VOL. 29, NO.1, 2004

LOCKHEED MARTIN

Service News

SPECIAL CORROSION ISSUE

A SERVICE PUBLICATION OF LOCKHEED MARTIN AIR MOBILITY SUPPORT

Image Courtesy of 109th Airlift Wing

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https://www.lmsupport.com

Volume 29, No. 1 2004

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Address all comments or questions pertaining to the Service News to the ***Service News Editor*** at **ams.portal@lmco.com**

RESTRICTION NOTICE

FROM THE EDITOR'S DESK . . .

The 2003 Hercules Operators Conference, held October 26 through October 29, was a huge success. The conference provided a forum for all Hercules Operators to come together and share common concerns and successes along with Service Centers, vendors/suppliers, and Lockheed Martin.

The first Hercules Operators Conference was held in 1982 with 48 attendees representing 15 operators from 10 countries. The 2003 conference was the 15th conference with 320 attendees representing 40 operators from 35 countries. In addition, 38 vendors, suppliers and Service Centers were represented.

Lt. Gen. Ed Tenoso (USAF, Retired) provided the welcoming remarks to open the 2003 Hercules Operators Conference. There were more than 50 HOC 2003 Presentations. These presentations are currently available on-line at https://www.lmsupport.com/ams/news/hoc2003/hocpre.cfm .

This issue of the Service News is dedicated to responding to inquiries and requests from several HOC attendees. Included is a detailed, informative article that provides tips and techniques for the proper maintenance to prevent aircraft corrosion. Corrosion continues to be a significant problem for many Hercules operators and maintainers. Also included in this issue is the first part of a multi-part article outlining the history of the Hercules Wing.

As we endeavor to provide informative articles and pertinent information, your suggestions are always welcome. Please forward your comments and suggestions via e-mail to the ***Service News Editor,*** Mark Braunstein, at ams.portal@lmco.com.

Image Courtesy of 167th Airlift Wing

ADVANCED LIGHTING CONTROL SYSTEM

By William Doty - Systems Engineering, Field Tech Support Sr.

The Advanced Lighting Control System (ALCS) provides lighting control for the flight station and dome lights of C-130H-3 aircraft. This system works in conjunction with the Night Vision Imaging System (NVIS) to provide balanced lighting to reduce distractions to flight crews wearing NVIS equipment. Two components comprise the ALCS: the Trim and Status Panel (TSP) and Lighting Control Units (LCUs).

The TSP is used to send and receive trim, channel, and fault information from the LCUs. From the TSP, the desired lighting levels can be set by two different methods. The first is manually using the knobs and switches on the face of the TSP. Once new settings are made, they can be saved utilizing the SAVE TRIM switch. The second method uses a laptop computer and ALCS software input through a nine pin RS-232 connector that is connected to the face of the TSP. The maintenance person can program the lighting to desired levels and save the changes for later when replacing an LCU.

Lighting Control Unit (LCU)

The current software uses DOS based diskettes. This is being replaced by a windows based version on a CD-ROM. The new software automatically loads when the CD-ROM is installed in a laptop computer. From this point, the user follows the prompts to work with the TSP and LCUs for making changes to the light settings. The user also has the ability to download and print a copy of the manual for the Host Computer Interface (HCI) which provides instructions on the use of the ALCS software.

The new software program uses six different tabs on the computer screen during program operation. The Main Tab selects the COM port to be used and the serial number of the aircraft being accessed. The Upload/ Download Tab enables the sending and receiving of data between the TSP and the laptop computer. The Channel Edit Tab contains all the information in each LCU, some of which can be changed from this screen. The Test Tab is used to test the basic software functions of the TSP and some of the hardware functionality. The Log Viewer Tab displays all of the Log Messages, which is information about what has been done previously to the system. The Compare Data File Tab is only visible when the selected aircraft serial number does not have an associated file with it.

Trim and Status Panel (STP)

The Microsoft® Windows based version of the ALCS software uses three types of files to run the application. The INI files manage the application. They contain information that perform the following tasks: application start up, access and display of information, directs which digital command is required to read and write to and from the TSP, and channel mapping for the maximum allowable current on each channel.

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There are two log files: *log.txt* which contains general information on user interactions with the system command upon which aircraft and uploads or downloads were performed; and the second file is the *session.txt* file which contains more detailed information for troubleshooting problems with the aircraft interface and software. Both of these files can be viewed using MS Word or Notepad.

The LCU is the other component of the ALCS. On the C-130H and LC-130H, there are two LCUs. The number one unit is installed in the underdeck; the number two unit is located in the underbunk. On the HC-130(H)N aircraft there are three LCUs. The number one LCU is located at the same location as the C-130H. Number two and three LCUs are located at the radio operator's station.

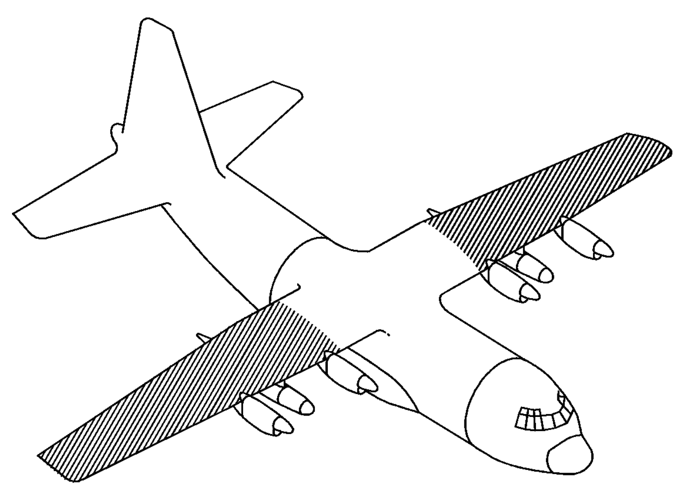
LCUs are the heart of the ALCS. Each LCU has 167 channels of varying current capabilities. There are 160 5VDC channels, one 28 VDC channel, and six 115 VAC channels which are no longer used due to incorporation of USAF TCTO 1C-130-1552. The 160 5VDC channels are divided between twelve dimming control inputs called zones. In each of these zones are five different current levels used to set the intensity of the lighting. Each channel can be trimmed within a range of -20% to + 15%. The 28 VDC channel is not able to be trimmed. This channel has a thunderstorm discrete input and a Normal/NVIS discrete input which turns the lights on or off as required.

HISTORY AND OVERVIEW OF WING IMPROVEMENTS (PART I)

By Dewey Meadows – Engineer Specialist, Sr.

This is the first of a series of articles discussing product improvements to Center and Outer Wings for the C-130/L-100 Hercules Aircraft. This article will highlight early Outer Wing changes from the C-130B/E of the late 1950s through the early C-130H of the 1970s. The outer wings have undergone more changes and improvements during this period than the center wing. The distinct evolution change breaks will be highlighted. The C-130A will not be a subject and will not be discussed in these articles.

