Lockheed

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service news

A Service Publication of Lockheed Aeronautical Systems Company

Mark II GPWS

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Lockheed Service News

A SERVICE PUBLICATION OF LOCKHEED AERONAUTICAL SYSTEMS COMPANY

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Photographic Support: John Rossino

Cover: Now 200 years young and more vital than ever to the nation's security, the U.S. Coast Guard begins its third century of service. Our cover photos show a few of the *more* than 30 C-130s the men and women of the USCG operate in carrying out their duties.

Focal Point

Meet Your Regional Service Managers

Joe Parnigoni

The Lockheed Hercules is by far the world's favorite heavy airlifter, with over 1900 C-l 30 and L-l 00 aircraft in operation throughout the globe. Quality product support is a key ingredient in this success story. and many Hercules operators ensure that their aircraft receive the very best in product support by contracting for dedicated technical services. They have Lockheed Field Service Representatives, "tech reps," on-site to provide constant and expert support for their everyday Hercules operations.

Not all operators feel that they require such regular, professional assistance, however. In order to maintain a link with customers who do not utilize such contract services, and also to supply Lockheed with important feedback on aircraft service and reliability, Regional Service Managers are stationed in key locations to provide basic coverage worldwide. These uniquely qualified service specialists also perform advisory functions for the other Lockheed tech reps assigned within their areas. They are truly special people, and we'd like you to meet them.

Dan Miller

Dan Miller is based in Cambridge, England, and maintains an office at Marshall of Cambridge Engineering. However, he spends most his time visiting Lockheed customers throughout the entire continent of Europe. Dan, a native of North Carolina, has an extensive background in aircraft maintenance. During 21-plus years in the U.S. Marine Corps, he worked on every aircraft type in the Corps' inventory, including the C-130. Dan joined Lockheed in September of 1980 and, following successful completion of the intensive training course given to Lockheed tech rep candidates, he served as a Field Service Representative in several important assignments in Africa and the Middle East.

L. R. Webb

L. R. Webb covers Africa and the Mideast from the Lockheed office in Amman, Jordan. Constantly on the go, "L.R." visits Hercules operators throughout Africa, as well as those in the Mediterranean and Arabian Gulf areas. A native Texan, L. R. retired from the U.S. Marine Corps following an outstanding career in military aircraft maintenance. His background includes extensive experience with the C-l 30, which he put to good use when he joined Lockheed in 1981. Before becoming Regional Service Manager, L. R. completed major assignments as a Lockheed Field Service Representative in Dubai and Algeria.

Fred Kasell

Fred Kasell has responsibility for the Pacific and Far East, but he is officially based in Marietta, Georgia. Fred travels to much of the Orient, as well as Australia and New Zealand, maintaining close contact with our many Hercules operators in this area. Fred is a native of Florida, and has an aircraft electronics background from his service in the U.S. Air Force. Fred's Lockheed career began in 1955 as a radio and radar technician and he joined Field Service in 1958. Over the past 31 years, Fred has served in many capacities, assisting the U.S. Air Force and Navy, plus overseas assignments in Australia, New Zealand, Africa, the Middle East, and the Orient.

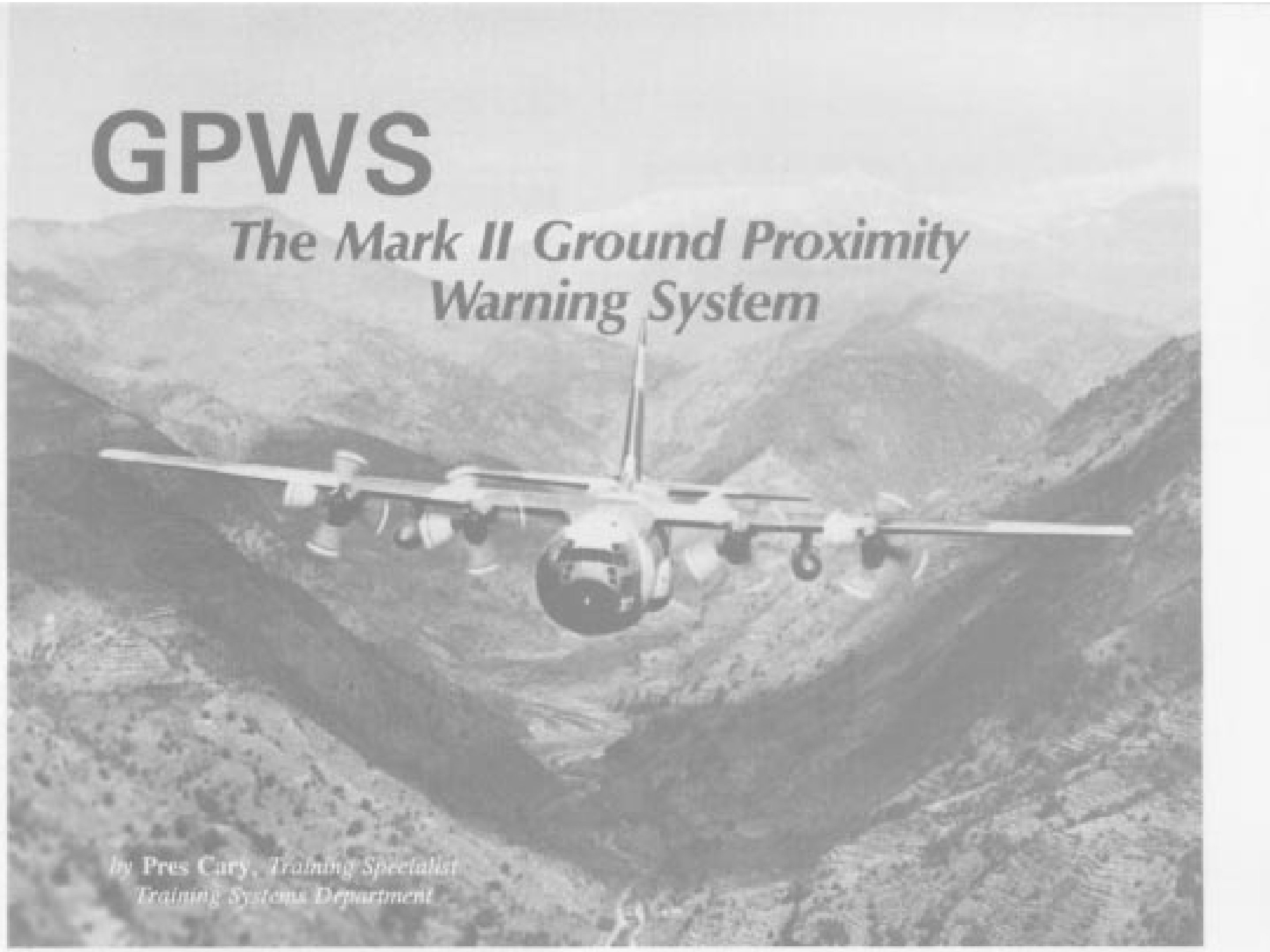
IPlease turn to page 15)

PRODUCT SUPPORT

LOCKHEED AERONAUTICAL SYSTEMS COMPANY

J. D. ADAMS (ACTING) DIRECTOR

C-130/Hercules SERVICE	SUPPLY SUPPORT	TECHNICAL PUBLICATIONS	SUPPORTABILITY TECHNOLOGY	TRAINING SYSTEMS
J. F. Parnigoni	D. R. Steele	C. E. Adams	H. D. Hall	E. L. Parker



GPWS

The Mark II Ground Proximity Warning System

by Pres Cary, *Training Specialist*
Training Systems Department

Many Hercules aircraft in use throughout the world are equipped with the Sundstrand Mark II ground proximity warning system (GPWS). This system is designed to alert the pilots when the airplane enters a zone in which contact with the ground is imminent unless positive corrective action is initiated.

