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service news

A Service Publication of Lockheed Aeronautical Systems Company

Fire Extinguisher Squibs

Lockheed SERVICE NEWS

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Photographic Support: John Rossino

Cover: A C-130H-30 belonging to the French Air Force flies over the City of Light. Photo courtesy of French military services.

Focal Point

Keeping the Electronic Edge

Terry James

Dedicated to complementing the high level of professionalism that is designed and built into Lockheed airlifters, the Electronic Support Equipment Engineering Department produces test equipment to support every electrical and electronic system on the Hercules aircraft. In our department, we always remember that the performance and reliability of any aircraft are dependent on the supportability of its systems. Our objective is to provide the best test equipment possible, tailored to satisfy the special needs of each of the three maintenance levels: organizational, field, and depot.

Today, our test sets are at work in 39 different countries and all branches of the U.S. military; however, our capabilities extend well beyond the production of individual test sets. We are able to provide complete, turnkey, avionics maintenance complexes; each consisting of an electric shop, instrument and autopilot shop, avionics shop, and calibration laboratory. These shops include test sets for each system, plus ancillary test equipment such as scopes and meters, work benches, tool kits, and facility power supplies.

For those of our customers who do not maintain a field or depot-level capability for servicing electrical or electronic line-replaceable units (LRUs), we operate a fully certified FAA repair station. This facility is supported by the same test equipment we sell to support the aircraft. The repair operation gives our engineers greater insight into how a set should be designed to best facilitate maintenance, and there is another bonus: it also improves the quality of information used in preparing the maintenance and operation manuals provided with all our test sets.

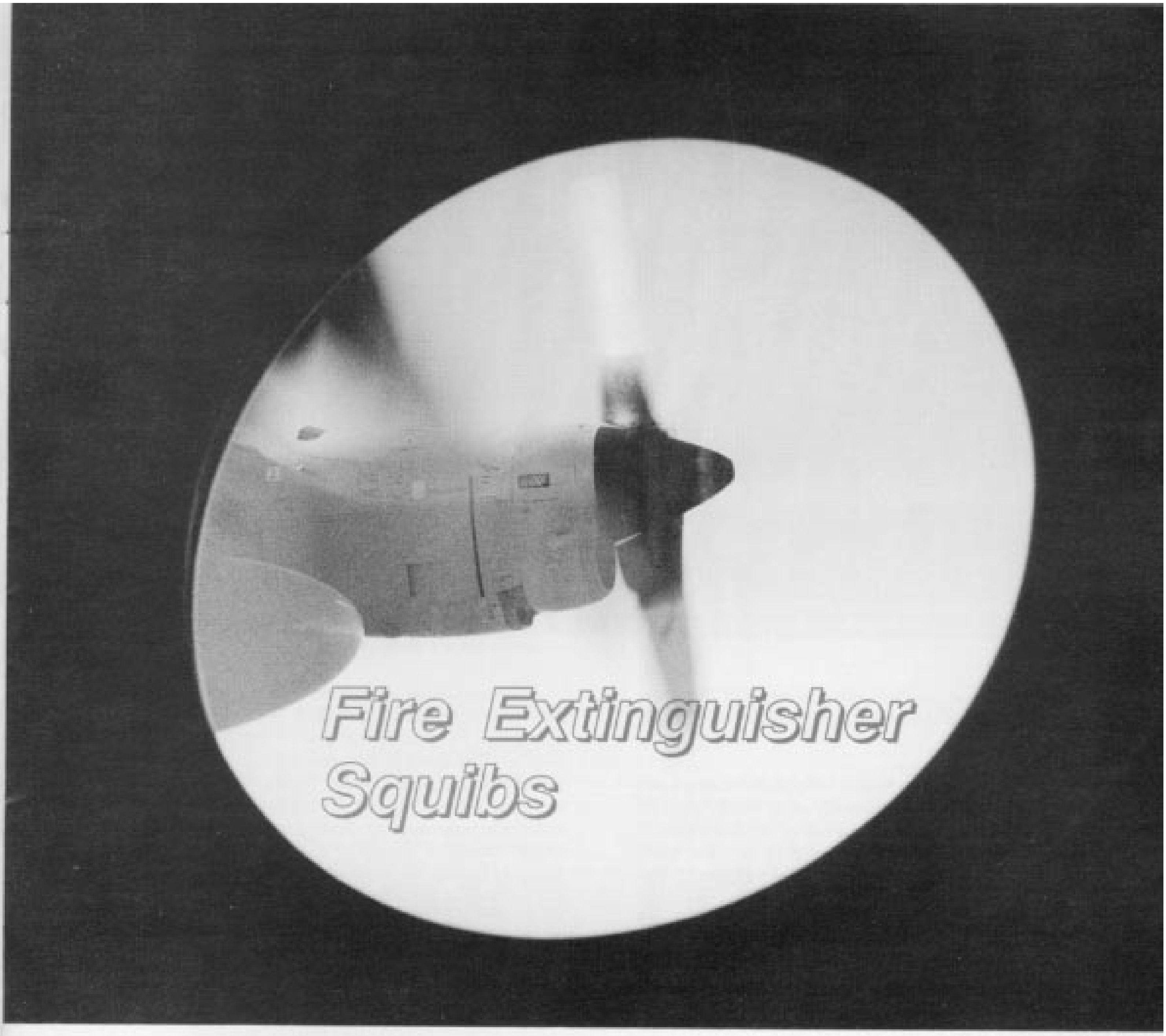
Over the years, Service News has published a number of articles describing examples of our test equipment. This is a tradition we look forward to continuing. In this issue, Mike Fortenberry adds to the list with his discussion of our PN 3402893.1 and PN 3402893-3 Temperature Datum Control Test Sets. But even with these additions, our story is far from complete. We have over 250 different pieces of support equipment available. ranging from simple cable adapters to totally automated precision measurement equipment. Each of these items is built to the highest quality standards, and designed to help you reduce maintenance costs and fleet downtime.

As elsewhere at Lockheed, our goal is to serve the needs of our customers with the very finest equipment and service available. We hope that you will not hesitate to let us know how we can best meet all of your requirements. To share your thoughts with us. and for further information about our test equipment, please contact us through the LASC Supply Sales and Contracts Department at the address shown at the bottom of page 15.

Sincerely,

Terry James

T. D. James, Manager
Electronic Support Equipment
Engineering Department



by Dick Bordeaux, *Training Specialist*
Customer Training Systems Department

When you pull a tire emergency handle in the flight station of a C-130 and position the extinguishing agent dischargetoggle switch, anelectrical circuit is completed which fires a small explosive charge in a device called a squib. The detonation of the charge releases fire extinguishing agent into one of the four engine nacelles or the GTC/APU area, depending on which has been selected by the operator.

Fire Extinguisher System Operation-An Overview

The agent used in the fire extinguishing system of the Hercules aircraft is contained in two spherical bottles located above the left main wheel well (Figure 1). In most aircraft, each of these containers has a capacity of 19 pounds of bromochloromethane (CB) or 22.5 pounds of dibromodifluoromethane (DB) fire extinguishing agent.