To many observers of various C-130/L-100 Hercules Aircraft, the wings look much the same from one aircraft to the next but subtle differences do exist. An example of this would be the landing light located in the trailing edge under the outer wing which would indicate the original configuration of the C-130B wing. For the replacement wings, the landing light is located in the leading edge. The most positive way to determine any outer wing configuration is to look at the identification plate located behind the numbers 1 and 4 engines on the rear wing beam. The plate will contain either the original factory installed serial number or replacement wing identification. The center wings do not have identification plates with the exception of the USAF Special Operations Forces (SOF) replacement wings.



C-130 / L-100 Outer Wings

C-130B/E Outer Wings

The C-130B/E outer wings were designed and first built in the late 1950s. These wings were installed on LM aircraft serial numbers 3501 through 4541 and were constructed primarily of 7075-T6XX series aluminum alloy. It had good strength-to-weight capability and was used throughout the industry. The

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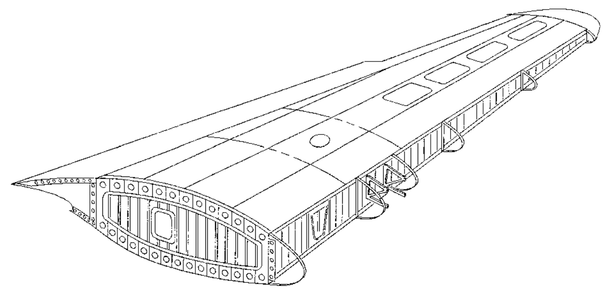
outer wing design incorporated this material in most of the major structure. Almost no one would have guessed then, that these aircraft would be in service 40 years later or be subjected to the severe USAF operational usage of the 1960s and 1970s in Southeast Asia. This usage initiated joint studies of wing service life by the US Government and Lockheed Martin. The Service Life Study included durability and fracture analysis, full scale durability testing and analysis of reported fleet service cracking for the C-130 wing. The study determined a major wing redesign was required to improve the C-130E outer wing service life. As a result, Lockheed Martin Aeronautics designed a new improved outer wing that would prove to be a major enhancement. This new improved outer wing is referred to as the Fiscal Year (FY) 1973 version.

FY'73 C-130H Outer Wings

The new FY'73 outer wings were designed in the early 1970s, built and installed from 1973 until 1983. The reference LM aircraft serials are 4542 through 4991. In addition to the new production wings installed on aircraft, replacement wings of the same configuration were also built and sold during this time period. These wings were identified by a Manufacturing End Product (MEP) serial commencing with MEP 12R-0001 and subsequent for LH wing and MEP 13R-9151 and subsequent for RH wing. Note, all wings are configured to an Engineering part number, and the formal part identification appears on the identification plate. The following are major improvements designed into these wings; however, not all improvements are listed below.



C-130 / L-100 Outer Wings

FY'73 Outer Wings Improvements

- *7075-T73 versus 7075-T6 Aluminum Alloy*. The basic wing structure, such as skin panels, beam caps, and wing joint attach fittings, is made from the 7075-T73 aluminum alloy which is less susceptible to stress corrosion cracking and more forgiving in the fatigue environment than the 7075-T6 material used on the C-130B/E wings. Along with this change was a general increase in part thickness to lower operating stress levels and improve fatigue resistance.

- *Engine Dry Bay Access Doors Changed to Elliptical Design*. This change was made to alleviate fatigue cracking in rectangle door openings. The box rib caps at these locations were changed to improve access into the dry bay.

- *A New Fuel Tank Water Removal System*. This system uses piccolo tubes between panel risers in the lower portion of the wings. It eliminates the weep holes in the skin panel risers which were a source of fatigue cracking.

- *Improved Fuel Tank Sealing System*. The fuel tank sealing includes fay surface sealed joints and wet installed fasteners using polysulfide sealant. The wing is then post assembly sealed which employs joint fillet sealing and fastener top overcoat. The wings are then standpipe tested for leaks using live fuel. If any leakage is found, the tank is repaired and re-tested.

- *Addition of Internal Refueling Pylon Attachment Backup Structure at Outer Wing Station 330*. This feature was for Tanker aircraft only on prior outer wings. (The three external attach fittings and the changes to the trailing edge rib are not included.)

- *Redesigned Fittings*. The fittings that attach the skin panel king pin risers to the wing joint fittings (rainbow) were redesigned to improve the fatigue resistance of the panels at OWS 35.

Look for the next article in this series on the Hercules Wing Evolution in the next issue of *Service News*. Part Two will feature the FY'84 Outer Wing Improvements.

PREVENTING AIRCRAFT CORROSION

By Everett J. Smith, M&P Specialist Engineer
Updated by Scott A. Jones, M&P Staff Engineer

This article is an expansion of *Service News* "Protecting Your C-130 Hercules Asset From Corrosion," Vol. 28, No. 2, 2003, and provides an update to *Service News* "Preventing Corrosion," Vol. 17, No. 1, January through March 1990. It will focus upon the prevention and control of corrosion along with basic requirements for maintaining the Hercules aircraft.

Numerous improvements have been made to the C-130 Hercules aircraft over the years. These include the use of more corrosion resistant aluminum alloys, improved finish systems, and increased use of corrosion-inhibiting sealants to name a few.

Unfortunately, these improvements cannot in themselves guarantee a permanently corrosion free airplane. A certain amount of corrosion is inevitable even with the best of care. Furthermore, as an airplane ages, corrosion problems tend to grow. This leads to an increase in labor, parts, and material costs. Just how rapidly these increased costs will accumulate depends to a great extent upon the quality of the operator's corrosion prevention and control program and his commitment to follow through on it.

Corrosion prevention must begin when the airplane is manufactured and must continue until the airplane is retired. In theory, an airplane could be operated indefinitely if it receives thorough inspections and prompt repairs. In practice, at some point, the operator will probably decide to retire the airplane because of escalating maintenance costs.

Cleaning the Airplane

Two primary reasons for cleaning airplanes are to remove corrosion-causing contaminants and to provide clean surfaces for good corrosion inspections. An additional benefit is that improved overall appearance of the airplane is achieved.

The importance of cleaning airplanes regularly cannot be overemphasized. How often an airplane requires cleaning is dependent upon its operational environment. For example, airplanes operating in arid, pollution-free environments require less frequent cleaning than airplanes operating in hot and humid climates, within about ten miles of seacoasts, or in most desert regions. Even though the climate may otherwise be acceptable, most deserts were sites of ancient sea beds and the sand often contains a significant amount of salt. This may have unexpected consequences in terms of exposure to corrosive contaminants and attack.

The Wash Rack Crew

Safety must always be the first consideration in any activity involving aircraft, and the wash rack is no exception. In particular, an appropriately designed safety device is necessary to protect workers from falls while they are cleaning upper wing surfaces. One such device is a cable running span wise and six to seven feet above the wing. Each end of the cable is fixed to an indoor wash facility wall or to posts in the case of an outdoor facility. Workers can then attach a lanyard from their safety harness to this cable if it is required to stand on the wing while washing.

