA

Recently, Mr. Dan Miller was assigned as Supervisor of the Support Center. Dan is a native of North Carolina and has an extensive background in aircraft maintenance. He served in the United States Marine Corps for 21 years, retiring as a maintenance officer. Dan has been a part of the Lockheed Martin Field Service organization for 19 years. Prior to his present assignment, Dan was responsible for aircraft delivery prep and transition of the Royal Air Force to the C-130J aircraft. Other assignments have included Regional Service Manager for North America, Regional Service Manager for Europe, and Field Service Representative in Gabon, Kuwait, and Sudan.

Dan brings a great deal of enthusiasm to the Support Center and is intent on achieving the highest level of customer service possible. Some of his near-term goals include streamlining our technical library and increasing the Support Center's level of expertise in the following areas: technical manuals/aircraft publications, electrical systems, and AGE/GSE.

We are committed to 100% customer support because we understand that we exist solely because of our customers. Please feel free to contact Dan with comments, suggestions, or questions. Dan's telephone number is 770-431-6564 and his E-mail is dan.e.miller@lmco.com.

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Dan Miller

1999 Hercules Operators Conference Wrap-Up

The 1999 Hercules Operators Conference (HOC) was held the week of 11 October 1999 here in Marietta, GA. More than 320 attendees representing a total of 28 countries made this HOC one of the best ever. Attendees included owners, operators, vendors, and Service Centers.

Attendees at the 1999 HOC each received a three ring binder containing all of the presentations from the conference. Over the years, this binder has grown in size. At the 1998 HOC, attendees asked that the binder size be reduced so that it would be easier to transport. In an effort to reduce the binder size, the 1999 HOC presentations were normally printed three slides per page. This resulted in slides that were too small to read in many of the presentations. So, many attendees asked that the presentations also be available in an electronic format and that the presentations be printed two slides per page in the future. To accommodate this request, we have posted the presentations on our web site, http://www.lmassc.com. Once at the site, follow the navigation buttons to the C-130/Hercules area and then to the Hercules Operators Conference area. The presentations are arranged by day of the week in the order that they were given. This will also give those who did not attend the opportunity to see some of the HOC proceedings. Each operator is encouraged to attend the HOC however, because the presentations available on the web site do not contain the spontaneous discussion that occurs during many of the presentations. The presentations in the binder for the 2000 HOC will be printed two slides per page.

The following pages contain debriefs of the Working Groups that were held during the HOC. Due to a lack of participation in some of the Working Groups, the Working Group concept is currently under evaluation. The goal is to involve as many attendees as possible in the Working Groups so that a maximum amount of information exchange may occur. Anyone with ideas or suggestions concerning the Working Groups should contact Mr. Tom Scoggins, HOC Co-Chairman.

The 2000 HOC has been scheduled for 2 - 6 October 2000, with early registration taking place on Sunday, 1 October. The location will once again be the Atlanta Marriott Northwest Hotel. During the next few months, all of the registration information and forms for the 2000 HOC will be posted on the web site (http://www.lmassc.com).

Each attendee is encouraged to give a presentation at the HOC.

Presentations range from five minutes up to twenty minutes in length. In an effort to improve the readability of the presentations, a template will be posted on the web site that must be used for all presentations at the 2000 HOC. The template will specify colors, type size, and layout, and will be designed to optimize the video projection equipment that will be in use. Please check the web site for more details concerning presentations.

There will be a $500 charge for display space in the exhibit rooms at the 2000 HOC. This charge will include one person's registration fee from the displaying organization. As of January, approximately one quarter of the display space is already taken, so anyone wishing to display at the 2000 HOC is advised to notify Tom Scoggins as soon as practical.

For more information concerning the HOC, please use the contact names and information listed below.

For general HOC issues, presentation subjects, display space, etc:

Tom Scoggins
Telephone: 770-431-6522
Facsimile: 770-431-6556
E-mail: tom.a.scoggins@lmco.com

For technical issues concerning presentations and questions regarding the web site:

Charles Wright, II
Telephone: 770-431-6544
Facsimile: 770-431-6556
E-mail: charles.e.wright@lmco.com

Corrosion Working Group

Nine different topics or aircraft corrosion problem areas were discussed. The topics followed by a discussion and/or comments for each are addressed. Mr. Ray Waldbusser (WR-ALC/LB-NV) and Mr. Scott Jones (LMAS) chaired the Corrosion Working Group meeting during the

Door prizes were part of the festivities at the Monday evening social.

Lockheed Martin Aeronautical Systems President Tom Burbage addressed the attendees on Monday evening.