The alert is accomplished by presenting the pilots with computer-generated "voice" messages through a flight station loudspeaker and the interphone system, and by the illumination of annunciator lights located on the glare shield and on the pilot's and copilot's instrument panels.

A GPWS INOP light and a PULL UP light are on the pilot's side of the glare shield. A PULL UP light is located onthecopilot's sideoftheglareshield. A BELOW G/S light is on both the pilot's and copilot's instrument panels. The messages are presented in a prioritized order, arranged according to the urgency of the warning.

The highest priority voice warning message consists of a cyclic tone "WHOOP, WHOOP," and the warning message 'PULL UP." Whenever this message is given to **the** pilots, the immediate action required is that **the airplane's** nose be pulled up and the speed be changed as necessary to increase the distance between the airplane and the ground.

At the heart of the system is the GPWS computer, which is located in the navigator's console to the right of the navigator's table. This is also the location of the GPWS air data computer. Single-phase, 115-volt AC 4OO-Hz and 28-volt DC to power the GPWS are supplied from the essential buses through two circuit breakers located on the copilot's upper circuit breaker panel.

The GPWS is operational between 50 and 2450 feet radio altitude. The system uses the radio altimeter (also called the radar altimeter) to gauge absolute altitude, and the barometric altimeter and the radio altimeter to determine the rate of altitude change. Airspeed is sensed in the form of a mach number by the air data computer. This information, together with data about **the** positions of the landing gear and the flaps, is sent to the GPWS computer for processing. The values obtained from these inputs enable the GPWS computer to calculate the position of the airplane relative to the ground with considerable accuracy, and then to determine which warning, if any, should be passed along to the pilots for a given hazardous airplane condition.

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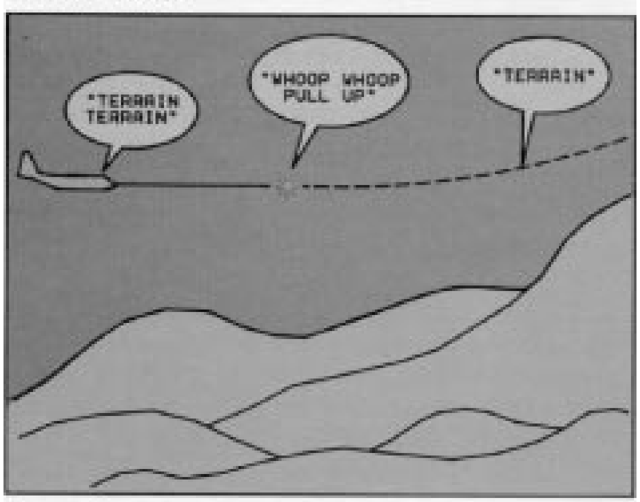
The modes of operation and the various warning indications for each mode and for the submodes are as follows:

Excessive Sink Rate

Mode 1: Excessive Sink Rate

Mode 1 has an outer and an inner boundary and is active between 50 and 2450 feet radio altitude. This mode of operation is computed from radio altitude and barometric altitude sink rate. If the outer boundary is entered, indicating an excessive rate of descent for a given altitude, the aural message “SINK RATE, SINK RATE” is repeated at 0.75 second intervals, and the PULL UP lights will flash. If the rate of descent is not corrected and the inner boundary is entered, the message ‘WHOOP, WHOOP, PULL UP” is repeated at 0.75second intervals until the mode 1 boundaries are cleared by the airplane. The mode is exited by reducing the airplane’s rate of decent by an appropriate amount.

Closure Rate

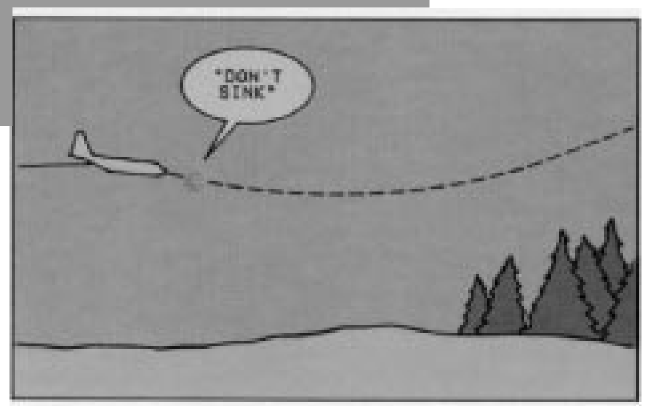


Mode 2: Closure Rate

Mode 2 is active between 50 and 2450 feet radio altitude, and is computed from the math number, radio altitude, radio altitude rate, barometric altitude rate, and flap position. With the flaps in the up position, mode 2A is operative. If the outer boundary is penetrated, the message ‘TERRAIN, TERRAIN” is heard and the PULL UP lights flash. Upon penetration of the inner boundary, the message ‘WHOOP, WHOOP, PULL UP” is repeated every 0.75 secondsuntilpositivecorrectiveactionistaken, or the terrain changes.

Upon leaving the inner warning boundary for whatever reason, the message changes to ‘TERRAIN,” repeated at 0.75-second intervals until the airplane has gained 300 feet of barometric altitude from the point at which the “PULL UP” warningwas discontinued. Withtheflaps inthelanclmg configuration, mode 2B is entered at the warning boundary and the message “TERRAIN” is heard at 0.75-second intervals until the boundary is exited. Mode 2B is active between 200 and 789 feet.

Descent After Takeoff



Mode 3: Descent After Takeoff

This mode is active between 50 and 700 feet of radio altitude during takeoff, or when either the landing gear or the flaps are raised during a missed approach below 200 feet. If the airplane loses approximately 10% of the highest altitude it has so far attained during a flight, the message “DON’T SINK” will be repeated at 0.75-second intervals until a positive rate of climb is established.

If the airplane begins to climb in response to **the** positive corrective action taken because of the warning, the message is discontinued, but the GPWS continues to compare the airplane barometric altitude to the altitude where the initial descent began. If the airplane descends again prior to reaching that altitude, another warning will be initiated.

Mode 4: Terrain Clearance

Mode 4 is activated upon clearing the upper boundary of mode 3 after takeoff. As in mode 2, this mode is subdivided into modes A and B, depending in this case on the aircraft’s landing gear and flap configuration.