In spite of the recognized complexities involved in cleaning airplanes properly, many operators use wash rack workers who have been given very little training in safe and effective airplane cleaning techniques. The most serious problem resulting from this lack of training is the misuse of wash rack chemicals. If not mixed and used correctly, or if unauthorized cleaners are used, substantial damage to the airplane can occur.

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For example, Stoddard solvent and solvent-type cleaning compounds will cause deterioration of most rubber products if not mixed in the correct proportions or not rinsed off completely during use. Strong, alkaline cleaning compounds will corrode aluminum alloys and can etch and damage some types of protective finishes. For the sake of the airplane, it is always best to use a dedicated cleaning crew. A well-trained, dedicated crew will soon master all the intricacies of airplane cleaning techniques and perform more efficiently than a "made-up" crew.

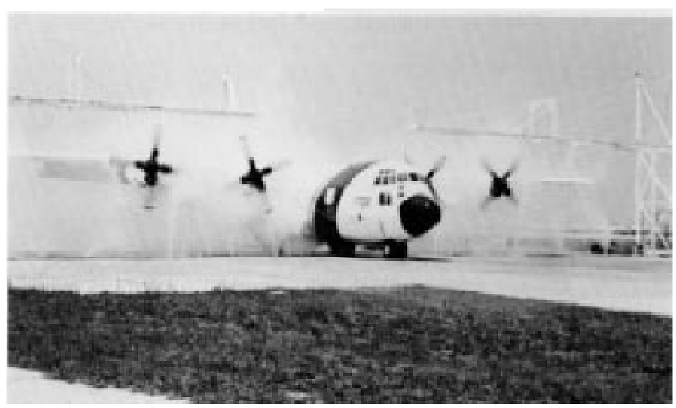
Whether the operator has enough work to justify a dedicated crew or not, everyone engaged in cleaning airplanes must be thoroughly trained. In addition to the personal safety aspects, the crew must be knowledgeable about the handling, mixing, and storage of all chemicals used on the wash rack. Each crew member must also know how to use the chemicals, tools, and equipment without causing damage to the airplane.

Wash rack workers need the protection of safety harnesses when working on the upper surfaces of the aircraft.

Washing Facilities

An airplane cleaning facility need not be elaborate to be effective, but it must be adequate to do the job year-round. It could be just a concrete pad, or it might be an elegant indoor facility with all the modern amenities. In either case, there are certain requirements for even the most basic wash facility.

Unless built-in stands are used, the facility must be large enough to allow movement of portable stands completely around the airplane. Stands, movable or fixed, should be of sufficient height to allow easy access to all exterior surfaces of the airplane. If airplane cleaning is done at night, the lighting should be bright enough to provide good visibility, with a minimum of shadows, for all surfaces being cleaned.



An automated outdoor rinsing facility helps protect Coast Guard aircraft from the corrosive effects of salt spray.

Rinse water pressure is not as important as the volume of water. As a rule of thumb, adequate pressure is available when the top of the tail can be rinsed by a worker standing on the ground. The volume of water used should be sufficient to provide a free-flowing action over the surface being rinsed; this requires a minimum flow of about eight gallons per minute.

Water quality is also important for washing and rinsing airplanes. In some parts of the world, the local water is not suitable for cleaning because of its "hardness." Hardness is a general term used to describe the amount of dissolved minerals, primarily calcium carbonate ($CaCO_3$), that water may contain. Total hardness or $CaCO_3$ should be limited to 420 parts per million (ppm). In addition, total dissolved solids should be limited to 500 ppm, sulfate to 107 ppm, and chloride to 50 ppm. Water containing less than these limits is considered satisfactory for washing aircraft. When water analysis indicates values significantly in excess of those listed, the water should be chemically treated to reduce the level of impurities before it is used to wash an airplane.

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Cleaning Hints-Aircraft Exterior

Commonplace tools used for washing include non-metallic cleaning brushes, abrasive pads, buckets, and so forth. Most operators also provide safety equipment such as face masks, rubber gloves, and wet weather gear to their washing personnel. There are, however, additional items listed below that some operators already use which make the job easier, provide a cleaner airplane, and help prevent corrosion.

- There is no substitute for a wet-or-dry vacuum cleaner to remove dirt and water from joints and crevices after washing.

- During the airplane exterior wash, particularly when using outdoor facilities, it is a good idea to use a foam generator. This equipment applies a layer of cleaning solution foam which clings equally well to vertical and lower horizontal surfaces, thereby keeping the cleaning solution against the surface for better cleaning action. The foam also resists drying on the airplane surface longer than the liquid solution. Low-pressure compressed air is required to operate the foam generator.

- Although cleaning solutions can be mixed by hand, mistakes in cleaner-to-water ratios can happen. The use of a chemical proportioner will eliminate mixing errors. Built-in mixing equipment, although more sophisticated, functions much the same way as the portable proportioner. In use, the equipment is connected to a water source and to a container of concentrated cleaning compound. The operator turns a valve to the desired mix ratio, activates the machine, and applies the mixed cleaning solution to the aircraft surface.

- Unless a built-in bulk storage and pumping system exists at the wash facility, an air-operated barrel pump is needed to transfer cleaning chemicals from the storage drums to mixing tanks, etc.

- The use of hot water (100°F to 150°F) increases its cleaning and rinsing ability, and reduces man-hours by as much as 20 percent, according to U.S. Air Force studies. If only a limited amount of hot water is available, use it for applying the cleaning solution and then rinse with cold water.

During airplane exterior cleaning, the brushes, mops, etc., should not be placed on the ground where they may pick up dirt that will damage the paint. Also, high-pressure water should not be directed toward wheel bearings or other lubrication points, or at thin-sheet honeycomb panels. After the wash, and before the airplane dries, apply a thin coat of soil barrier (Cee-Bee A-6 or Eldorado PC-1020 or equivalent) to hard-to-clean areas and to areas subject to urine spray. Typical of such locations are engine exhaust paths and aft fuselage belly and ramp skin panels for Hercules aircraft still using the urinals with the overboard drain system. Relubricate all lubrication points within the cleaned area.

Cleaning Hints-Aircraft Interior

The use of water hoses for cleaning inside the airplane is not recommended because of possible damage to the electrical equipment, and also because of the corrosion that could be caused by water and cleaning solutions entering inaccessible areas of the airplane and remaining there. It is best to use a rag or sponge to apply cleaning solution from a bucket. After scrubbing interior surfaces with a soft, bristle brush, wipe off all dirt and cleaning solution thoroughly with a rag or sponge, rinsing frequently in clean water. Use a wet-or-dry vacuum cleaner or dry rags or sponges to remove excess water.

Another criterion which must be taken into account is the type of cargo being hauled. Anytime a corrosive cargo such as cement, fertilizer, animals or animal carcasses, or similar items, is transported, the airplane interior should be thoroughly cleaned after each mission, including under the floor if a cargo spill is suspected. Each operator should evaluate his own operation and establish a cleaning

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frequency that will satisfy the requirements of his individual corrosion-prevention program.

