FROM THE EDITOR’S DESK

This issue is focused on the Hercules wing. A number of recent activities, such as the release of Service Bulletins on Wing Service Life Assessment and Center Wing Inspections for Fatigue Cracking, have captured our attention as we look to sustain our fleets in an economical and safe manner. Structural integrity of the Hercules Center Wing is not a new topic but one that has become more prevalent as our fleets have aged. Many of our aircraft are over 30 years old and although they are well maintained, they are susceptible to degradation from structural fatigue or other age related issues, depending on their specific history and environmental usage parameters. In this Service News Magazine, we have briefly described the issues with Center Wing Service Life and have provided a summary of the options available to you as an operator. Given the complexity of this topic, we cannot hope to answer all questions here; however, if you do require additional information, contact our Technical Support Center, by telephone at 770-494-9131, or send an email message to hercules.support@lmco.com.

With this issue, a new feature highlighting the global sustainment capabilities of the Hercules Service Centers is introduced. There are a small number of highly capable, regional Hercules aircraft and engine MRO facilities around the world that Lockheed Martin has authorized to perform specific sustainment tasks in support of Hercules operators. This issue features the Service Center in the country of Argentina, Lockheed Martin Aircraft Argentina, S.A., (LMAASA) servicing parts of the South American continent.
Lockheed Martin Air Mobility Support (AMS), in cooperation with key C-130 operators, has been engaged in reassessing C-130 center wing service life issues for the past several years. Numerous presentations and side meetings have been held on center wing service life at the 2002, 2003, and 2004 Hercules Operators Conference with domestic and international operator participation.

Some C-130 (and commercial 382 Model) operators are experiencing fatigue cracking in the center wing lower surface structure earlier than expected, while others have not yet found any significant fatigue cracks. Examination of the in-service fatigue cracking data has resulted in a review of the service life assessment methodology and issue of two Service Bulletins.

Service Life Assessment Methodology

The methodology of assessing structural service life prior to 2004 was based on an economic model that estimated the time in service when fatigue cracking would be too costly to repair. In recent years, structural integrity issues known as widespread fatigue damage have altered the analysis approach towards a risk management methodology. As the wing structure ages, concern of multiple fatigue cracks initiating and propagating in such a way to adversely affect the strength of the wing structure has necessitated this change.

Lockheed Martin AMS is performing analytical work, in conjunction with the United States Air Force (USAF), using the new service life analytical methodology. A USAF Aircraft Structural Integrity Program (ASIP) Independent Review Team (IRT) has assessed the updated methodology and subsequent recommended actions.

All service life assessment and analysis efforts require knowledge of the typical operational usage that the aircraft experiences. This is determined by completing an Operational Usage Evaluation which defines the rate of fatigue cracking in terms of the baseline usage. The rate of fatigue cracking is defined by a usage severity factor relating actual flight hours to the established service life baseline, expressed in terms of Equivalent Baseline Hours (EBH). EBH is determined by multiplying the center wing flight hours times the operational usage severity factor. Note that EBH is not the same as aircraft flight hours, unless the usage severity factor is 1.0.

Service Life Assessment

With support from Lockheed Martin AMS, USAF established service life EBH limits and issued an Interim Safety Supplement which led to grounding or flight restrictions against numerous aircraft. Special center wing structural inspections are currently being developed by USAF to evaluate the grounded and restricted aircraft.

Lockheed Martin AMS developed center wing service life limits for International Military

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and Commercial Operators using a similar methodology. Wing Service Life Service Bulletin (SB) 82-788 was released to military operators on 17 March 2005 and SB 382-57-84 was released to commercial operators on 10 June 2005. The military Service Bulletin requires the operator to perform an initial assessment of the severity of usage to estimate the EBH (the commercial version assumes the severity factor is 1.0) with subsequent actions provided in a series of categories dependent on the center wing EBH:

- Lockheed Martin Aeronautics Operational Usage Evaluation – a thorough evaluation of aircraft severity factor and determination of EBH
- Widespread Fatigue Damage (WFD) Inspections required for center wings with greater than 40,000 EBH - WFD inspection SB 82-790/382-57-85 was released on 8 August 2005 to provide details of inspection requirements
- Operational Restrictions required for center wings with greater than 46,000 EBH
- Aircraft Grounding required for center wings with greater than 50,000 EBH
- Successful implementation of WFD inspections and subsequent repair action can relieve operational restrictions and grounding actions.

Summary

Numerous operators have already taken positive action towards evaluating their fleet for center wing fatigue cracking. After the initial usage assessment performed by the operator, it is important that all operators have Lockheed Martin AMS perform the complete Operational Usage Evaluation, as specified by SB 82-788 and SB 382-57-84.