The tire bottles are charged with nitrogen gas to an operating pressure of between 600 and 640 psi at 21 'C (70°F). A gage mounted outside each bottle's lower hemisphere indicates the pressure. These gages are usually oriented in such a way as to allow visual checking of the bottle's internal pressure by an observer in the wheel well below. In some configurations, the

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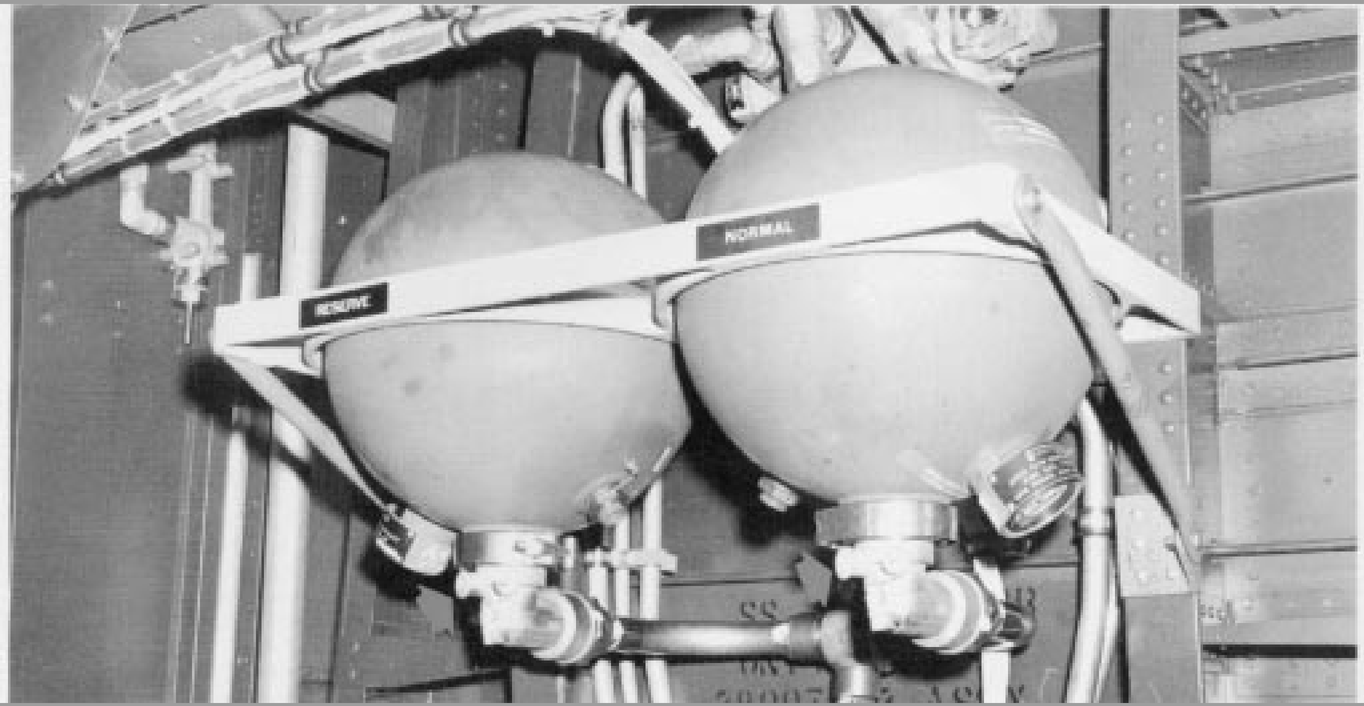


Figure 1. Fire extinguishing agent is contained in two spherical bottles mounted just above the left main landing gear wheel well. Before flight, squibs will be installed in the fittings indicated above.

gages are turned so they may be checked from the outside through an access door in the center upper wheel well panel.

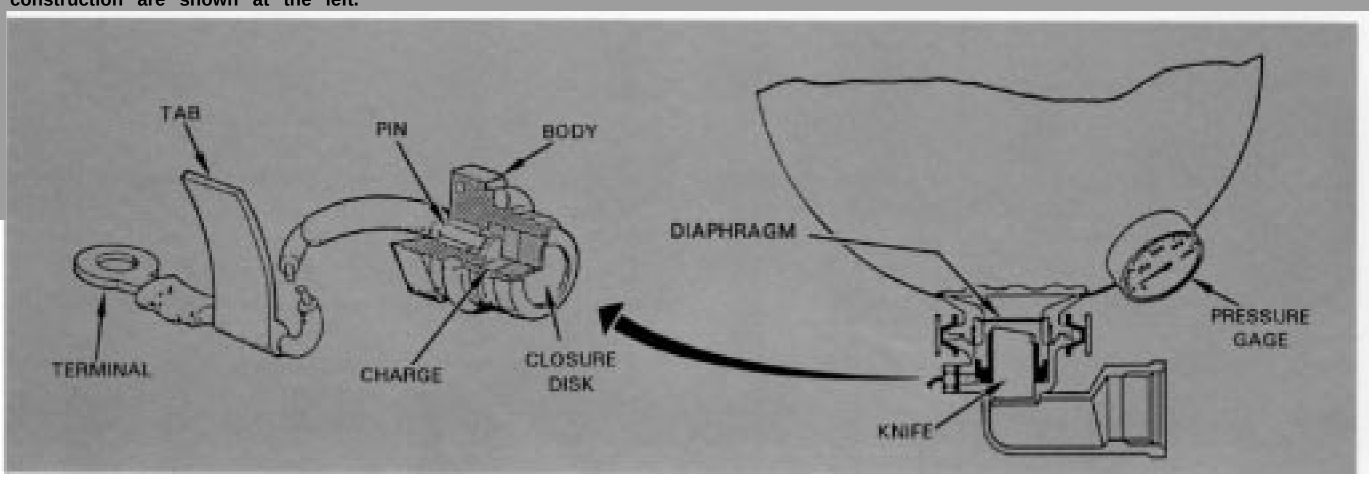
Each of the two fire bottles is equipped with a squib located in the outlet seal assembly of its discharge port. When the squib associated with one of the fire bottles is fired, a contained explosion drives a circular knife through a frangible diaphragm, shown in Figure 2. The diaphragm is in fact the seal for the container, and when it is ruptured, the fire extinguishing agent inside the bottle is released under high pressure into the system plumbing. The CB or DB agent then travels through tubing and a series of directional control valves into the area where it is needed (Figure 3).

The containers are selected for discharge one at a time by an agent discharge switch, which must be armed before use by pulling out one of the fire emergency handles. The agent is then directed through a valve into the fire extinguishing system manifold. The manifold has four solenoid-operated directional control valves which are sequenced to direct the agent to the desired engine nacelle or the APU/GTC compartment. When the agent reaches the selected area, it is expelled through perforations in the outlet line.

Squibs: Description and Service Life

Figure 2 illustrates the fire extinguisher system squib that is used on the Hercules aircraft. The squib is

Figure 2. The fire extinguisher squibs are located in the outlet seal assembly of each fire extinguisher discharge port. Details of squib construction are shown at the left.