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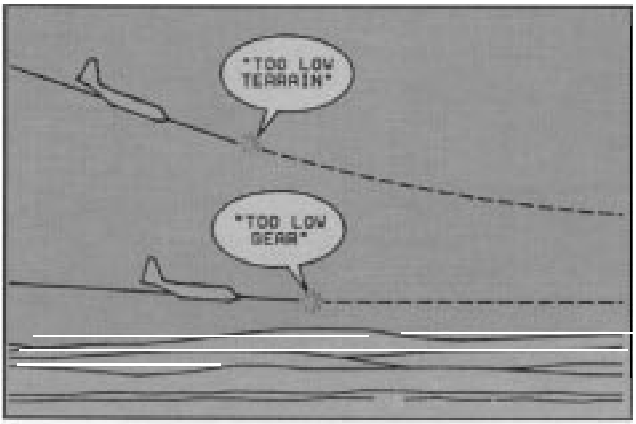
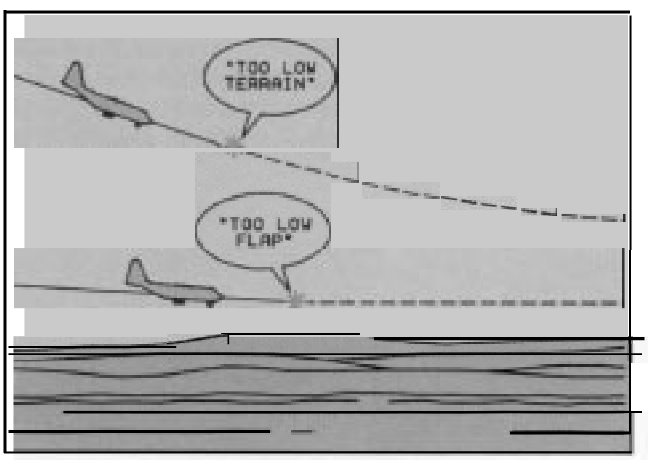
Terrain Clearance-Gear Up



Mode 4A: Terrain Clearance-Gear Up

Mode 4A monitors two conditions during landing, the airspeed in mach and the position of the landing gear. If the upper boundary of 1000 feet is penetrated at a speed of mach 0.45 or greater, the message "TOO LOW, TERRAIN" is heard and the PULL UP lights flash. The 1000-foot upper boundary at mach 0.45 decreases linearly to 500 feet above ground level (AGL) at mach 0.35. If the boundary of 500 feet is penetrated at a speed of mach 0.35 or less and the gear is up, the message "TOO LOW, GEAR" is heard and the PULL UP lights are flashed. In either case the message is repeated at 0.75-second intervals until the condition is corrected.

Terrain Clearance-Flaps Up



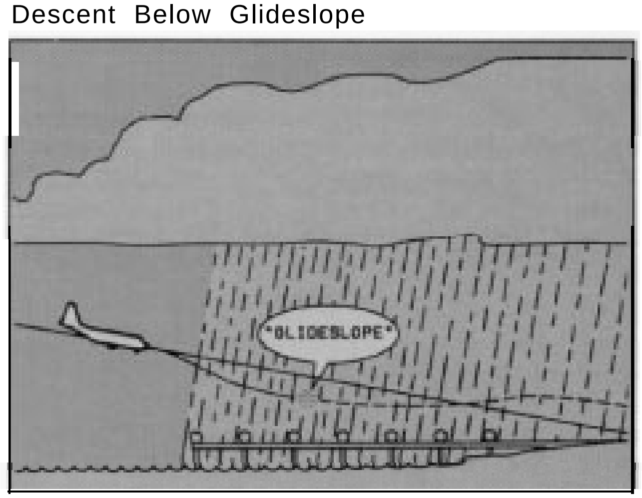
Mode 4B: Terrain Clearance-Haps Up

This mode is activated when the gear is down and the flaps are not in the landing position. If the 1000-foot boundary is penetrated at speeds of mach 0.45 or above, the message "TOO LOW, TERRAIN" is heard and the PULL UP lights flash. The 1000-foot boundary is decreased linearly to 200 feet between mach 0.45 and mach 0.29. If the boundary is penetrated at speeds of mach 0.29 and below, the message "TOO LOW, FLAP" is heard and the PULL UP lights flash. An override switch on the flight control pedestal is available to bypass the flaps-up input to the GPWS and simulatea flapsdowncondition. This feature canbeusedtoeliminateunwantedwarningmessages in cases where the pilot decides to execute a flaps-up approach to landing.

In the event the landing gear is extended and then retracted, the message "TOO LOW, GEAR" is heard at 200 feet AGL if the gear is still retracted. In either case, the message is repeated every 0.75 seconds until the condition is corrected. The GPWS automatically switches from mode 4B to mode 3 when the boundary of mode 4B is passed in full landing configuration: gear down and flaps down.

Note that the mach numbers mentioned in the preceding paragraphs are the values the GPWS computer is designed to respond to when the system is installed in a pure jet aircraft. Since the Hercules is a prop jet aircraft and operates at somewhat lower speeds, the air datacomputer output must be modified such that the GPWS computer senses aircraft movement faster than is really the case. For the Hercules aircraft, the mach numbers given above must be multiplied by a factor of 0.75 to obtain the mach values actually used.

Descent Below Glideslope



Mode 5: Descent Below Glideslope

The glideslope (G/S) warning mode is enabled when an instrument landing system (ILS) frequency is selected, the gear is down, G/S VALIDITY is present, the BACK LOC and CANCEL signals areabsent, and the airplaneis between 50 and 1000 feet of radio altitude during approach to landing. If the glideslope boundary is penetrated with the airplane flying below the glideslope beam center, the message "GLIDESLOPE" is heard at a reduced volume level and the BELOW G/S lights flash.

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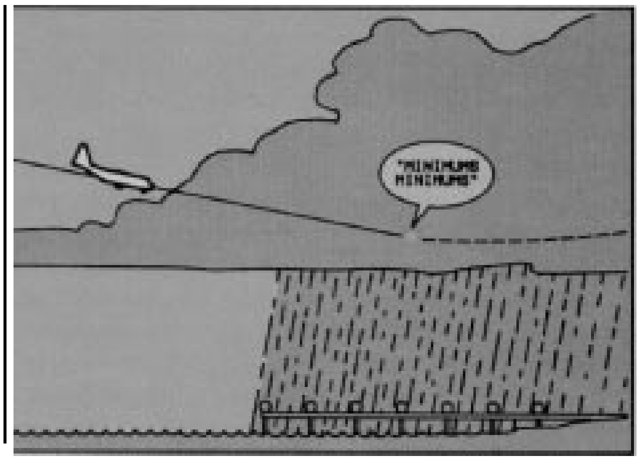
This is a "soft" warning, repeated at a rate determined as a function of radio altitude and G/S deviation. If the G/S deviation exceeds 2 dots (0.7 degrees) below the beam when the airplane is between 150 and 300 feet, a "hard" warning is heard in which the volume and frequency of the message "GLIDESLOPE" is increased. The message stops if the aircraft returns to the glideslope beam center. The mode 5 warning can also be cancelled below 1000 feet of radio altitude by pressing either of the BELOW G/S lights.

Descent Below Decision Height



Mode 6: **Descent Below Decision Height**

The message "MINIMUMS, MINIMUMS" is heard onetimewhentheaixplanepassesthroughthepreset decision height (DH) altitude as determined by the radio altimeter. The DH index may be set anywhere between the radio altitudes of 50 and 1000 feet.

Message Priority and BITE

It is possible that more than one warning could be activated at the same time. A priority system has been established in which a higher priority message will immediately interrupt a lower priority message. A lower priority message can be activated only after appropriate corrective action has allowed a higher priority message to be discontinued. The table at the right shows the priority of the GPWS warning messages.