Aircraft interiors must be cleaned thoroughly after each mission involving the transportation of animals.

Fire Extinguishing Agents

Most fire extinguishing agents are corrosive and can very quickly produce severe corrosion on airplane structure. Bromochloromethane and foam type agents are the most notable offenders in this regard. Some of the more commonly used dry powder type agents, such as potassium bicarbonate (PKP), are only mildly corrosive. However, after exposure to heat, the residue may convert to potassium hydroxide, which is very corrosive indeed.

As if that were not already bad enough, both of these potassium salts are hygroscopic and will absorb moisture, creating a corrosive poultice on airplane surfaces. The soot generated by an airplane fire is carbon contaminated by a variety of combustion byproducts, depending upon what is being burned. Like the agents in dry powder extinguishers, soot is both corrosive and hygroscopic. Airplanes contaminated with fire extinguishing chemicals and soot must be cleaned and neutralized as soon as possible after exposure. Regardless of the type fire extinguishing agent used, it is recommended that the affected areas be water rinsed and/or neutralized as soon as possible to minimize corrosive attack.

Inspecting for Corrosion

Have you ever wondered why some mechanics are better at finding corrosion than others? In addition to being well-trained, mechanics who show a special knack for finding corrosion have developed the ability to recognize corrosion “indicators.” Indicators are those little things that point toward a potential corrosion problem. These can be anything out of the ordinary, such as missing sealant in a joint, a wet area or tide marks where water has been in contact with aircraft surfaces. Chipped or discolored paint may also be an indicator of possible corrosion problems.

Finding corrosion is perhaps as important as removing it, because once the corrosion is found and documented, the airplane’s condition has become a “known.” As long as safety of flight is not affected, the corrosion may be removed at another time.

Remember, however, that the severity of corrosion increases with time, so repairs should not be delayed too long. After a few inspections, a pattern often emerges in which corrosion will be found in the same areas on all Hercules aircraft operating out of a similar environment. Some problems will differ from model to model because of changes in materials and processing and the finishing improvements that have been incorporated over the years since the first Hercules airplane was built.

Training for anyone performing corrosion inspections should, as a minimum, consist of thorough familiarization with the types of corrosion which may be encountered and the corrosion history of the airplanes that will be inspected. The only tools required are a bright light, a 10x magnifying glass, a mirror, a pit depth guage, and a machinist’s scribe for probing suspected corrosion. A borescope is ideal for looking into small openings without requiring disassembly of the adjacent structure.

Corrosion Removal

There are two recognized methods for removing corrosion: chemical and mechanical. For a number of reasons, the chemical method of corrosion removal is not widely used by operational organizations.

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Chemicals work more slowly than the mechanical methods, and there is a danger that chemicals will enter joints, be difficult to remove, and cause further corrosion. To be considered are also questions of personal safety and waste disposal.

Most corrosion must be removed mechanically. In many cases an abrasive blaster can speed up the cleaning chore.

Most corrosion problems have to be attacked mechanically, and there are a number of methods by which this can be done. These include everything from the use of sandpaper to complex methods involving abrasive blasting. The method of selection will depend upon the type of metal, the location and accessibility of the corroded area, the degree of damage, and the type of corrosion involved.

A typical corrosion removal sequence proceeds as follows:

- Protect the area surrounding the corroded area from damage during the corrosion repair.
- Clean the affected area of dirt, grease, etc.
- Remove the corrosion. To avoid stress risers (crack starting points), be sure the corrosion removal surface is left in the shape of a saucer, with no sharp angles. Also ensure that all corrosion is removed and the affected area is polished smooth.
- Check the depth of the area where corrosion was removed with a depth gauge and do the necessary documentation. Some operators require this step before and after removing corrosion.
- Shot-peen the treated area when required.
- Apply conversion coating (Alodine) to the removal area on aluminum. Follow the operator's finish requirements for other pretreatments.
- Fill depressions on upper horizontal surfaces with a corrosion-inhibiting sealant to prevent water puddles from forming in them.
- Re-apply appropriate finish after sealant has cured.

Sealants

Sealant may be the most versatile and effective weapon in preventing aircraft corrosion ever introduced. It is used to exclude moisture and water and to separate joined metals. Exterior joints and gaps are filled with sealants to prevent water and chemicals from entering. In addition to environmental sealing, sealant is also used for wet-installation of fasteners, pressure sealing, and aerodynamic smoothness.

The use of sealant, specifically to combat corrosion in the Hercules aircraft, started with the manufacture of Lockheed Martin serial number 4127 in May 1965. At first, a non-corrosion inhibiting sealant of the MIL-S-8802 type was employed. Beginning with LM serial number 4331, built in September 1968, a corrosion inhibiting sealant conforming to MIL-S-81733 was introduced.

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Some sealants are formulated for specific uses such as applications in high-heat areas, containment of fuel, and electrical conduction with corrosion protection. In general, a sealant should be used only for its intended purpose, but some sealants may be used as substitutes for others when necessary. Descriptions of the more common sealant types used on the Hercules airplane today are listed below:

- *MIL-S-38249:* A firewall sealant formulated for use in sustained temperatures ranging from -65°F to +400°F. It can withstand a flash temperature of +2000°F for 15 minutes. Lockheed Martin also uses a silicone-based, high temperature sealant, AMS 3374 (Dapco 2100 Primerless Firewall Sealant, manufactured by D Aircraft Products), interchangeably with MIL-S-38249.

- *STM 40-114:* This is a polysulfide corrosion-inhibiting sealant with aluminum particles added to provide electrical conductivity. Its temperature range is -65°F to +250°F. It is used for faying surface sealing when corrosion protection and electrical conductivity are required; i.e., to protect structure under antennas. This material is commercially available as Pro-Seal 872, manufactured by PRC-DeSoto International.

- *MIL-S-8784:* A low-adhesion polysulfide sealant used for sealing removable panels. It is available in formulations for brushing (Class A) or for use with a spatula or sealant gun (Class B). This material should not be used for permanent installations. Although MIL-S-8784 has low peel strength, it is recommended to apply a bond release agent, such as MR225 or Plastilease 334, manufactured by Valspar-Gardena, to the panel during reinstallation to make future removals even easier.

- *AMS-S-8802:* This is a polysulfide sealant used for fuel tank fillet sealing and brush-overcoating of fasteners. It is also used on the exterior of the airplane to satisfy the aerodynamic smoothness requirements. Its effective temperature range is from -65°F to +250°F. As a last resort, AMS-S-8802 may be used as a substitute for MIL-PRF-81733 for faying surface sealing and wet installation of fasteners.

The use of sealants during aircraft manufacture has proved an effective and versatile weapon against corrosion.