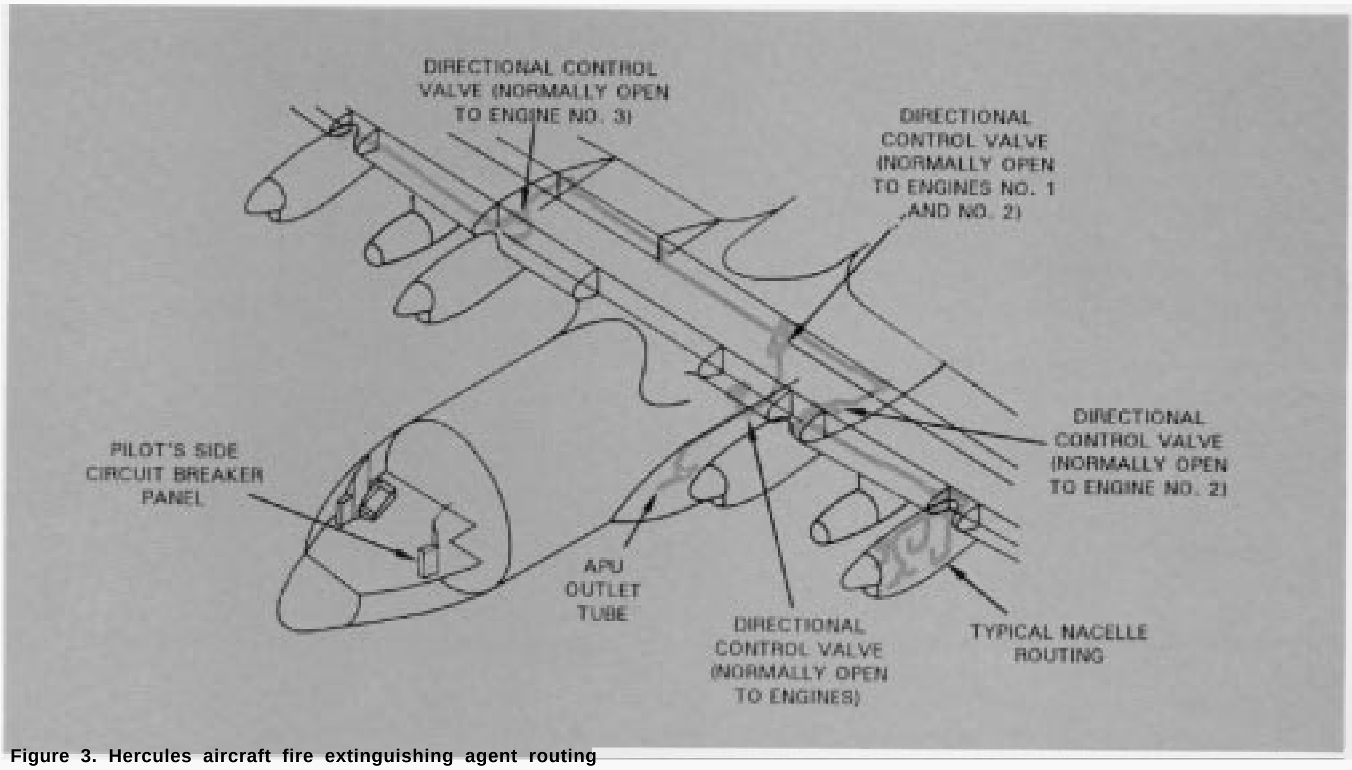


Figure 3. Hercules aircraft fire extinguishing agent routing

a steel-encased unit, cylindrical in shape at one end and hexagonal at the other. The explosive charge is contained in the cylindrical end. **A** terminal lead attached to the hexagonal end provides the electrical connection necessary for firing the squib.

The explosive charge, or load, consists of a powder-type agent which is mixed with acetone to form a slurry and then sealed into the squib casing. An electrical bridge element is attached to the interior end of the terminal lead and routed through the load chamber to ground on the interior surface of the squib case. The wire element has a resistance of 1 ohm. When subjected to a suitable electrical current, it quickly becomes hot enough to ignite the load and fire the squib.

The date of manufacture is stamped on a wrench flat at the hexagonal end of the squib body. The last three digits of the manufacturer's part number are stamped on the flat opposite the one on which the manufacturing date is displayed. For example, one flat might be marked l/91, and the opposite flat 199. This would mean that the manufacturing date was January, 1991, and the last three digits of the part number are 199. This information is also displayed on a tag attached to the squib's terminal lead. The tag is usually detached from the lead when the squib is removed from storage and installed on the aircraft.

The squib currently used in the Hercules aircraft fire protection system is PN 4199-1, manufactured by Holex, or PN 802465-2, produced by Teledyne McCormick Selph. Despite the difference in manufacturers, the applicable National Stock Number (NSN) for both units is the same: 1377X0677-6281.

It is important to keep in mind that squibs have limited service life. Lockheed now recommends a maximum total service life of three years from the date of manufacture for squibs. Operators should, of course, comply with the guidelines shown in the authorized maintenance manuals applicable to their aircraft when considering squib service **life.**

Safety Considerations

Fire extinguisher squibs must be handled with extreme care. Squibs are explosive devices which could cause serious injury or death if fired accidentally. A squib must never be struck, dropped, or exposed to heat above 74°C (165'F), and no attempt must ever be made to open a squib or disassemble it. Since squibs are designed to be fired electrically, they must always be protected from sources of static electricity or any other form of uncontrolled electrical current.

Do not attempt **to check the continuity of an uninstalled squib, or hold a squib in your hand when you check it. Also, never check squib continuity with a standard multimeter.** This will send too much current through the squib and could cause it to detonate. Only authorized, "safe" multimeters may be used in testing them. The following test sets are also suitable for checking the continuity of fire extinguisher squibs: PN 4-OOITS (NSN **4925~00-454-2510AQ) and PN 101-5BFG (NSN-4925~00-907-2894AQ).**

Squib Electrical Data

Squibs are designed to detonate at a minimum voltage of 18 volts and a minimum current of 1.5 amperes. A squib should not tire when a current of 0.5 amp maximum passes through it for 60 (+/- 10) seconds, or when it is repeatedly checked for resistance with a current of 0.2 amp maximum. It should be noted that at least one vendor (Holex) recommends a maximum of 0.01 amp for repeated checks.

Special attention should also be given to the storage of these devices. Squibs should never be stored in an ordinary warehouse with other aircraft parts; they must be kept with other pyrotechnic, ordnance, or munitions items.

Inspection and Removal

TheAirForceT.O.s,U.S. Navy NAVAIR manuals, and Lockheed SMPs and TMs include squib inspection and on-the-aircraft squib continuity checking as part of the fire extinguishing system inspection procedure.

Squib checks are normally carried out in conjunction with other tasks involving the fire extinguishing system, such as testing for leaks and the proper operation of the electrically operated directional control valves. Please note that the following discussion deals only with that part of the tire extinguishing system inspection procedure that pertains to the squibs themselves, and is intended only as a general discussion. Always refer to the authorized manuals for **your particular aircraft before undertaking any maintenance or inspection activities.**

Squibs should be removed for proper inspection. First, ensure that the FIRE? EXT circuit breakers on the pilot's side circuit breaker panel are open and that all fire handles on the fire emergency panel are pushed in. Discharge static electricity from your body before working on the squib wiring by touching the nearest ground wire or bare metal on the airframe.

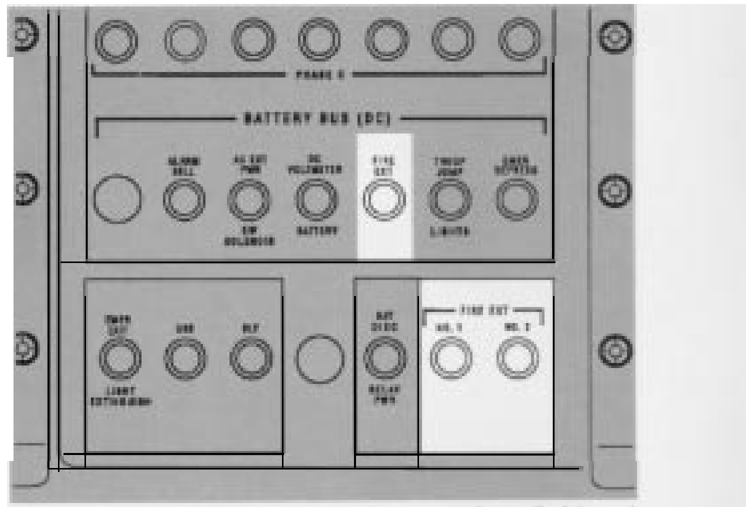
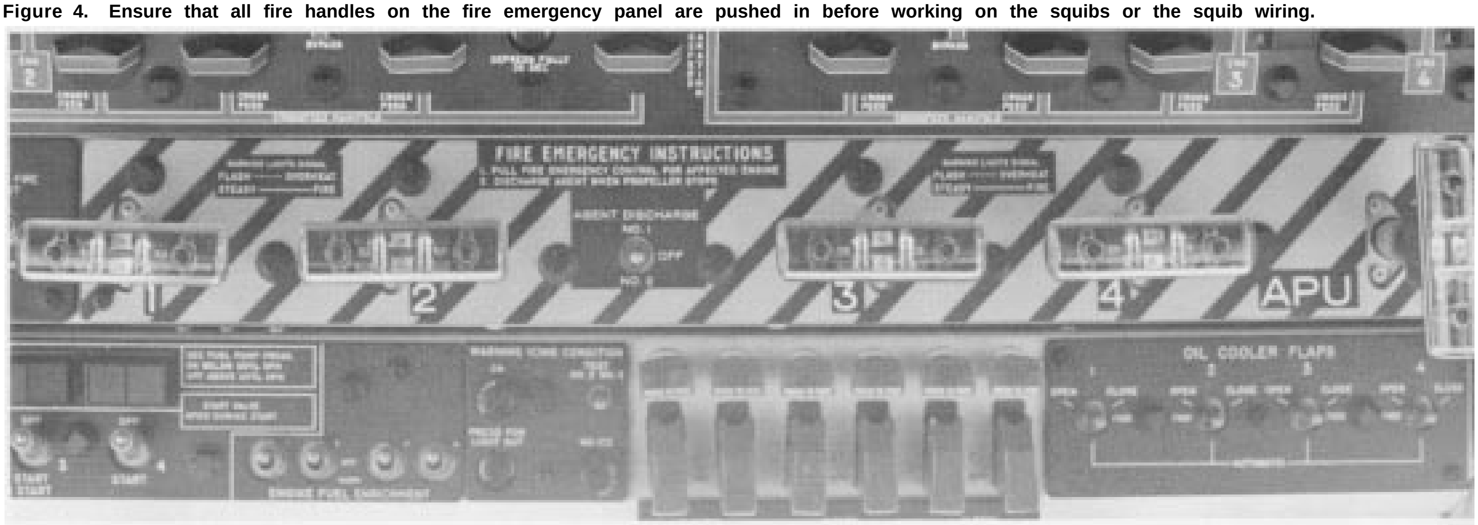


Figure 5. The FIRE EXT circuit breakers must be pulled (open) prior to squib inspection.