The GPWS has built-in test equipment (BITE) which continuously monitors the system's operation and will give a GPWS INOP light if it finds a malfunction. There is also a manual self-test capability. A self-test may be initiated by pressing either PULL UP light assembly and holding it. When the airplane is on the ground with the flaps up, the results of this action will be the message "GLIDESLOPE" one time, and then message "WHOOP, WHOOP, PULL UP" four times at a reduced volume level and the PULL UP light will flash six times if **the system** is functioning properly.

If the PULL UP light assembly is released prior to the last "WHOOP, WHOOP, PULL UP," **the volume** level will return to normal loudness. The GPWS also monitors the inputs from all interfacing systems. If any of the interface signals go invalid, the GPWS will turn on the GPWS INOP light.

A GPWS test can also be accomplished in flight above 1000 feet radio altitudewith the landing gear **up.** Testing the GPWS in flight will produce the same results as the ground test except that the 'WHOOP, WHOOP, PULL UP" message will continue and the PULL UP light will flash until the test switch is released.

GPWS WARNING MESSAGE PRIORITY

Priority	Message	Mode
1	WHOOP, WHOOP, PULL UP	1 and 2
2	TERRAIN, TERRAIN	2
3	TOO LOW, TERRAIN	3
4	TOO LOW, GEAR	4A
5	TOO LOW, FLAP	4B
6	MINIMUMS, MINIMUMS	6
7	SINK RATE	1
8	DON'T SINK	3
9	GLIDESLOPE	5

Complete checkout procedures for the GPWS may be found in applicable technical manuals: T.M. 382C-2-7, or SMP-581. Wiring diagrams are found in T.M. 382C-2-12, or SMP-582. Inspection procedures are found in SMP-515-C.

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CHECKING

FEDC Valve Installation

by **Wayne Thompson,** *Field Service Representative*
C-13O/Hercules Field Support Department

Most valves manufactured for use in aircraft cannot be installed backwards because they include design features intended to prevent such improper installations from occurring. In some cases, however, this is not a practical option and another method of ensuring a correct installation must be found.

The PN 695680 fire extinguisher directional control (FEDC) valves on the Hercules aircraft belong in this category. There are four FEDC valves installed on each Hercules aircraft; two above the left main landing gear, and one each in dry bays No. 2 and No. 3. Since all three ports on these valves are the same size, and the valves themselves are designed to be installed in any position, it might at first glance appear difficult to establish if the FEDC valves on your aircraft have been properly installed. However, each valve is provided with an indicator lever on both sides of the valve body which show the position of the valve. Checking the position of these indicator levers offers a quick and reliable way of determining a good installation.

Indicator Lever Position

The principle behind the following checks for correct FEDC valve installation relies on the fact that the indicator lever shaft is spring-loaded to the valve's closed position. You should be able to move the lever to the open position with your fingers, and when you release the lever, the spring-load will force it back to the closed position. By determining which direction the valve indicator lever shaft rotates when you apply finger pressure to the lever, you can establish if the valve has been installed properly. If the lever for each valve operates as described in the following paragraphs, the valve is installed correctly.

FEDC Valve Checks

All of the FEDC valves are accessible either by sight or feel. Checking them for proper installation is a simple procedure that can be carried out by the crew chief or flight engineer during an aircraft preflight inspection. Note that the checks described in this article should be done with all fire emergency control handles in the normal position. The checks can be accomplished either with aircraft power applied or removed.

GTC/APU FEDC Valve: Access to this valve involves standing on top of the left forward main landing gear tire. Reach through the opening for the screwjack assembly and toward the rear of the aircraft. Locate the line coming down from the fire bottle and follow it until you come to the valve, all by feel. The valve indicator lever will point inboard, and you should be able to rotate it clockwise against the spring tension, toward the tail of the airplane. Viewed from outside the airplane and above the valve, this would be to the right

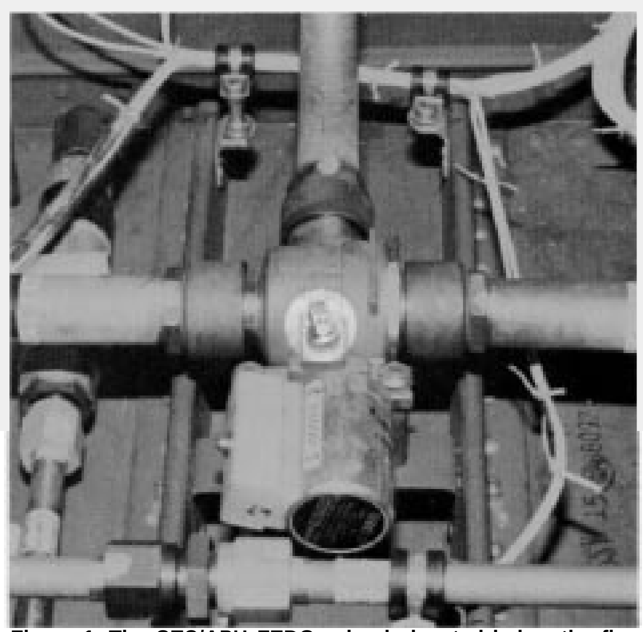

Figure 1. The GTC/APU FEDC valve is located below the fire extinguisher bottles above the left main wheel well.

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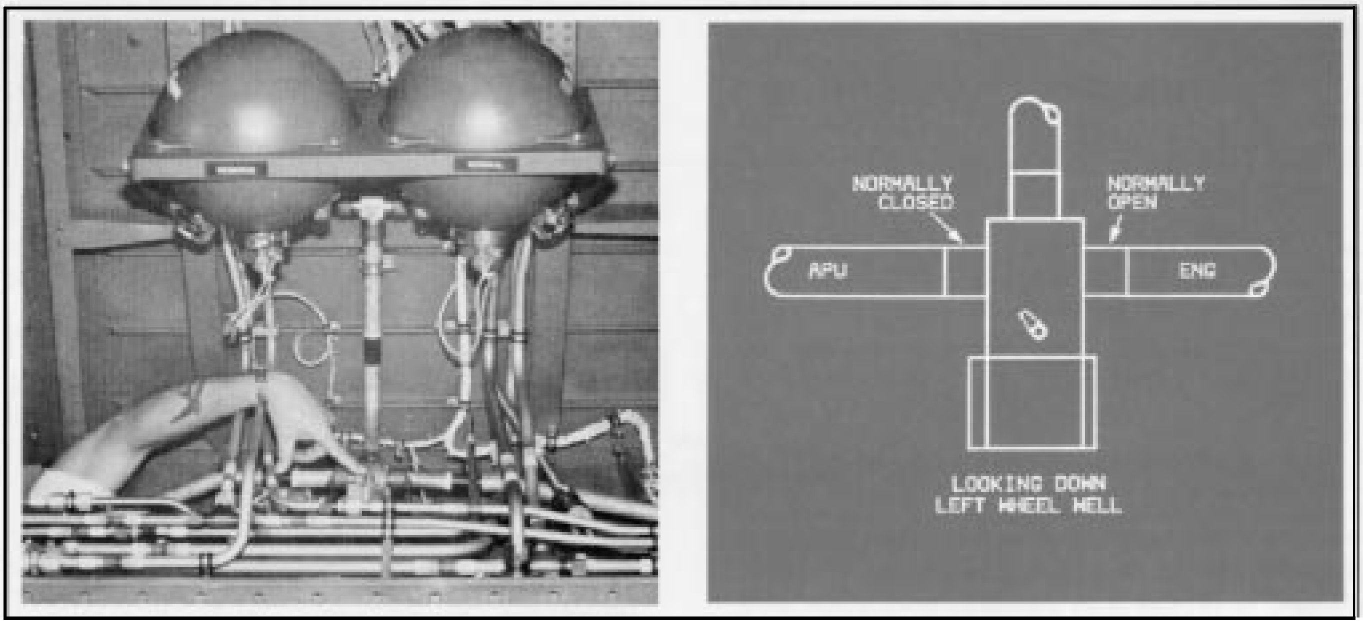


Figure 2. Showing a dexterous (and decorated) arm, the author demonstrates the proper technique for reaching the GTC/APU FEDC valve. The correct valve lever position is shown in the diagram at the right.