1999 Hercules Operators Conference.

1. Rudder Corrosion Update
A speedline for replacing affected rudders is now in operation at Lockheed Martin's Greenville, SC facility. The cause of corrosion was due to an alkaline contamination believed to have been introduced in one and/or two different manufacturing steps.

2. SMP 515-B Update
Release status of SMP 515-B, Corrosion Prevention and Control Manual, was provided. Expected release is first quarter 2000. Details of all updates were provided at the 1998 HOC.

3. ICARR Presentation
Overview of Inspection, Corrosion and Repair Recording software.
Front-end data collection tool developed for USAF, USN, and USMC.
Features include input validation and work unit code recognition.
Discussions resulted in that each operator use their own procedures to collect corrosion data and to collectively share and analyze this data at next years Corrosion Working Group meeting. Then, if trends are detected, use this data to tailor the SMP 515-C Inspection program accordingly.

4. Toilet Service Pan Corrosion at FS742.8
Corrosion has been found on some pans between the pan and duct installation. A Service Bulletin is being written to inspect and repair as necessary for LMAS 4992 and up. A production fix has been incorporated to improve the finish, fay surface seal with corrosion inhibitive sealant, and to use titanium and CRES fasteners for installation.

5. Center Wing Panel Corrosion Below Engine

Vice President & General Manager of Hercules Programs Gene Elmore presented a Hercules Program brief on Monday morning.

In addition to technical briefings during the HOC, Ole Nicolaisen of the Royal Danish Air Force gave a short speech at the Monday evening social.

Heat Shields

The inboard engine heat shields contain foam for dampening purposes but also tend to collect and hold moisture and exhaust soot. Over time, a breakdown in the protective finish, MIL-P-27725 primer, occurs on the lower center wing panel where it is in contact with the foam. Severe pitting corrosion has been reported when this condition exists. Beginning on LMAS 5510 and up, the center wing panel finish for this area will be one coat of MIL-P-23377 epoxy primer followed by two coats of MIL-C-85285 white polyurethane topcoat.

Discussions included that the area must be very clean for inspection and that USAF is bonding boron/epoxy patches on when applicable for repair.

6. Forward Fuselage Skin Corrosion Under Air Conditioning Scoop

A potential corrosion problem exists for aircraft prior to LMAS 5372 that did not have epoxy primer on the skin covered by the air conditioning scoop. A TCTO is being written to inspect and apply a finish as necessary for these aircraft. The USCG noted that for some of their aircraft, they have successfully used a borescope through the aft drain hole of the scoop to inspect for corrosion on the skin.

7. Dehumidification

Experience has shown that dehumidification reduces moisture and corrosion and improves reliability for avionics equipment installed on aircraft. A question was asked if anyone had data showing reduced corrosion occurrences on aircraft structure. No comments were received.

8. Corrosion Preventive Compounds

USAF noted a change to T.O. 1C-130A-23 eliminating the use of MIL-C-11796 CPC for the FS737 end fitting. The new recommendation is to use MIL-C-85054 Amlguard. Sabena noted that they use Dinol AV-5 and AV-30 for this part and that up to three applications can be performed before removal is required for visual inspection. Canadian Air Force noted that they have been using LPS Hardcoat on many areas of the aircraft for approximately four years. They will report at next years meeting on their experience with this product.

9. USCG MLG Spindle Fracture

USCG reported a MLG spindle failure that occurred during a sharp turn while taxiing in cold weather. Inline corrosion pits connected by cracks were responsible for the failure. No other operators reported having a similar problem and therefore, this failure was considered an isolated incident.

Action Items

1. LMAS to provide written meeting minutes for inclusion in an upcoming Service News publication.

2. All Corrosion Working Group participants to share collected corrosion data at next years meeting. Also report experiences, good or bad, with the use of corrosion preventive compounds (identify which product) and dehumidification.

Propulsion Working Group

The following items were covered in the Propulsion and Mechanical Systems Working Group:

1. Rolls-Royce Allison discussed recent engine Service Bulletins.
2. A user reported a number of failures of the Elevator Hydraulic Boost Pack. Resolution was provided in a side meeting.
3. A user reported worn Throttle Cables coinciding with non-phenolic rub blocks. Lockheed Martin accepted an action item to provide resolution.
4. A user reported widespread failures of the Propeller Heater Boot. Lockheed Martin accepted an action item to work with Hamilton Sundstrand to provide resolution.
5. Propeller Blade inspection methods were discussed.
6. The requirements for Dynamic Propeller Balancing were discussed. Lockheed Martin, Rolls-Royce Allison, and Hamilton Sundstrand each reported that they do not require it.
7. A user reported a high number of failures of an Air Conditioning Pack. Allied-Signal accepted an action item to investigate.