- *MIL-PRF-81733:* Available in two classes and four types, Class 1 material is a polysulfide rubber base sealant ,and Class 2 is a polythioether rubber base sealant. Both contain corrosion inhibitors, but only Class 1 sealants are used on the Hercules. It is widely used for wet-installation of permanent fasteners, faying surface sealing of permanently joined structure, and for repairs. Its temperature range is -65°F to +250°F. Type I is brushable. Type II is a paste for use with a spatula or sealant gun. Type III is sprayable. Type IV is used when extended assembly time is required.

Sealant Savvy

All sealants have a specified shelf life listed on the container. Shelf life is the length of time the material may be stored and used without its integrity being affected. However, to reach its full shelf life, a sealant should be stored in a cool, dry area. Under no circumstances should sealant be stored where a temperature of 80°F is exceeded. Since the temperature in most parts of the world rises above 80°F, at least during the summer, it is advisable to use an explosion-proof refrigerator for storing the sealant.

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Some sealants may still be usable for a while after expiration of their shelf life date, but extreme caution should be exercised before using them. It is very disappointing to discover the sealant will not cure after structure has been assembled. To avoid encountering this situation, mix a small amount of sealant as a test and note the cure time. If the base material is smooth and free of lumps, if the catalyst has not dried out, and if the cure time is within the manufacturer's specification shown on the container, the sealant is usable.

Structure under antennas is a common site for corrosion, particularly where the antenna is not sealed, or gaskets have been damaged.

There are three main problems encountered while mixing and using sealants, and all are avoidable with proper care and attention to detail. (1) When sealant does not cure or takes too long to cure, the problem usually is that the sealant was over or under catalyzed. Occasionally, outdated sealant will be the cause. The use of a gram scale to accurately weigh the sealant base and catalyst, will ensure a correct mix ratio every time. (2) Marbleized (streaky) sealant is caused by incomplete mixing, and as a result, the streaked areas of catalyst or base material will not cure. (3) Surfaces must be really clean for good sealant adhesion; otherwise, moisture will penetrate between the sealant and the structure by capillary action and cause hidden corrosion.

Temperature and humidity greatly affect curing of sealant. For example, curing times for sealants are based upon a standard condition of 77°F and 50 percent relative humidity. For every 15°F decrease in temperature below 77°F, the cure time doubles. For every 15°F increase in temperature over 77°F, the cure time is halved. Cure times may be shortened by applying heat, but do not exceed 140°F during the cure cycle. Before applying sealant, ensure that the structure is 40°F or warmer and will remain so until complete cure of the sealant.

Corrosion Preventive Compounds

Corrosion preventive compounds (CPCs) come in a variety of types with many different chemical and physical characteristics. Historically, they have been placed into two major categories: water displacing and non-water displacing. Today, a new generation of CPC products is available that combine the most desirable properties from both these categories.

Water-displacing compounds are light duty, oil-like compounds having the ability to displace water and penetrate voids in faying surfaces, cracks, and around fastener heads. These compounds usually provide a wet, non-drying thin protective coating of one mil (0.025 mm) or less in thickness and are clear or almost clear in appearance. They do not provide long lasting protection and are much less effective in areas of high water runoff when compared to non-water displacing compounds.

Non-water displacing or barrier type compounds are heavier bodied oils or greases that provide longer lasting protection. They generally provide a protective coating that can be up to three mils (0.075 mm) or more in thickness. Most dry to a durable, firm, non-tacky film and usually are lightly color-tinted brown, blue, or pink to provide a visual indication of where they have been applied. Others are waxy in appearance and remain viscous. These compounds generally do not penetrate faying surfaces very well. Because of this, sometimes they are applied on top of water-displacing compounds to provide added protection. When used for this purpose, it is referred to as a two-step or dual-coat CPC application system.

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Next generation compounds provide penetrating, water-displacement capabilities along with barrier type performance with one product. These CPC products go on wet like water-displacing compounds and quickly penetrate voids, cracks, or faying surfaces and displace moisture. Then, after a short period of time, the CPC product cures to a firm, non-tacky, barrier type film.

No CPC should be relied upon to provide permanent corrosion protection. Reapplication is required periodically. Although CPCs contain oil, they provide poor lubricity and should not be used in sliding joints. Also, CPCs should not be used on or near liquid oxygen systems and equipment, on or off the airplane. Oxygen in contact with CPCs could result in fire or explosion. Most CPCs may be obtained in either bulk form or packaged in aerosol containers.

Three commonly used military specification CPCs are identified below:

- *MIL-C-16173*: This CPC may be obtained in five grades, ranging from a very viscous, wax-like type material, to a very thin, transparent film CPC. Grades 3 and 4 are the two types most often used on airplanes. Grade 3 is a water-displacing type, and Grade 4 is non-water displacing.

- *MIL-C-81309:* There are two types and classes of this CPC, all of which are water-displacing. Class 1 is supplied in bulk form; Class 2 is distributed in aerosol containers. Type II of either class can be used for corrosion protection of metallic structure. Type III of either class is an avionics grade and can safely be used on electrical connectors and equipment.

- *MIL-C-85054*: This material, also known as Amlguard, forms a clear, dry, flexible film which is removable with solvent. Amlguard should not be used in tight-fitting joints or on moving or sliding parts. It offers excellent temporary protection for chipped paint spots.

General CPC Usage Guidance

Thin, water-displacing, penetrating CPC products, such as MIL-C-81309 and MIL-C-16173, Grade 3 CPCs are easily washed away. However, these products are believed to still be present in faying surfaces where voids in finishes or sealant may exist. Frequent reapplication is required to ensure adequate protection. It would not be unreasonable to reapply these type products every 30 days. Because they are easily washed away, their use on external and water run-off areas should be avoided in favor of using a more durable CPC product.

Soft, waxy, non-curing CPC products, such as MIL-C-16173, Grades 2, 4, and 5 tend to easily trap dirt, debris, FOD, and soot. For this reason, their use on external areas, wheel well areas, and cargo compartment areas should be avoided. CPCs, with trapped dirt and debris, provide a potential for adverse damage to occur. Damage may be in the form of wear or abrasion of underlying protective finishes and possible galvanic interactions between the trapped particles and substrate. Also, these type products are visually unpleasing once they have been contaminated with trapped particles. However, these products are usually self-healing, meaning they can reflow to some extent if scratched or locally damaged. Thus, they can provide long lasting protection. They are best suited for use in enclosed areas where the risk of airborne contaminants is low.

Firm, hard-film CPC products, such as MIL-C-85054 and MIL-C-16173, Grade 1, provide long lasting, barrier-type cured films that allow visual inspections to be performed without removal. They are not as durable as primer or paint finishes and do not contain UV stabilizers; therefore, use on upper external areas should be avoided. Also, they should not be considered as a replacement or substitution for the more durable paint finish systems. However, they are ideal products to use for touching up paint chips

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until the finish system can be properly restored. They are easily softened by hydraulic fluid, and use on or near areas where hydraulic leaks are present or likely should also be avoided. Thin coat applications are preferred over thick applied ones for optimum curing and ease of performing visual inspections. There is a high potential that thick or heavily applied products will not cure properly, and therefore, remain tacky, which is undesirable.