Disconnect the two lead wires from the aircraft to the terminals on each fire bottle discharge head and tape them away from the terminal strip. Disconnect each squib lead and attach it to the squib flat with 0.20 safety wire, grounding it to itself. Carefully remove the squibs from the discharge head of the fire extinguisher bottle, using the proper size wrench and a smooth, steady, turning motion. Repeat the procedure with the other fire extinguisher bottle.

After a squib has been removed, inspect it visually for corrosion, physical damage, or a loose electrical connector. Check the date ofmanufacture, which will be stamped on one of the wrench flats. Remember that the combined shelf and service life of a squib should not be allowed to exceed a maximum of three years, or the time requirement set in the maintenance manual for your particular aircraft.

Figure 4. Ensure that all fire handles on the fire emergency panel are pushed in before working on the squibs or the squib wiring.



Out-of-date or defective squibs must be disposed of in accordance with the procedures contained in AFR 127-100 (Explosives Safety Standards) and T.O. llA-1-42 (General Instructions for Disposal of Conventional Munitions), or the equivalent.

Squib Installation

Before installing or reinstalling a squib, check once again to ensure that the FIRE EXT circuit breakers on the pilot's side circuit breaker panel are pulled (open), and that all fire handles on the fire emergency panel are pushed in. Remember that the agent discharge switch is armed anytime a fire handle is pulled and the aircraft battery is installed, regardless of the battery switch position.

Inform all personnel in the area of your intentions and periodically check to see that the No. 2 nacelle area remains clear. The normal, static valve positions dictate that an inadvertently fired squib will discharge agent into the No. 2 engine nacelle.

Make sure that the inlet port of the fire extinguisher bottle is clear of obstructions; then install a squib in the firing chamber of each fire extinguisher bottle. Always use a new O-ring (PN 29513-136) between the squib and the adapter. Tighten the squib to a torque value of 90 to 100 inch-pounds.

Before reconnecting the squib wiring, discharge any static electrical charges by touching bare metal on the aircraft structure or a grounding stud. Verify that there is no power on the FIRE EXT circuit, and then connect the wiring to the two terminals on the forward fire bottle discharge head. Connect wire No. W413C16 to the power (insulated) terminal first, and then "unsafety" the squib wire from storage position on the hex flat and install it on the insulated stud with the power lead. Finally, connect ground wire No. W416A16N to the ground (uninsulated) terminal.

Connect the wiring to the two terminals on the aft fire extinguishing agent bottle discharge head in a similar manner. Wire No. W412C16 and the squib wire are connected to the power terminal. Wire No. W415A16N must be connected to the ground terminal.

Squib Continuity Checkout Procedure

When checking squib continuity, be sure to use an ohmmeter that produces a current of less than 10 milliamperes and has an error limit (including sensitivity) of no more than 0.05 ohms; in other words a safe meter. Current higher than the authorized value may detonate the squib. Note that in some manuals this limit is set at a lower value. Be sure not to exceed the limit given in the maintenance manual that applies to your particular airplane.

Verify that the squib is properly installed in the operating head, that the operating head is secure on the fire extinguishing agent bottle, and that the bottle is correctly installed in the mounting brackets. Ensure that all the aircraft wiring is properly connected.

Check to ensure that the extinguisher discharge area (usually the No. 2 engine nacelle) is clear, and remains clear, while making a continuity check. The fire extinguishing agents are hazardous to health, and this precaution is necessary to avoid possible injury to personnel in case of accidental discharge.

When the above conditions are met, connect a safe ohmmeter which produces a current of less than 10 milliamperes between the power terminal and the ground terminal at the side of one fire bottle's discharge head. Measure the resistance through the squib, and then repeat the test on the other fire bottle. Resistance should be 1 (+/-O.15) ohm if the squibs are satisfactory.

Check that continuity exists between each fire bottle ground terminal and the airplane ground stud. The resistance should not exceed 0.0025 ohm. After the checks have been completed satisfactorily, return the upper wheel well area to the normal configuration. Finally, reset the FIRE EXT circuit breakers in the flight station to reactivate the aircraft fire extinguishing system.

Reduce pressurization fatigue cycles by using this new

Outflow and Safety Valve Tester

by **Roy H.** Webber, *Staff Engineer*
Supportability Technology Department

No components of the Hercules aircraft pressurization system are more crucial for proper operation than the outflow valve and the safety valve. The outflow valve, which is located on the right side of the aircraft behind the flight station, is used together with the pressure controller to maintain the cabin pressure at a constant level automatically. It also limits the cabin-to-atmosphere differential pressure.

The safety valve, located in the left aft corner of the cargo door, gives overpressure relief if the combination of the pressure controller and outflow valve fails to regulate the cabin pressure properly. On military models, the safety valve also opens along with **the** outflow valve to completely depressurize the airplane.

Conventional **Testing Requirements**

Faulty outflow valve or safety valve operation is among the commoner causes of aircraft pressurization problems. However, the conventional testing method used to check the operation of these valves that is described in the aircraft technical manuals requires the performance of a full battery of pressurization troubleshooting procedures. While theseprocedures will isolate a faulty valve successfully, they are designed to detect a variety of other causes of pressurization system problems as well, and include a timed pressure drop leakage test, a system operational test, a pressure controller test, and a number of other checks.

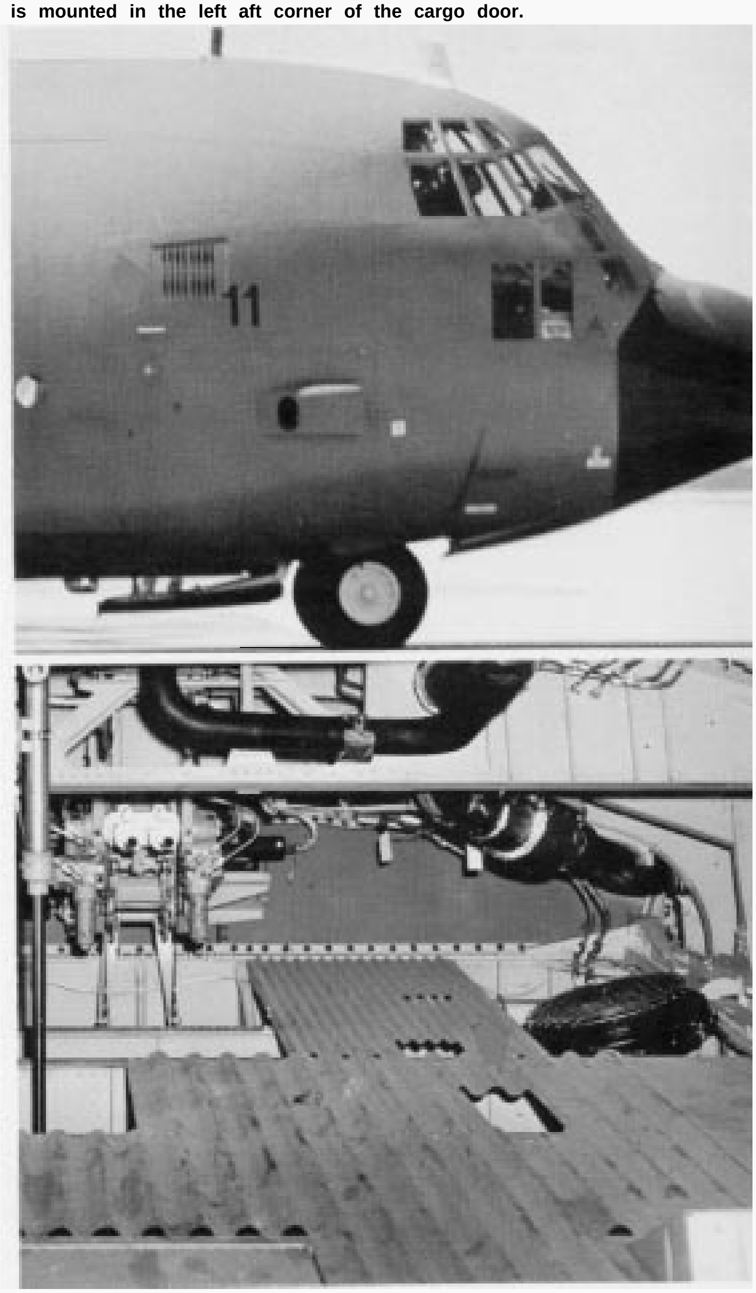
These tests are necessary for a complete checkout of a pressurization system that has an unknown problem, but they are costly both in terms of time and of labor. They also add a pressurization cycle to the aircraft.