Structural Integrity and Avionics Working Groups

There were no action items that resulted from either the Structural Integrity Working Group or the Avionics Working Group.

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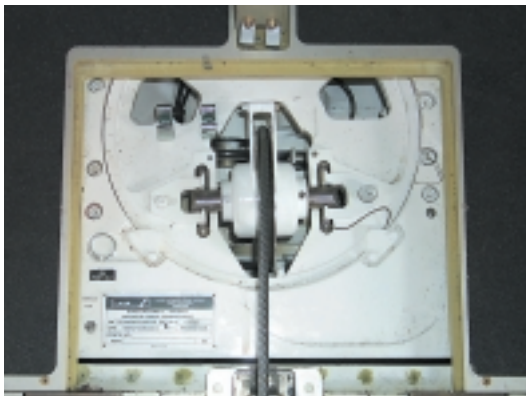
continued from Focal Point, Page 2...

More and more Hercules aircraft are now being utilized in humanitarian missions. For example, the very first operational missions of the C-130J were relief missions to Honduras in the wake of Hurricane Mitch in 1998. Even now, C-130 aircraft from around the world are airlifting relief supplies to Venezuela in the aftermath of terrible flooding and mudslides.

As the Year 2000 dawns, the Hercules moves from the role of a medium range tactical transport to a transport aircraft capable of supporting needs around the world. This worldwide mission demands even greater support capabilities from Lockheed Martin. To this end, the Hercules Support Center is also changing to better accommodate our customers' more demanding requirements. As detailed in the article on Page 10 of this issue, Mr. Dan Miller has been named the new supervisor of the Hercules Support Center. Dan brings with him a wealth of knowledge and experience on a wide variety of Hercules aircraft. The Hercules Support Center is available to you 24 hours per day, seven days per week.

One of our more significant improvements in support recently was the introduction of the Field Information Network (FIN). FIN allows our Field Service Representatives who are on assignment around the world to have unprecedented access to information from other Field Service Offices and the Hercules Support Center.

As the role of the Hercules and the requirements placed upon the Hercules operators continue to change, Lockheed Martin Field Service will change as well. Our continuing goal is to provide unprecedented support to all Hercules operators with on-site Field Service Representatives and the use of the Hercules Support Center. ❒



Integral Cargo Winch Kit for C-130H and Previous Aircraft

by **Bill Strait,** *Senior Engineer, Airlift Derivative Programs*

Prior to development of the C-130J, loadmasters for older model aircraft would maneuver a 300-lb winch around the cargo compartment to be used with on/off loading of cargo. It had to be secured to the floor rings with chains and straps and required considerable space. Reconfiguration to add or remove the winch increased both aircraft turnaround time and loadmaster workload.

For the C-130J, Lockheed Martin Aeronautical Systems (LMAS) designed the Enhanced Cargo Handling System, which integrated a winch with the aircraft cargo floor. Using this "J" design data, LMAS has created a retrofit kit to install a similar integrated cargo winch system on C-130H and older model aircraft.

The integral cargo winch is installed under the floor on Buttock Line 0 between Fuselage Stations 257 and 277. Operation of the winch is accomplished by removing a quick access panel and locking the sheave into place. This sheave is capable of swiveling 360° to accommodate a variety of loading situations. The photo at the top of this page shows the winch in a deployed state and the photo at the bottom of the page shows it in a stowed state with the cover off.

Among the advantages of this retrofit, a loadmaster gains the ability to safely operate the winch from any location within the vicinity of the load through the use of the control pendant. The pendant may be connected to one of two different length cords and plugged into either of two outlets located in the forward and aft cargo compartment. Also, the reel-out/reel-in speeds are infinitely variable with the thumbwheel on the control pendant.

The integral cargo winch's capabilities were demonstrated during the test loading of a 24-ft Type V airdrop platform weighing approximately 25,000 Ibs. A 10,000-lb forklift and an extended cab pickup truck were also winched on/off the aircraft.

Winch Specifications:

Input Power:	200 VAC to 35 Amps
Control Power	28 VDC to 5 Amps
Max Rated Load	6500-lbs
Stall Load	8000-lbs
Variable Speed:	
High Speed	0-56 ft/min
Low Speed	0-30 ft/min
Limit Load	10000-lbs
Ultimate Load	12000-lbs

Installation of this winch can be done with a minimum modification retrofit kit containing all of the required engineering, wiring, parts and instructions.

Contact:
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