(see Figures 1 and 2). If the lever moves as described, the valve is installed properly.

Center Wing FEDC Valve: Access to the center wing FEDC valve is by sight only unless the exterior access panel above and behind the left aft main landing gear is removed. Stand on the left aft MLG tire and shine a flashlight upward through the slot at the forward outboard comer of the mudguard mounted just aft of the vertical beam. See that the valve indicator lever points toward the right as you face inboard (Figure 3). The indicator will appear to point downward and slightly aft of the vertical position.

No. 2 Dry Bay FEDC Valve: To check the No. 2 dry bay FEDC valve, you will first need to open the dry bay access panel. Then, facing forward, lie down on the wing and reach with your let? hand through the access panel opening toward the leading edge to locate the valve lever (Figure 4). Check the valve movement as indicated on the diagram. The lever will be spring-loaded toward the right (in a counter-clockwise direction), and you should be able to move it toward the left (clockwise) with your fingers.

No. 3 Dry Bay FEDC Valve: The FEDC valve in the No. 3 dry bay can be located and checked in a similar manner,

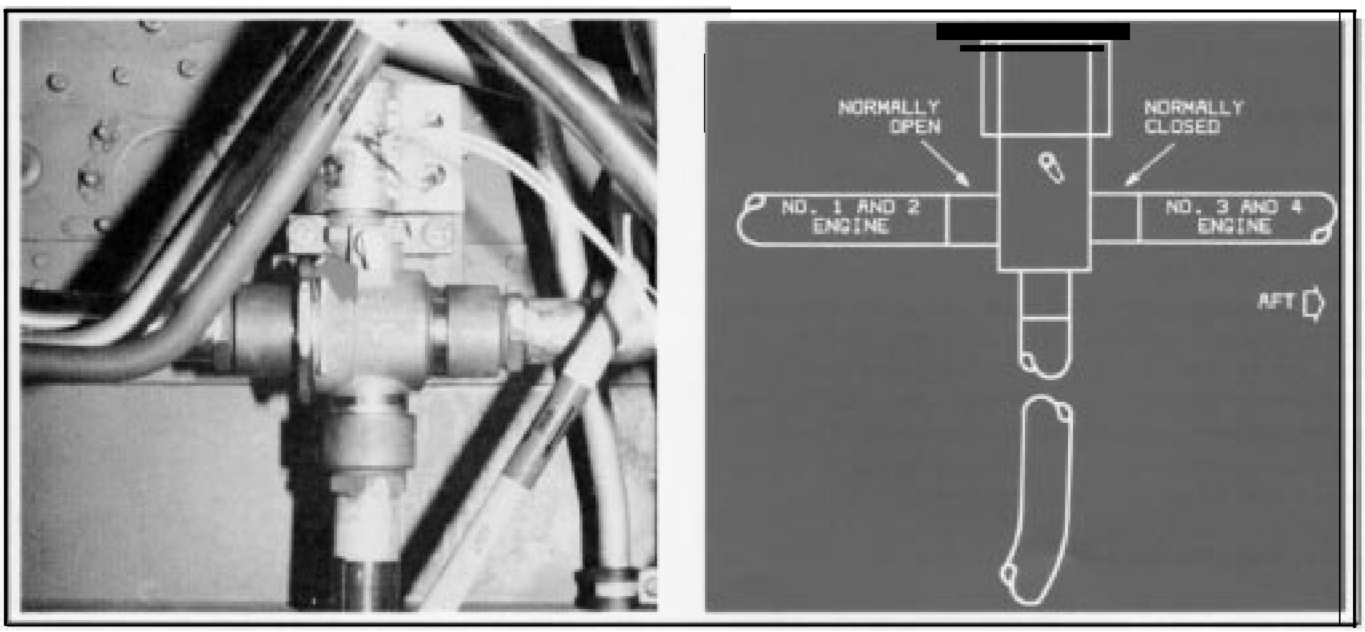
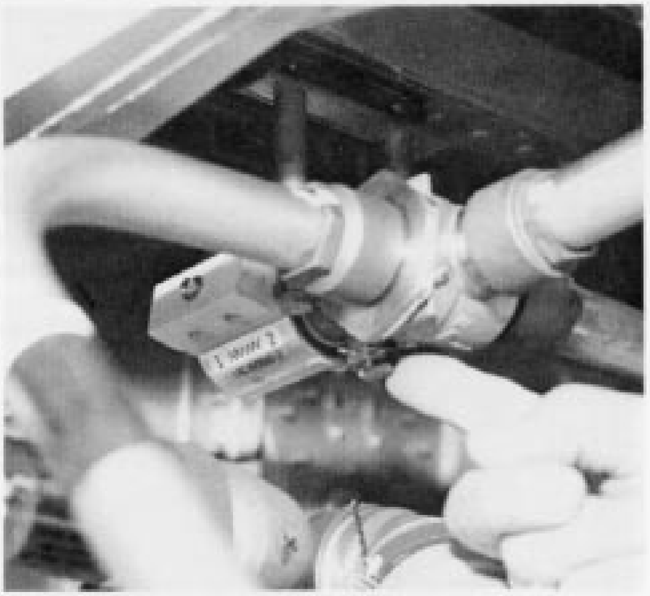


Figure 3. Under normal conditions, the center wing FEDC valve can only be checked visually. Compare the photo above with the idealized representation at the right for the actual appearance of indicator lever.