It should be apparent that several types and categories of CPC are available for aircraft use. Careful selection and use of the proper CPC will help in preventing the onset of corrosion in many areas of the Hercules aircraft. Remember that while CPCs are very practical weapons in the corrosion prevention arsenal, they are not intended to provide permanent corrosion protection and must be periodically reapplied to remain effective.

Special Problems

Many engineering drawings and specifications have traditionally required antenna mating surfaces and fasteners be free of insulating finishes in order to provide good electrical conductivity. Unfortunately, where antennas are not sealed, corrosion is commonplace on structure under the installation. Wherever metal-to-metal contact is required, the reason for corrosion susceptibility is obvious.

Some antennas are installed with rubber or cork gaskets. A common corrosion hazard associated with rubber gaskets is they may be damaged or deformed by airplane cleaning chemicals and weathering, which allows moisture to penetrate. Cork gaskets are also somewhat problematical; they tend to wick water into the antenna and structure interface.

Service News, Vol. 14, No. 4, October-December 1987 provides a helpful procedure for sealing VHF NAV antennas. This procedure may be used to install any antenna where metal-to-metal contact is required. Do not forget to apply a bond release agent to the antenna before installation. The procedure may also be used in lieu of installing the rubber or cork gasket when its use is not prohibited by maintenance managers or engineering.

If a gasket must be used, apply ample amount of sealant to the structure before installing the gasket and antenna. After installation, apply a fillet seal around the antenna periphery with MIL-S-8802 fluid-resistant sealant.

Prevention and Repair Examples

Regardless of airplane age, doing frequent inspections, cleaning regularly, removing corrosion promptly, and keeping finishes and sealant intact will minimize corrosion damage on the Hercules airplane. The following paragraphs offer several examples of corrosion-prone or corrosion problem areas and the recommended prevention and repair techniques:

Latrine, urinal, and galley areas are more subject to corrosive attack than anywhere else on the airplane. Special sealing and acid-resistant finishes have been used on structure under this equipment since Lockheed Martin serial number 4127. This means airplanes that were manufactured previously will require more attention to these areas than the newer ones.

On all airplanes, look for corrosive fluids, dirt, chipped or deteriorated paint, and missing or damaged sealant on structure under and around these installations. After cleaning and drying, carry out the necessary corrosion, paint, and sealant repairs. These areas may benefit further with the appropriate use of CPCs. Pay particular attention to structural joints and crevices. If there is any chance of the CPC being inadvertently applied to avionics equipment, either protect the equipment or use an avionics grade CPC. Be sure to remove any CPC overspray which may have reached the floor as CPCs are slippery and overspray on the floor may cause a safety hazard.

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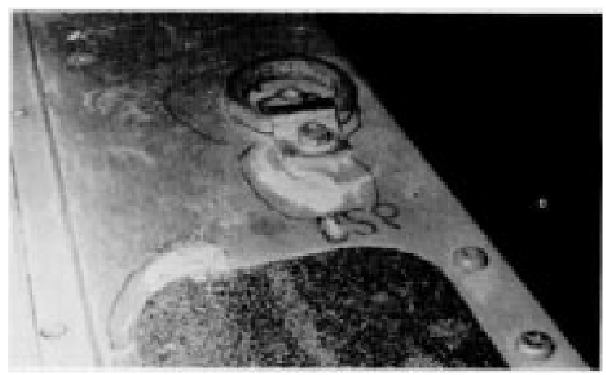
Over the years, there have been many instances of severe corrosion on the upper surface of cargo floor chine caps. Water entering through open doors and hatches, spilled cargo, and latrine fluids all contribute to the corrosive environment of these chine caps. On airplanes with the aerial delivery system rails installed, fluids enter the rail and structure interface by capillary action. Fluids and soils can also be entrapped in the opening between the chine cap and the inboard portion of the Z-shaped doubler under the D-ring fittings where sealant is not used to prevent entry.

Since moisture will remain under the rails and doublers longer than in an open area, corrosion will progress more rapidly. To prevent corrosion of the chine cap, remove the rails (if used) and the doublers and thoroughly clean the cap upper surface. Remove any corrosion found, apply conversion coating to the affected area and fill any depressions to slightly above the cap surface with corrosion-inhibiting sealant. Once the sealant has cured to at least a tack-free state, apply one coat each of epoxy primer and polyurethane enamel to the whole chine cap upper surface. After the paint has dried, reinstall the Z-doubler, D-ring, and bolts with a corrosion-inhibiting sealant on all contacting surfaces. Use low-adhesion sealant for bolt installation. Do not apply sealant to the underside of the rails.

There have been instances where attempts were made to grind corrosion from steel fasteners on wing and empennage panels with the fasteners still in place. This practice weakens both the fastener and the surrounding aluminum structure. When rusty fasteners are found, they should be replaced. Use corrosion-inhibiting sealant to install the new permanent fasteners. Wet install temporary fasteners with low-adhesion sealant.

An alternative to fastener replacement is to remove the rust with portable abrasive blast equipment and A-A-59316, Type III, Grade B or C glass beads, provided there is no corrosion in the fastener-to-structure interface. Adjust the air pressure to the lowest setting which will remove the rust but not cause damage to the fastener or surrounding structure. Immediately after corrosion removal or new fastener installation, clean the area and apply the appropriate finish system. Do not use the same glass beads for abrasive blasting more than one type of metal. The glass beads become contaminated with minute particles from the part being blasted, which could cause corrosion of a dissimilar metal. Also, blasting of metals with a thickness of 0.0625 inch or less could damage the metal.



The corrosion resistance of the cargo floor chine caps can be enhanced by cleaning, sealing, and painting the upper surfaces.

Glued to the fuselage side panels are vertical rows of felt which act as stand-offs for the cargo compartment insulation blankets. There have been reports of corrosion forming behind these strips. If corrosion is found on your airplane, remove the felt strips and underlying old glue with wood or phenolic scrapers. Remove the corrosion, clean the affected area, apply conversion coating to unpainted spots, and touch up the paint. After the paint has dried, reinstall the felt strips (or install new strips) with sealant, extending the sealant slightly beyond the width of the felt to prevent moisture that may entrap in the felt from contacting the metal structure.

Have you ever seen a drain hole that appeared to be drilled in the wrong place because it did not completely drain the low spot? Misdrilled holes are not unheard of, but every effort is made to drill the hole at the lowest point. However, this is not always possible due to structural concerns. When low

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spots are found not completely drained, take note of the water level and then thoroughly dry the area. Remove the dirt and debris and fill the spot up to the water line with corrosion-inhibiting sealant. Slope the sealant toward the drain hole, being careful not to clog the hole. After the sealant is tack-free, apply a thin coat of polyurethane enamel over the sealant.