A Streamlined Approach

Lockheed has now developed a new support equipment item, the Outflow and Safety Valve Tester, which can be used for fault isolation of a defective outflow or safety valve without resorting to the full complement of pressurization system tests. The tester is designed to connect to the outflow valve or safety valve and determine if the butterfly valve is operating properly in all of its required modes. If a faulty outflow or safety valve is found and replaced, and retest shows that the new valve is working properly, further troubleshooting of the pressurization system by conventional methods may be unnecessary.

This new test set contains the necessary vacuum set assemblies, valves, regulators, gages, tubing, and hoses to enable the outflow and safety valves to be checked for valve settings and pressure without pressurizing the aircraft. Development of this item was sponsored and funded by Warner Robins ALC at Robins AFB, Georgia.

Figure I. **The outflow is located at the back of the flight station behind these exterior vents; *(below)* the safety valve is mounted in the left aft corner of the cargo door.**



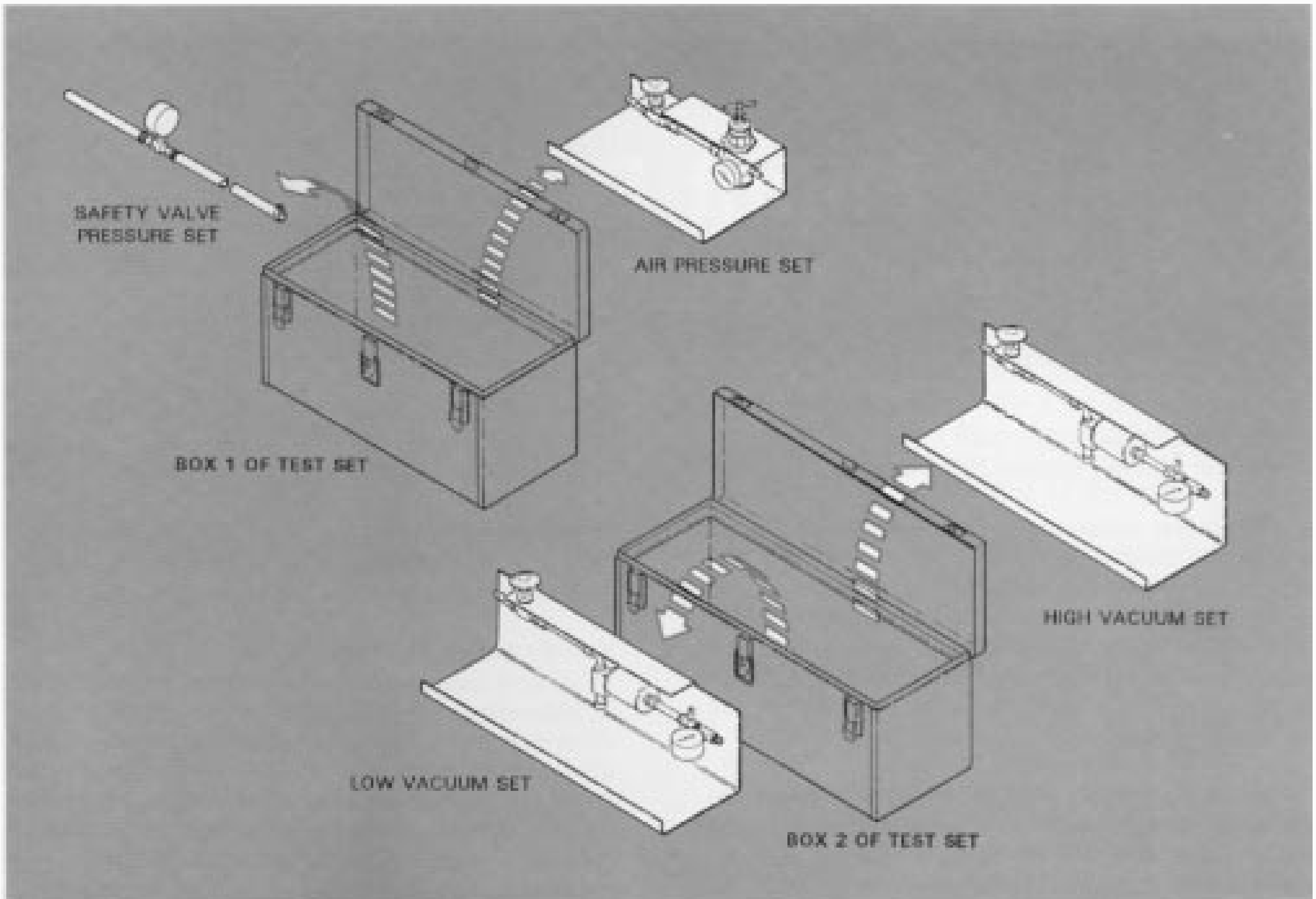


Figure 2. **The components of the Outflow and Safety Valve Tester are supplied in two conveniently designed toolboxes.**

All components of the test set are contained in two tool boxes (Figure 2). These include a safety valve pressure set assembly, an air pressure set assembly, low vacuum set assembly, a high vacuum set assembly and (not pictured) a control assembly, two hose assemblies, and a cup assembly. Instructions provided with the test set describe how these components are used to test an outflow valve or a safety valve as installed on the aircraft.

The instructions guide the technicians in the correct hookup of the test set hoses to the valve that is to be evaluated. They also provide procedures for use of the test set valves during testing, and describe the observations to be made in determining whether the unit is operating properly. Two technicians are required to perform the tests. An external source of shop air is the only power needed.

The advantages of using this test set for fault isolation of an outflow valve or a safety valve may be summarized as follows:

1. Aircraft pressurization is not required, thus saving time and manpower.

2. A pressure fatigue cycle on the structure is saved each time the tester detects a faulty valve whose replacement clears a pressurization problem.

3. Personnel are not unnecessarily exposed to the potential hazards of dealing with a large, pressurized structure.

Further Information

The new Lockheed PN 3403248-l Test Set, Outflow and Safety Valves, is now in the Air Force inventory, and is being stock listed. The engineering drawings have been submitted to and approved by the Air Force.

For further information concerning the operation of this test set, and for ordering information, please contact: Customer Supply Business Management, Dept. 65-11, Zone 0.577, Lockheed-LASC, Marietta, GA 30063; Telephone: 404-494-4214; Fax 404-494-7657; Telex 804263 LOC CUSTOMER SUPPL.

A DIGITAL Flight Data Recorder for Hercules Aircraft

by **Mel Reid,** *Training Specialist*
Customer Training Systems Department

Flight data recorders (FDRs) are electronic devices designed to monitor and record significant flight data parameters during aircraft operation. Because of the importance of this information to enhancing the safety of flight, FDRs are built to survive most conditions that might be encountered in an air crash, such as temperature extremes, high shock and puncture forces, and immersion in liquids.

In the event of an accident, the FDR is a valuable source of information for the National Transportation Safety Board (NTSB), the aircraft operator, aircraft manufacturer, and other investigative organizations. In other applications, user and manufacturer engineers can use the information from the recorder to study trend data of selected flight parameters. The FDR is sometimes called a "black box," but nowadays it is actually painted international orange to facilitate recovery. FDRs usually begin recording when aircraft power is applied, and record continuously during aircraft operation. Data recording ends when aircraft power is removed.