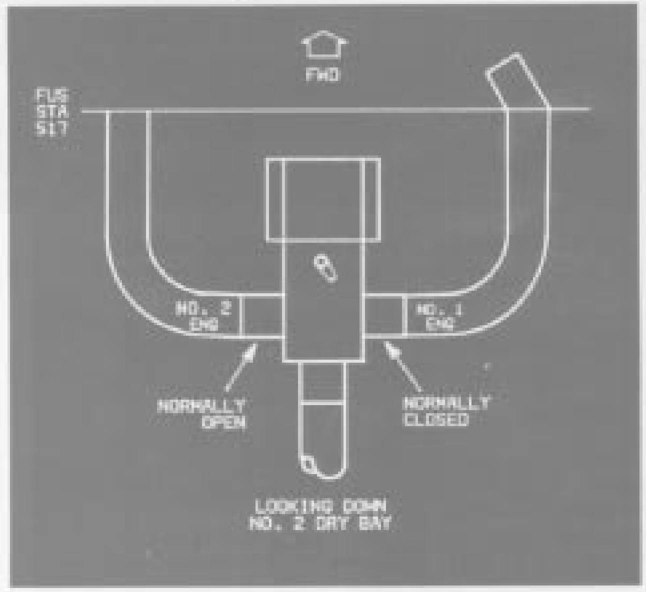
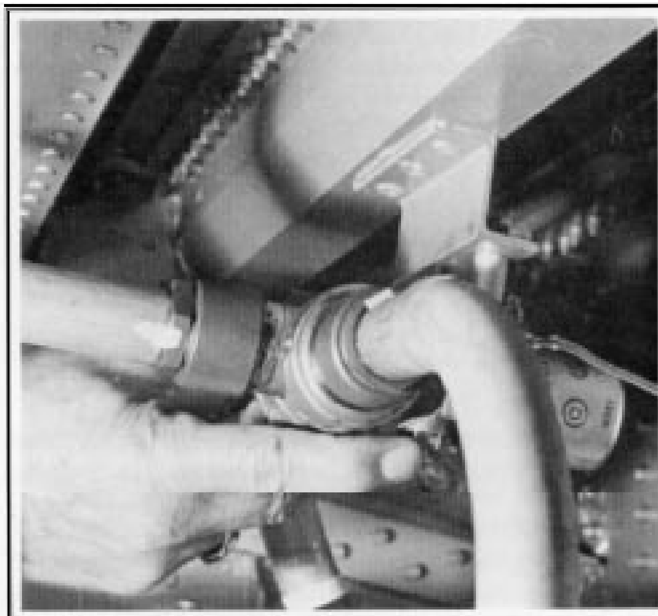


Figure 4. The No. 2 dry bay FEDC valve can be reached through the dry bay access panel. Note on the drawing the apparent--bl only apparent-discrepancy in the tubing to the engines in this dry bay.

except in this case it is more convenient to use your right hand (Figure 5). Here again, the indicator lever will be spring-loaded toward the right (counterclockwise), and in a correct installation you should be able to rotate it to the left (clockwise) againstthe spring tension.

Verifying that the fire extinguisher directional control valves have been properly installed in your aircraft is a relatively simple task, and well worth the small amount of time and trouble involved. In the majority of cases you will just be confirming that a proper installation has been made. But your aircraft's fire extinguishing system is one system where even the smallest margin of error is unacceptable. It's a good feeling to know that if a fire warning light should ever illuminate, the extinguishing agent can be delivered both when it is needed, and where it is needed,



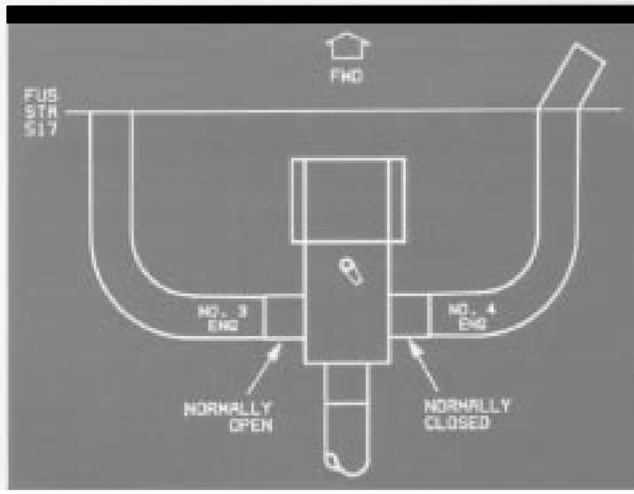
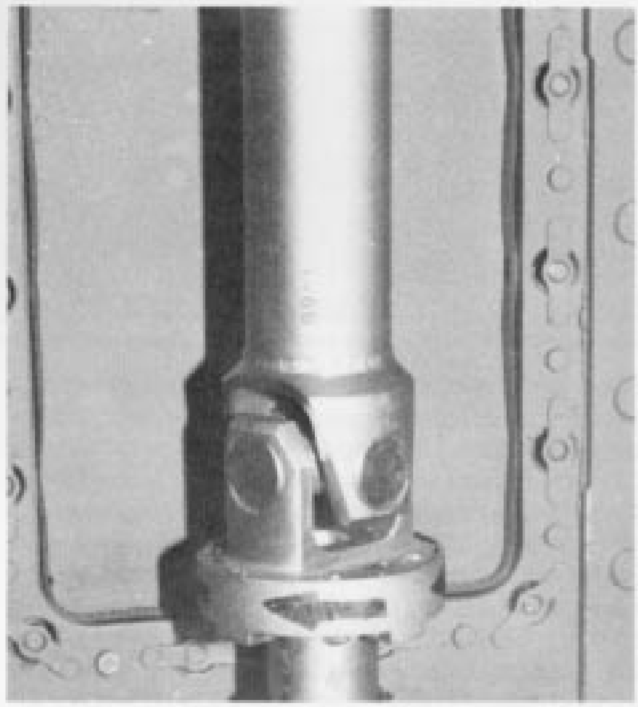


Figure 5. The procedure for checking the FEDC valve in the No. 3 dry bay is similar to that for No. 2 dry bay. The diagram at the right shows correct lever position in a good installation.

MLG Emergency Extension Update

by Mike Brooks, Field Service Representative
C-130/Hercules Field Service Department

MLG torque shaft lower universal joint, typical of airplanes built prior to LAC 5162. Note the bolted coupling.



LAC 5162 end subsequent Hercules aircraft are equipped with quick-disconnect couplings at these locations.

Two changes have recently been made to the main landing gear emergency extension system of the Hercules aircraft. The changes consist of the replacement of the main landing gear torque shaft lower universal joint companion flanges and the main landing gear emergency engaging handle with new components of updated design. These improvements have been incorporated on new production aircraft, and all of the new parts have been designated as preferred spares for the corresponding components on older aircraft.

MLG Vertical Torque Shaft

Aircraft built prior to Lockheed serial number LAC 5162 were equipped with PN 8372-Ml, PN 8372, PN 69757943, *or* similar MLG vertical torque shafts. In these designs, theuniversal joint companion flanges are connected by four bolts. LAC 5162 and subsequent aircraft use PN 8372442 at these locations. The vertical torque shaft lower companion flanges in this case are connected by a single, knurled, quick-disconnect coupling.

Full instructions for the operation of both types of emergency disconnects are already contained in the emergency procedures section of the U.S. Air Force flight manual, T.O. lC-130H-1, Change Il. Instructions for the use of the new quick-disconnect coupling will be added to the flight manuals of earlier-model C-130s.

A significant amount of documentation has already been published on this subject. Information on the new coupling is contained in Revision 20 to AFM 382/E/G, dated 10 January 1990 for commercial Hercules customers. Basically the same type of information is contained in Operational Supplement No. C-130-49, dated 28 February 1990, for overseas military customers who purchased their aircraft directly from Lockheed.