Sometimes engineers design unusual drain systems which require special attention to remain effective. Such is the case with the rubber seal at the base of the pylons that support the external fuel tanks. Although this extruded rubber strip is designed as an aerodynamic seal, it is also supposed to permit fluids inside the pylon to drain out from beneath the seal and at sites where the seal strips overlap. Unfortunately, the seals may stick to the paint on the tank, trapping the fluid inside the pylon. If sticking of this seal becomes a problem, a simple remedy to maintain a water passage is to cut a narrow notch in the seal on each side of the pylon just forward and aft of the forward beam.

Drainage problems are not limited to places which are easy to see and inspect. Under the right conditions, hidden drainage problems can turn up in some unusual parts of the aircraft structure, such as the dorsal and the horizontal stabilizer. Information on draining moisture from the dorsal of airplanes built prior to LM serial number 5058 can be found in *Service News,* Vol. 13, No. 4, October-December 1986. Preventing moisture entrapment in the horizontal stabilizer is discussed in *Service News,* Vol. 14, No. 3, July-September 1987.

No Magic Formula

We have already noted that the evolution of the Hercules has resulted in a more corrosion-resistant airplane. It is not, however, immune to corrosion. The longevity of the Hercules aircraft largely depends on how well the airplane is maintained by the operator. In order for the Hercules to realize its maximum service life, each operator must establish a viable corrosion prevention and control program. There is no magic formula involved. It takes personal interest, professional attention, and a lot of hard work, beginning at the time of manufacture and continuing throughout the life of the airplane.

The operator should first review present capabilities versus what is required to establish and maintain an effective program. Second, he should build a tailored program and ensure everyone within the maintenance complex knows and does his part. The quality of the operator's program depends upon the skill and dedication of all involved. But the rewards are worth the effort. A good corrosion prevention and control program will help ensure many years of safe and reliable Hercules operation.

Editor's Note:

This issue of *Service News* incorporates several changes in appearance to enhance the electronic readability of the document. This is the third issue produced solely for electronic distribution. We continue to learn from the experience and your suggestions.

Service News now has a larger font size and a sans serif font style making it easier to read online. The document is formatted in a single column, eliminating the need for continual scrolling up and down. Lastly, we have tried to control the number, size, and resolution of images to make the file size smaller, reducing download time.

SB82-770/382-28-19 - FUEL – SFAR 88 – DRY BAY ZONAL INSPECTION AND INSPECTION/ REPAIR OF STATIC GROUND TERMINALS OF FUEL SYSTEM PLUMBING

This Service Bulletin consists of visual/electrical inspections of fuel system plumbing grounding/ bonding connections for corrosion and/or incorrect resistance, misplaced or inappropriately installed grounding/bonding straps, installation of new grounding/bonding straps, visual inspection of fuel system electrical wires, and visual inspection of fuel tanks for contamination. This Zonal Inspection further expands into any system capable of developing enough energy to cause an ignition of the fuel system or is a source of fuel for a primary/root cause fire.

SB82-767/382-57-80- WINGS - INSPECTION AND COLD WORKING OF FLAP TRACK RIB ATTACHMENT TEE AT FLAP STATION 28.17

This service bulletin was issued to inspect for fatigue cracks in the lower eight holes in the flap track rib attachment tee P/N 348624-14L/-14R (Lockheed Martin serial no. 4542-4991) P/N 3325706-1/-2 (Lockheed Martin serial no. 4992 and up), at Flap Station 28.17. These fastener holes are common to the 348624-4 fitting. Several instances of cracked and severed parts have been found. This service bulletin also directs the cold-working of these holes as a fatigue cracking preventative measure.

SB82-773/382-28-21 - FUEL – SFAR 88 – LIGHTNING BONDING JUMPER INSTALLATION

The FAA has concern over the Wiggins Series 3600 fuel tube connectors. Specifically, the FAA is concerned that lightning currents could potentially cause arcing/sparking across poorly bonded tubes. There is concern only for those couplers that are located in fuel vapor areas and/or carry fuel vapors.

The intent of this Service Bulletin should be accomplished when the fuel tanks are next opened.

This effort is to add approximately 540 lightning bonding straps across the Wiggins fittings and fuel tubes bulkhead feed-through of the Hercules fuel system.

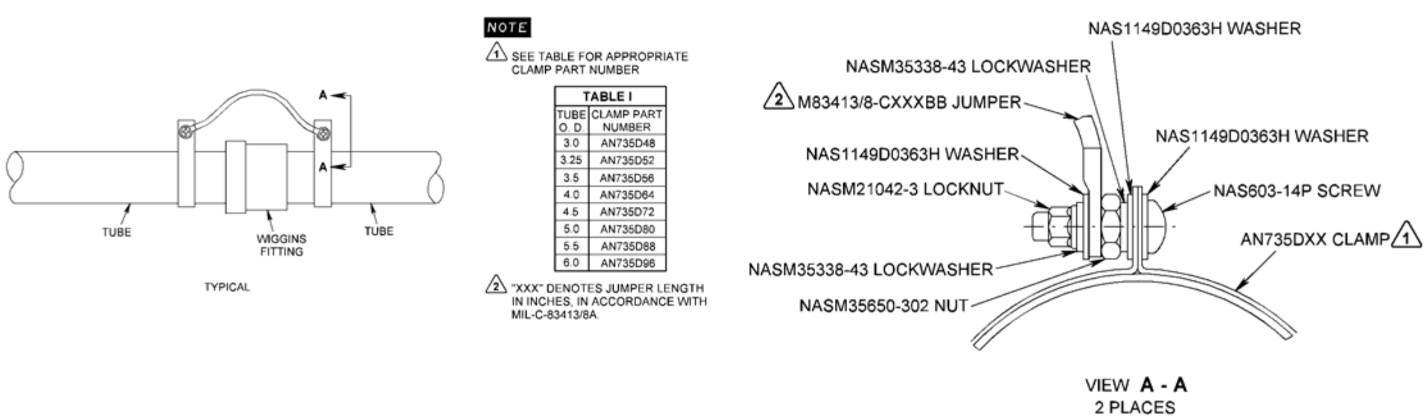

TABLE I

TUBE O. D.	CLAMP PART NUMBER
3.0	AN735D48
3.25	AN735D52
3.5	AN735D56
4.0	AN735D64
4.5	AN735D72
5.0	AN735D80
5.5	AN735D88
6.0	AN735D96

Tube-to-Tube Bonding Strap Installation
Figure 2

SB82-769/382-27-47- FLIGHT CONTROLS – INSPECTION OF RUDDER AND ELEVATOR COUNTERBALANCE

This Service Bulletin provides for inspection of the rudder counterbalance weights for Interference damage by the Hi-Lok pins on the 389624-1 Inboard Balance Assembly. If the fasteners interfere with the rudder counterbalance, this Service Bulletin provides for removing and replacing the elevator counterbalance assembly Hi-Lok pins.