For many years, the FDR installed on the commercial and some military versions of the Hercules was the model LAS-l09C or LAS-109D, made by Lockheed Aircraft Service Co. (LAS), Ontario, California. This is an analog system that records elapsed flight time and a limited number of flight parameters on an aluminum foil tape installed in a cartridge in the recorder unit. During operation, motor-driven spindles move the tape past several movable, metal-tipped pens that scribe lines onto the foil tape. A fixed pen marks a baseline that serves as the reference line for measurements. The scribed lines thus form a permanent recording on the foil tape, which can store about 200 hours of flight operation data before a new tape cartridge must be installed.

Each movable pen is connected to an electrical servo system that receives signals from sensors or from other systems that provide flight parameter information. For example, a sensor built into the flight recorder unit monitors outside dynamic and static air pressures. This sensor converts the pressures into electrical signals that are applied to one of the pen servo systems. The pen scribes a line onto the foil tape that represents aircraft altitude when compared to the reference line, which is marked onto the tape at the same time.

New FM Requirements

The demonstrated value of FDRs in the ongoing effort to improve flight safety, together with continuing advances in electronics technology, have helped define an expanding role for these devices in the future of aircraft operations. In recent years, the Federal Aviation Administration (FAA) has established increasingly stringent requirements designed to take advantage of new FDR technology in controlling commercial flight operations in the United States. All large commercial aircraft, including the L- 100 Hercules, are now required to have an approved, ***digital*** flight data recorder on board. These units must include not only digital flight

Figure 1 The 109-series FDR was mounted in a spherical, protective container.

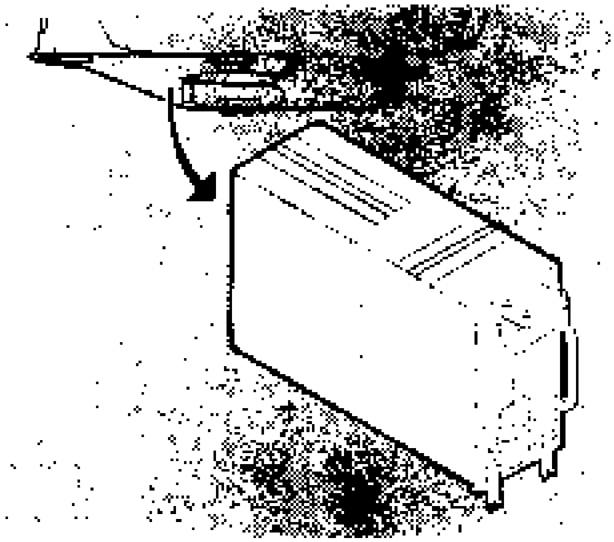


Figure 2 The mounting location for FDR and DFDR units is in the aft cargo compartment on the right-hand side

data acquisition, but also magnetic tape data recording. The new recorders also have higher crash survivability and can monitor an increased number of parameters.

Older, analog FDRs such as the LAS models 109C and 109D utilize servo-driven pen mechanisms and can record only a few flight parameters. They have little flexibility and no expansion capacity for monitoring additional parameters. The parameters recorded by these older recorders are limited to relative flight time, heading, altitude, airspeed, vertical acceleration, and a selectable discrete event (such as keying a radio, marker beacon detection, etc).

Furthermore, utilizing the data that are recorded by these analog systems is no simple undertaking. The foil tape output has to be analyzed by a certified specialist. The specialist, using keen skills, must visually compare scribe lines representing flight data with a calibrated plastic overlay placed on the foil and registered with the reference line mentioned above. Using this method, the specialist converts the scribed data into meaningful terms: altitude in feet, magnetic heading in degrees, and so forth.

Compared to the output of digital recorders and the data reduction methods applicable to them, both the basic operation of the analog recorder and the data interpretation by visual methods contribute to relatively imprecise and low resolution measurements.

The **Digital Difference**

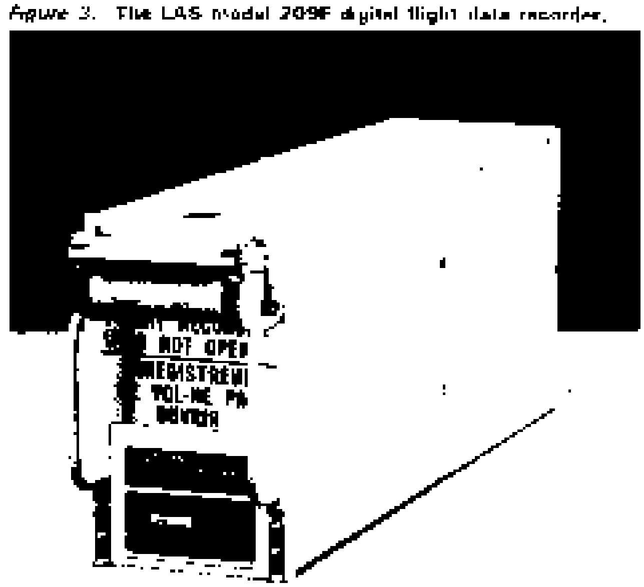
Technologically, the LAS 209F digital flight data recorder (DFDR) now being installed in newly delivered commercial Hercules aircraft and many military aircraft strikes quite a contrast to the analog system. Digital data recording provides not only the capability to record a great deal more data, but has the potential for significant expansion to meet future requirements.

The new Hercules flight recorder system consists of a flight data acquisition unit (FDAU,) and a DFDR. The FDAU is located in the IFF overhead equipment rack; the DFDR is mounted forward of FS 880.0 in the aft cargo compartment on the right-hand side.

The FDAU provides multi-channel signal inputs for 11 to 52 external sensors, with other channels reserved for additional sensors to allow for future monitoring expansion in addition to present requirements. The FDAU can monitor input from a variety of flight data sensors and systems, including the following:

- Power plant system parameters, including engine torque, reverse thrust, and throttle positions.
- Flight control surface position parameters, such as flap, aileron, elevator, and rudder positions.
- Automatic flight control system (AFCS) mode engagement discretes, such as heading hold, altitude hold, instrument landing system approach (ILS), etc.
- ILS radio mode signal status, such as glideslope deviation, localizer deviation, and marker beacon approach status.
- Radar or radio altitude.
- Aircraft attitude and acceleration parameters, such as pitch/roll attitude and longitudinal and lateral acceleration.

Figure 3. The LAS model 209F digital flight data recorder.