MLG Emergency Extension Engaging Cable

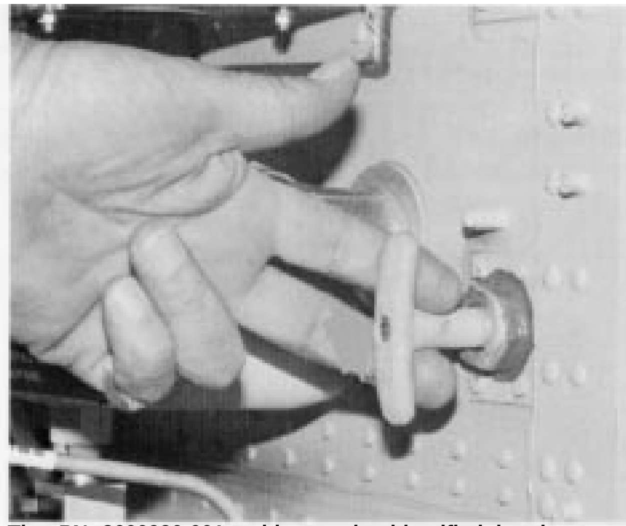
In addition, a new and more reliable main landing gear disconnect cable assembly has been developed for the Hercules aircraft. This cable, PN 2600930401, is now being installed on new production aircraft and is considered the preferred spare. The new cable can be identified by the screw placed in the center of the top portion of the T-handle, versus the set screw located on the side of the shaft of the T-handle in the case of the older PN 57-2757-2100 and PN 40798-l cables.

All three of cable assemblies are completely interchangeable, but there is an important difference to note in the operation of the new cable. The operational instructions given in some of the flight manuals specify that the T-handle be rotated counterclockwise before being pulled all the way out. This should not be attempted in the case of the new cable because the T-handle will not rotate until it is extended to its full length. It is important to bear this in mind. The PN 2600930401 MLG disconnect cable assembly is of sturdy construction, but attempting to force the T-handle to rotate before extending it fully could cause the cable to jam, or damage the T-handle's locking mechanism.

Note that the older cables may be operated by using either the old or the new procedure. Therefore, a safe and effective procedure common for all cable types is to pull the cable T-handle out to its full extension, and then rotate the handle counterclockwise to lock it.

Documentation Updates

A service bulletin will be issued requiring replacement of the old emergency procedure decals for the vertical torque shaft and the MLG emergency extension engaging cable. The replacement decals will cover the procedures for both the old and the new designs of the torque shaft and engaging cable.



The PN 2600930-001 cable can be identified by the screw placed in the center of the T-handle.

Additional information on the new procedures is contained in the documents cited on page 10: Revision 20 to AFM 382/E/G, dated 10 January 1990, and Operational Supplement No. C-13049, dated 28 February 1990. The revised operating procedures for the MLG emergency extension engaging cable will also be included in future updates of the Hercules flight and maintenance manuals.

New *Temperature Control System Test Set*

by **Robert D. Ryder,** *Electronics Engineer, Senior Electronic Support Equipment Engineering Department*

The interface among the various components of the Hercules environmental temperature control systems is complex, and technicians often find that functional testing of the system at the organizational level is a tedious and time-consuming task.

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The Lockheed Aeronautical Systems Company has developed a new, state-of-the-art, environmental temperature control system test set for checking the flight station and cargo compartment temperature control systems. This test set can be used on the aircraft for testing the entire environmental control system, or in the shop for checking major components during intermediate or depot-level repair.

Testing Capability

The PN 3402750-l test set is capable of testing the following individual components.

- Flight station temperature control box.
- Cargo compartment temperature control box.
- Flight station/cargo compartment water separator low limit control box.
- Flight station temperature control valve.
- Cargo compartment temperature control valve.
- Flight station/cargo compartment water separator low limit temperature control valve.
- Flight station/cargo compartment temperature sensor.
- Flight station duct sensor.
- Flight station/cargo compartment duct overheat sensor.
- Flight station/cargo compartment water separator duct sensor.
- Cargo compartment duct sensor.
- Cargo compartment duct overtemperature sensor.

The test set includes all equipment needed to carry out a complete system checkout on the aircraft and accomplish full functional tests of the major components in a shop environment. Operating instructions and a maintenance manual for the test set are also included. The test set is mounted in a sturdy aluminum case, and weighs just 30 pounds. The only electrical power required is 28 volts DC.

Test Set Operation

When the test set is in use on the aircraft, a cable is connected between the component under test and the aircraft system. The technician is then able to insert control signals and monitor system output.

The diagnostic capability of the test set can be illustrated by the following example. A technician has been told that the flight station temperature control system is not functioning properly. He takes the test unit to the aircraft, connects it to the system in question, and follows the instructions provided in the cover of the test set case.

After applying electrical power to the aircraft, the technician places the master air conditioning control to the NO PRESS position and the flight station shutoff valve to NORM. When the test set is activated, it will first initiate a

power-on, self-test procedure. After completion of the self-test, the unit will prompt the technician to select the desired test mode.

In this example, the flight station temperature control system has been reported as malfunctioning, so the technician enters the command “01” on the test set keypad. The unit will then begin a complete checkout of the flight station temperature control system. As the test proceeds, the operator will be prompted to enter new commands as required.

If no malfunctions are detected, the entire system can be checked in ten minutes. If problems are found, the test set will pinpoint the discrepant line replaceable unit (LRU) or circuit involved. Individual LRUs may then be tested on the aircraft or in the appropriate repair shop.

If at any point during the tests the technician suspects that the test set itself is malfunctioning, he can cheek all aspects of the unit’s operation by entering the self-test command “96.” The self-test will determine if a problem exists and, if so, pinpoint the particular component at fault.

Further Information

The **new Lockheed** PN 3402750-I C-130 Temperature Control System Test Set is in the Air Force inventory, stock-listed under NSN 4920-01-292-2173.

For further information concerning the operation of the test set, and for ordering information, please contact: Supply Sales and Contracts, Dept. 65-11, Zone 0577, LASC-Georgia, Marietta, GA 30063. Telephone: W-494-4214; FAX 404-494-7657; Telex: 804263 (LOC CUST SUPPLY).

Parker Hannifin Corporation has acquired the Bendix starter product line and has assigned responsibility for repair and spare parts to its aftermarket division, which is known as Parker Bertea Aerospace and headquartered in Irvine, California.

ENGINE STARTER NEWS NOTES

by Dare1 A. Traylor , Service *Analyst Coordinator*
C-I3O/Hercules Field Service Department

There is now an increased amount of maintenance data available, and more facilities for starter repair and overhaul. In addition, an alternate starter has been introduced.

Publication No. 36U-1-858B

The current vendor manual, Technical Manual Operation and Maintenance Instructions Publication No. 36U-l-858B, provides updated information on the 36E84-18Q series of starters for **the** maintenance technician. Among the items addressed, the following are of particular importance:

1. The engine drive coupling and bolt must be used for one installation only.

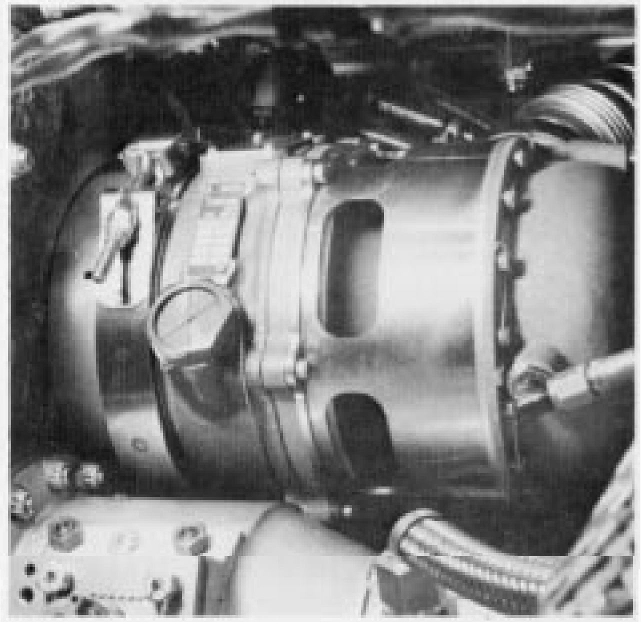
2. Excessive coupling (jaw) and seal wear may indicate that the air control valve is leaking and requires maintenance or replacement.