SB82-768/382-57-81- INSPECTION OF FOUR CENTER WING BEAM CAPS AND STRINGERS FOR HEAT TREATMENT AND CORROSION

Hercules operators have reported finding exfoliation and pitting corrosion in the center wing beam caps made from 7075-T6 Aluminum Alloy. Lockheed Martin Aeronautics Company recommends that the inspection/modification specified herein be accomplished at the next convenient maintenance period, but not to exceed 360 days after receipt of this Service Bulletin. Lockheed Martin Aeronautics Company also recommends repeating this inspection every five years.

This service bulletin consists of an eddy current conductivity testing of four center wing beam caps made from 7075 Aluminum Alloy to determine alloy heat treatment for identification purposes. If the center wing beam caps are manufactured from 7075-T6 material, clean for visual inspection for corrosion, cracks, and other defects.

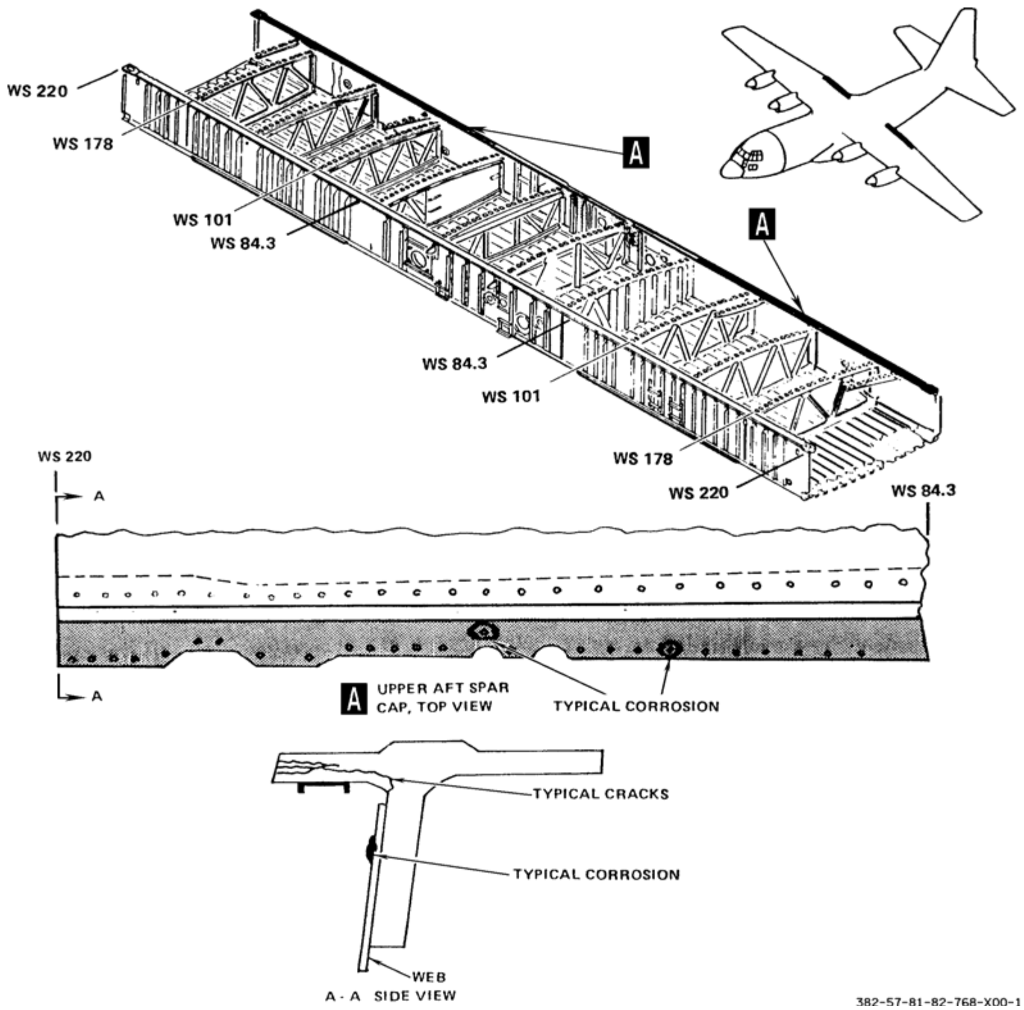

Figure 1. Inspection of Center Wing Beam Caps

Operator's Corner In This Issue:

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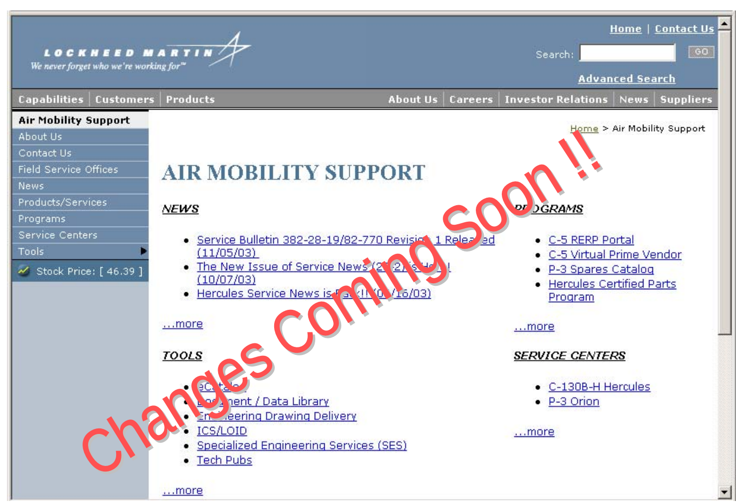
INFORMATION TECHNOLOGY UPDATES

AMS Information Technology Team

The Air Mobility Support (AMS) Information Technology Team has been working hard to improve communications among Lockheed Martin AMS and the many operators, maintainers, suppliers, and partners involved in sustaining the Hercules fleet around the world. One of the biggest assets to this communication has been the World Wide Web. AMS is using its presence on the web to provide information and tool access to those who need to communicate with Lockheed Martin, no matter where they might be located or in which time zone they operate.

Many of you have visited the Air Mobility Support presence on the World Wide Web, https://www.lmsupport.com, and we have received many favorable comments about the site. In addition, we have received some very good suggestions on how to improve this capability. We have taken these suggestions in conjunction with Lockheed Martin Corporate strategies and are planning a major change to our web site.



You will still see the same familiar information with the links to support tools such as the Enterprise Data Collaboration System (EDCS)/ Livelink, except now the site will be consistent with the other Lockheed Martin sites and will share a common infrastructure. This will allow you to receive any information you might need, from any Lockheed Martin business, in a common environment. It also provides a much better foundation to grow our web presence to offer more capabilities in the future. Don't worry, the current web site at https://www.lmsupport.com will still be there for a few more weeks, and there will be an automatic redirect to the new site. As always, your suggestions are welcome. Send any comments via email to the Air Mobility Support **Web Master** at *ams.portal@lmco.com*.

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On the World Wide Web - *https://www.lmsupport.com*

Image Courtesy of 463rd AG