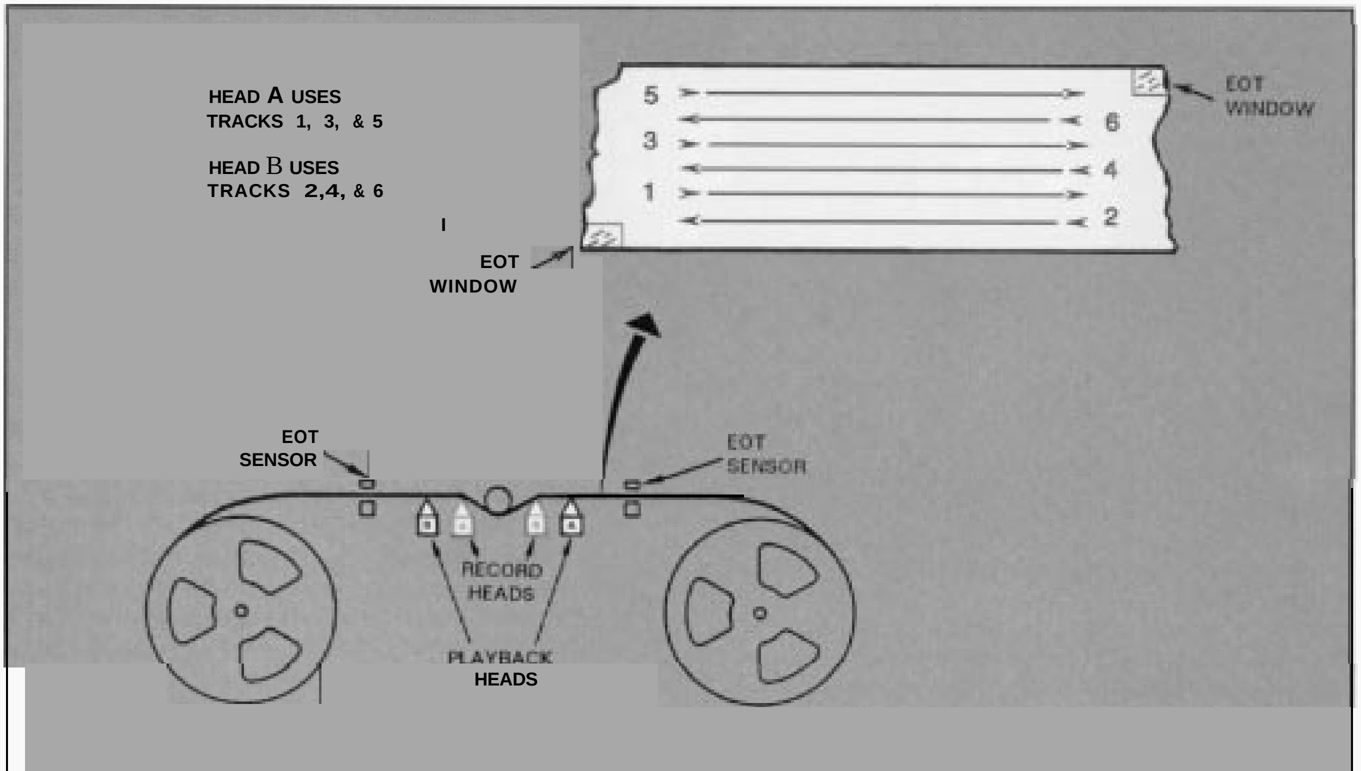


Figure 4. The DFDR's recording process makes efficient use of the magnetic tape medium to store 25 hours of data

- Miscellaneous systems and activities, including outside air temperature, main landing gear touchdown circuit switch, hydraulic pressure, ground speed, and radio keying signals.

The FDAU processes the input from the flight data sensors and systems into a single data stream which is transmitted to the DFDR for storage. The DFDR is an environmentally protected, multi-track magnetic tape unit. As installed on the Hercules, the unit can record 47 mission flight parameters on l/4-inch magnetic tape.

Tape Technology

The six-track tape is wound on coaxially mounted reels that reverse at the end of the tape. Tape reversal is initiated by optical detectors that sense clear windows near the ends of the tape. The magnetic tape passes two record heads, A and B (Figure 4), and two playback heads, B and A, at a speed of 0.37 inches per second. Each record head utilizes three active recording gaps (a fourth gap is unused). Head A records on tracks 1, 3, and 5; head B records on tracks 2,4, and 6. Data stream signals are applied to the recording gaps sequentially, andmicroprocessor-controlledswitchingensuresthatthe data stream is directed to the proper record gap.

Data to track 1 is recorded on track 1 by head A, gap 1 until the end of tape (EOT) is encountered. At this time two things occur: The dam is switched to record at head B, gap 2, and the tape reverses. The dam is then recorded on tape track 2. When the tape again reaches EOT, the data is switched back to head A, gap 3, and records on track 3. This reversing and switching action occurs six times in a 25-hour period. At the end of this period, head A, gap 1 records over the previous track 1 data and the entire process repeats for another 25 hours.

The magnetic tape therefore contains the last 25 hours of flight data at any given time. The Hercules DFDR system allows ground copying of the 25 hours of recorded data in only sixteen minutes, using a ground support tape copy unit with the DFDR in high-speed playback mode.

Figure 5. **With this ground support tape unit, the 25 hours of recorded DFDR data can be copied in just 16 minutes.**

The acquired information is stored on the tape in a digitally coded, serial format. These data have much better resolution and greater precision than those offered by the analog system, and they can readily be reduced for interpretation by high-level digital analysis. A suitable computerized data reduction system can provide hard copy data in either analog or digital format.

Today’s Performance Standard

While the 109~series FDRs perform the task for which they were designed dependably, they are limited in capability, flexibility, data reduction accuracy, and crash survivability when compared with their 209-series replacements.

The LAS 209-series magnetic tape recorder with FDAU unit is a proven system which has been the standard FDR for commercial airlines since 1972. This generation of FDRs was introduced into Air Force C-141s in 1982, and Air Force C-130s in 1986. This system offers significant improvements over the older, analog system. The 209~series recorder has greater monitoring capability, better data resolution, higher reliability, greater precision, and can provide consistent data reduction information and improved crash survivability.

Future Developments

Even more impressive developments lie ahead in this area. LAS in Ontario, California, is advancing the art of the FDR by bringing 2lst-century technology within our reach today in the form of the solid-state flight data recorder (SSFDR).

The recording medium for the new LAS 2100-series SSFDR, now being certified, will be high-density 1 -and 2-megabit flash memory chips instead of magnetic tape. The recording time of these storage units will continue to be 25 hours, and the recorded data will remain recoverable for two years or more.

The SSFDR will be able to operate in the temperature range of -50°C to 7O'C, and is protected from salt-water immersion up to hydrostatic pressures of 8700 psi and G forces equal to 3400 Gs for 6 milliseconds. Like the current 209F model, the SSFDR will be able to resist fire temperatures of 1100°C for up to 30 minutes, and puncture (spear) forces equivalent to a 500-lb weight with a l/4-inch sphere surface dropped from 10 feet.

Another advantage of these units as compared with magnetic-tape DFDRs will be a notable increase in the MTBF (mean time between failures). Currently about 8000 hours for the 209 series, the MTBF for the solid-state unit is expected to be better than 20,000 hours, an almost three-fold improvement. The solid-state recorders contain no moving parts and require no

Figure 6. The LAS model 2199 SSDFR, now being certified, will incorporate 2lst-century solid-state technology.

scheduled maintenance, so the cost of routine upkeep for the new design should be significantly lower.

The data supplied to Lockheed’s new SSFDR can be accessed with an IBM personal computer using an RS-422 interface. By using the appropriate software supplied on 5-1/4 or 3-1/2inch floppy disks, these desktop computers become the SSFDR’s ground support equipment. The ability to utilize standard IBM-compatiblecomputerssignificantlydecreases thesupport costs of the SSFDR because these computers are inexpensive and widely available throughout the aviation industry.

Advances in flight recorder design and development is making it easier for operators, regulatory organizations, and manufacturers to track and analyze flight dam. This will play a key role in future progress in the areas of aviation safety and aircraft performance.

The author and the *Service News staff* wish to thank Richard W. Nance of Lockheed Air Service Co. for his invaluable assistance in the preparation of this article. For further information about LAS flight dam recorders, please contact Mr. Nance at the Lockheed Aircraft Service Company, P.O. Box 33, Ontario, CA 91761-0033; Tel. 714-395-6225; Fax 714-395-6224

service news

NEW

Two Test Sets for the Temperature Datum Control System

by **Michael L. Fortenberry,** *Staff Engineer*
Electronic Support Equipment Engineering Dept.

Lockheed Aeronautical Systems Company has developed two new test sets that greatly facilitate testing, troubleshooting, and calibrating the electronic temp-perature datum control system of the Allison 501/T56 engines that power the Hercules aircraft.

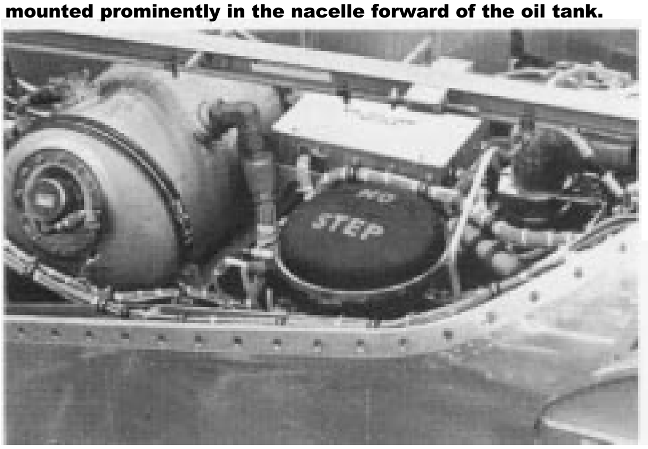
The temperature datum (TD) control system operates in conjunction with the temperature selection network of the 501/T56 turboprop engine and includes a TD control unit, usually called the TD amplifier, a set of 18 engine thermocouples, and the electro-hydro-mechanical TD valve of the engine fuel system. In operation, the system is able to maintain the engine turbine inlet temperature selected by the throttle lever position at any point within the flight range, and also limit the maximum temperature throughout the entire throttle range.