3. Excessive force must be avoided during installation of the engine drive coupling into the gearbox splines.

4. The use of check gage PN 2881348, which is supplied with each starter, is required to **verify** proper installation clearances. This will ensure that the starter has proper engagement during the start, and proper clearance after disengagement.

5. The **revised** 36E84-184 series starter duty cycle schedule must be strictly adhered to, as follows:

   One minute **on**
   One minute off
   One minute **on**
   Five minutes off
   One minute **on**
   30 minutes off.



The new Parker starter mounted on the starter pad of the T56 engine gearbox.

It is easy to cause heat damage to the starter if the approved duty cycle is exceeded. Particular care should be taken not to violate these time limits during maintenance action that requires the starter to motor the engine, such as during compressor washing or cleaning, turbine cool-down, and similar operations.

Considerable progress has been made in resolving recurrent maintenance problems associated with the Bendix PN 36E84-184 series starters in the area of seals and couplings, air pressure sensing lines, starter control valves, and starter nonengagement.

Seals and Couplings

The starter shaft seal and the engine drive coupling should be replaced every 1200 hours of engine operation or 800 starts, whichever comes first. The starter drive coupling should be inspected at this time to ensure that proper

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engagement has been taking place, and the coupling should be measured for excessive wear.

Experience indicates that the starter drive coupling should be replaced at every second seal replacement in most cases. Instructions for seal and coupling replacements are contained in Bendix Publication No. 36U-l-858B.

Air Pressure Sensing Lines

Starter air pressure sensing lines should be checked periodically, especially in case of repeated starter failures on a particular engine. Sensing line leakage will cause higher than normal air pressure to the starter, faster spin- up, and possible damage to the coupling and clutch.

Starter Control Valves

The starter control valve should be checked for leakage past the butterfly on engines having repeated starter failures. A relatively small amount of leakage can cause partial engagement, or slow disengagement. This may result in wear of the coupling because of overrun during acceleration and normal operation.

Proper pressure rise rate is also important to long starter service life. Operators whose aircraft are equipped with PN 38E73 starter control valves should ensure that the instructions for rise rate adjustment contained in Bendix Service Bulletin No. 124A have been complied with. The adjustment procedure is also covered in Vol. 13, No. 1 (January-March 1986) of Service News.

Starter Nonengagement

Whenever the starter does not engage, the start attempt should be discontinued immediately. The cause must be investigated before any further attempt to use the starter.

Nonengagement allows the starter to reach free-run speed. Repeated free-run operation can cause internal damage and require that the starter be returned for repair or overhaul. Note that simple seal or coupling replacement usually corrects nonengagement problems (see the paragraph on seals and couplings, above).

Repair and Overhaul Facilities

Lockheed has been working with Parker Hannifin to reduce starter overhaul turnaround time and to improve the maintenance and operational data available to our customers.

Parker Bertea and Microturbo, Ltd. offer authorized overhaul service for Parker Han&in/Bendix starters. Two authorized repair facilities are as follows:

Proper installation of critical starter components is essential to long service life.

Parker Bertea

Parker Hannifin has developed a starter production facility at Irvine, California. Overhaul work is being done in Irvine by their Parker Bertea division. The address and telephone numbers are:

Parker Bertea Aerospace	Tel: 714-660-83 10
16666 Von Karman Ave.	Telex: 678-304
Irvine, CA 92714	Fax: 714-660-8390

Microturbo, Ltd.

In the U.K., Microturbo, Ltd. has been licensed by Parker Hannifin to repair and overhaul starters. This company is now on line for starter work, with parts and technical data on hand. Microturbo’s address and phone numbers are:

Microturbo, Ltd.	Tel: 0329-283611
Fort Wallington	Telex: GB G 86489
Fareham, Hants	Fax: 0329-220631
England PO 16 8TT	

Unauthorized Repair Facilities

Unfortunately, several other companies are also attempting to repair these starters, and may be working without sufficient technical data. Some units returned to

A powerful handful: The compact size of the Parker starter belies its rugged durability.

Parker Hannifin for repair have been found to be improperly assembled, and may contain bogus parts.

Should any customer elect to send starters to a facility other than Parker Bertea or Microturbo, he should be aware that Parker Hannifin Corp. does not provide technical data to unauthorized repair stations. All bona fide C-130/L-100 operators are, of course, provided with all necessary repair and overhaul data.

New Starter Approved

The Bendix-type PN 36E165-2QC starter, now being manufactured by Parker Hannifin and pictured in this article, has been qualified for C-130/L-100 use. The new starter is an adaptationof the PN 36E153-XX starter, which is already approved for use on KC-135R aircraft equipped with CFM56 engines. The PN 36E165-2QC is interchangeable with the PN 36E84-18Q series starters in form, fit, and function. One difference, however, is that the new starter uses engine oil for lubrication instead of grease.

Since FAA approval has already been obtained, the PN 36E165-2QC starter is being entered in the parts lists for approved use on Hercules airplanes in service. This starter is also now being installed on new production Hercules aircraft.

Service News extends special thanks to Phil Penegar and Floyd Jones of the LASC prop and engine shop for their valued assistance in the preparation of this article.

(Continued from page 21

Jim Wainwright

Jim Wainwright also operates from the Field Service office in Marietta, but he travels South America constantly in support of Hercules operations on that continent. Jim is from Virginia, and joined Lockheed in 1969 after a 24.year career in U. S. Marine Corps aviation. An experienced Hercules flight engineer, he was one of the first Marine Corps C-l 30 flight engineers, and received his C-l 30 training at Lockheed while in the Corps. Jim is fluent in Spanish, and has served in major Field Service assignments in Alaska, Venezuela, Argentina, Malaysia, Spain, and Oman.

Our fifth Regional Service Manager, Frank Griffith, has unique responsibilities. He supports U.S. Government Air Reserve Forces, the U.S. Coast Guard, and domestic commercial customers. Frank, a native Georgian, came to Lockheed in December 1952 following eight years of service in the U.S. Navy. After working for a while on the Lockheed production line, Frank joined Field Service in 1956 as one of our first tech reps. He has successfully completed many and varied assignments, supporting the U.S. Air Force and Marine Corps, as well as Lockheed overseas customers in the Far East, the Middle East, and Africa.

Frank Griffith

We in the C-l 3O/Hercules Service Department are particularly proud of our Regional Service Managers and the contribution they make to the success of every operator of the Hercules aircraft. Now that you have been introduced, please feel free to call on the Service Manager covering Your area. You will find his numbers listed at the right. Remember, they are there to support you!

Sincerely,

J. F. Parnigoni. Manager
C-130/Hercules Field Service Department

Lockheed Field Service
Regional Service Managers

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