Consistently accurate operation of this vital control system is essential for safe engine operation and efficient fuel consumption. The Lockheed-manufactured Temperature Datum Control Test Sets described below provide an easy way to ensure that the entire TD system is maintained in optimum operating condition.

Test Set Part Number 3402893-l

Test set PN 3402893- 1 is an organizational-level test set housed in a portable aluminum instrument case. It is designed to enable the user to conduct on-aircraft tem-

Figure 1. **The TD amplifier is not difficult to find. It is mounted prominently in the nacelle forward of the oil tank.**



perature datum system performance testing, including the following:

- Static checkout of the complete TD system.
- Calibration of the turbine inlet temperature indicator.
- Analysis of the TD system control schedule.

The TD system components which can be tested by the PN 3402893-l Test Set are listed below.

Temperature Datum Amplifiers		
Vendor	PN	**Allison PN**
Bendix	179822-1	6842553
Bendix	5502636-l	6859769
Bendix	5502636-2	23008288
TI	543681-I	6870095
TI	839966-l	6887091
CE	23052609	23052609

Note: TI=Texas Instruments; CE=Combustion Engineering

Turbine Inlet Temperature Indicator

PN 9A375

Other System Components

Speed-Sensitive Switch
Throttle Lever Actuated Switches
TD Control Switch
TD Valve
Temperature Schedule Potentiometer

Supplied with the PN 3402893-I test set is a comprehensive operation and maintenance manual. It includes a functional description and wiring diagram of the test set, a functional test procedure, calibration data, troubleshooting procedures, and a parts list.

The manual includes all data necessary to perform flight line functional testing and provides linkage with the appropriate vendor manual section(s) for system fault isolation. This test set utilizes 400 Hz, 115 VAC, and 28 VDC aircraft power for its operation. The weight of the complete unit is approximately 20 pounds.

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Figure 2 (above). **For flight-line TD system checking, the portable PN 3402893-l test set provides an excellent selection of on-aircraft functional tests.**

Figure 3 (right). **The PN 3402893-3 tester is designed for use in field-level maintenance shops.**

Test Set Part Number 3402893-3

The PN 3402893-3 Test Set is a field-level tester housed in a single-bay cabinet. It is designed for use in a field-level maintenance repair shop to test, trouble-shoot, repair, and calibrate TD control amplifiers. This set will test the following TD control configurations:

Vendor PN		Allison PN
Bendix	179822- 1	6842553
Bendix	179727-2	6895769
Bendix	5502636-l	6859769
Bendix	5502636-2	23008288
Bendix	5502636-4	23009288
TI	543681-1	6870095
TI	839966-l	6887091
CE	23052609	23052609

The test set console consists of meters, switches, controls and the other components necessary to perform the required maintenance functions. Included is a holding fixture for supporting the TD amplifier during test and repair. The test set console also contains a calibration unit for selecting proper resistor values during calibration of the TD amplifier.

The PN 3402893-3 Test Set measures 58 inches high, 24 inches wide, and 44 inches deep (including a 20-inch work surface). It requires 400 Hz, 115 VAC electrical current for operation.

Included with the 3402893-3 Test Set is a comprehensive operation and maintenance manual for the test set, which includes a functional description with wiring diagrams, a functional test procedure, calibration data, troubleshooting procedures, and a parts list.

The manual also includes complete testing procedures for the controls previously identified and detailed diagnostic procedures to permit the technician to determine the failed part and return the unit to a serviceable condition. The instructions are profusely illustrated and contain numerous tables to assist the technician in locating the components and determining required values, etc.

All vendor LRU technical manuals referenced in the test set manuals are also provided with the test sets. For further information concerning the operation of these test sets, and for ordering information, please contact: Supply Sales and Contracts, Dept. 65-11, Zone 0577, Lockheed-LASC, Marietta, GA 30063. Telephone: 404-494-4214; Fax 404-494-7657; Telex: 804263 (LOC CUST SUPPLY).

Lockheed
Customer Training Systems Department
Lockheed – LASC
Marietta, GA 30063

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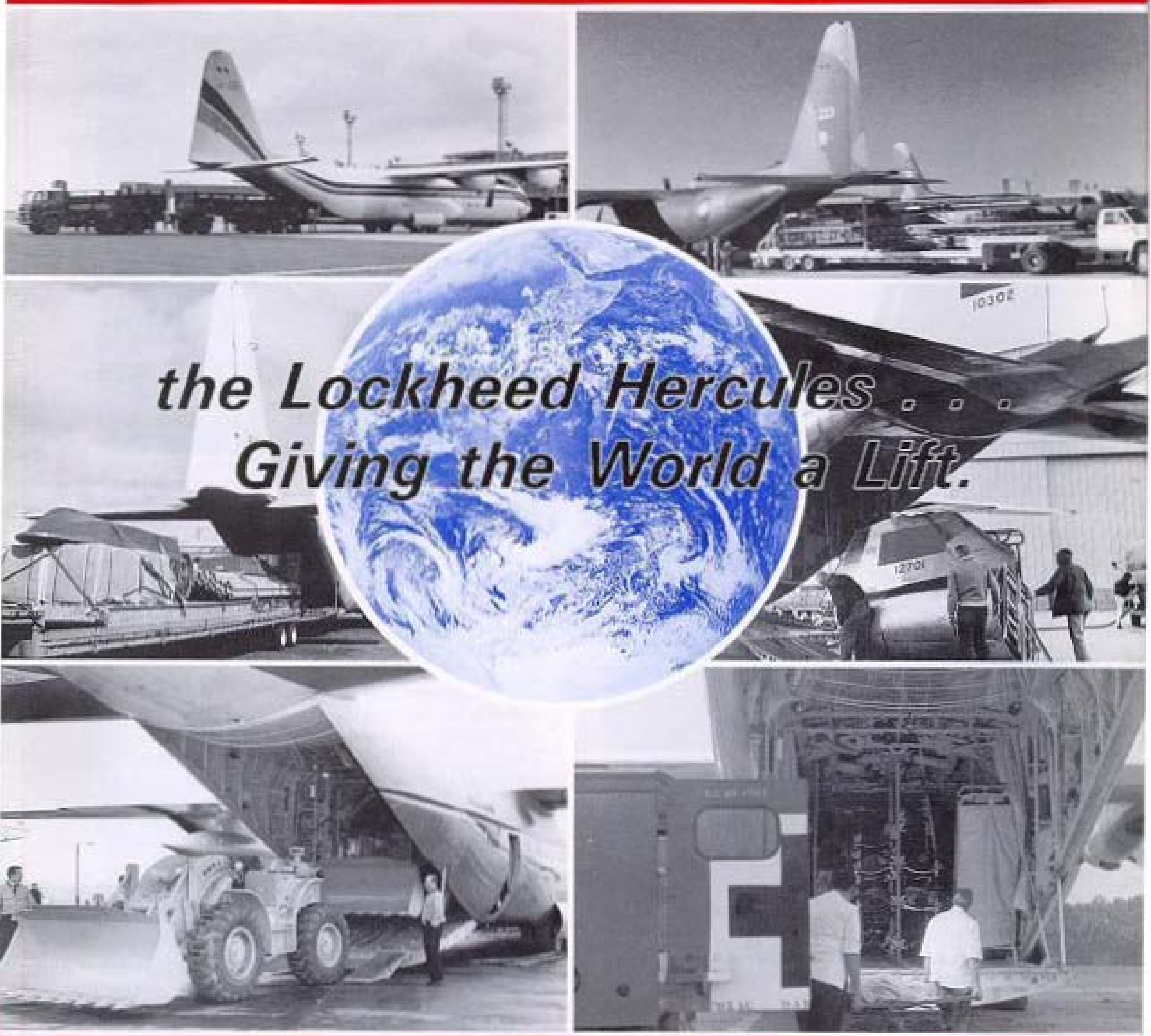

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