Not all C-130 aircraft operate the same and the type of usage has a significant affect on rates of fatigue cracking. In order to ensure continued safe operation of the aircraft, the severity of usage must be taken into account. LM Aero AMS has made specific recommendations to all operators via Service Bulletin for implementation of significant structural inspections, flight restrictions, or aircraft groundings.

Lockheed Martin AMS is available to provide dedicated support to operators addressing the C-130 Center Wing Service Life issues. Whether answering technical questions about center wing fatigue, providing center wing service life briefings, performing the Operational Usage Evaluation, or defining tailored structural inspections, Lockheed Martin Air Mobility Support is committed to supporting all of our C-130 operators.
Articles in recent Service News issues discussed the history of the various C-130 Outer Wing versions. This article will address the history of the C-130 (and commercial 382 Model) Center Wing and will provide an overview of configurations and product improvements from the C-130B to the latest C-130J configuration. With the release during the past six months of Service Bulletins addressing center wing service life issues, it is important to first understand the various center wing configurations on C-130B/E/H/J aircraft.

**C-130B and Early C-130E Center Wings**

The original center wings installed on C-130B and early C-130E aircraft, from 1957 until 1968 (Lockheed Martin Aeronautics serials 3501 through 4298), have been replaced on all remaining in-service aircraft. The original C-130B/E center wings delivered with these aircraft have been retrofitted with a center wing with increased service life and improved materials. The replacement center wing was identified by Manufacturing End Product (MEP) serial numbers.

**Late C-130E and Early C-130H Center Wings**

The equivalent configuration center wing, used as the MEP replacement center wing on the C-130B and early C-130E aircraft, was also installed on new production C-130E and C-130H aircraft starting at Lockheed Martin Aeronautics Serial Number (SN) 4299. This new center wing on Serial Number 4299 and subsequent aircraft, as well as the MEP replacement center wings, addressed the fatigue cracking problems found during full scale durability testing and on in-service C-130B/E aircraft.

As production of the C-130E and C-130H progressed, many additional product improvements, including improved materials and detail fatigue enhancements, were made over the years to these model center wings. Other than these continual improvements, the C-130B/E replacement center wings, the late C-130E and the early C-130H production center wings are basically very similar and have the same overall service life potential.

The improvements incorporated into the late C-130E and early C-130H center wings include:

- Upper surface dry bay access door openings changed from rectangular to elliptical at SN 4314.
- 7075-T6 to 7075-T73 aluminum alloy material changes in many parts for improved corrosion resistance starting at SN 4314.
- Improved durability of lower forward beam cap corner fittings at SN 4331.
- Integrally reinforced stringers made from 7075-T73 aluminum alloy replaced stringer/strap assemblies made from 7075-T6 aluminum alloy at SN 4334.
Dry bay finish changed to white polyurethane. White finish is both more abrasion resistant than the previous gray color epoxy and improves inspection in the dry bays.

Special Operations Forces (SOF) Center Wings

In order to meet the needs of the United States Air Force (USAF) Special Operations Forces (SOF), a center wing with significantly increased durability was designed specifically for these aircraft in the late 1980s. This wing is typically referred to as the SOF center wing. The USAF contracted with Lockheed Martin Aeronautics to design and build center wing replacement kits for 79 of their SOF aircraft used in severe fatigue environments.

Late C-130H and C-130J Center Wings

In the early 1990s following the design of the SOF center wing, some of the SOF durability enhancements were incorporated into the C-130H production center wing at Lockheed Martin Aeronautics Serial Numbers 5306. These were specific improvements to local areas of the center wing; while improving the durability of those local areas, it did not significantly affect the overall service life of the center wing. The C-130J center wing is the same configuration as the late C-130H center wing. Some of the durability improvements incorporated into the late C-130H and C-130J center wing include:

- Hi-Tigue fastener system was added at SN 5215 replacing many Lockbolts, Hi-Loks and Taper-Loks. Most structural fasteners are interference fit steel Hi-Tigue pins with steel nuts. The Taper-Lok fastener remains at fatigue critical joints.
- New front and rear beam webs - Additionally, the front beam web splice was moved inboard from Wing Station (WS) 174 to WS 168.
- New wing attach angles at WS 61 with improved stress corrosion cracking resistance - These attach angles were designed with thicker legs and prevents these from being replacement parts for older aircraft unless a new center wing is installed simultaneously.
- A new lower front beam cap - The beam cap was reshaped in the area of Wing Station 174.

Summary

All center wings currently in service on C-130B/E/H/J aircraft are basically the same configuration and are sometimes referred to as the C-130B/E center wing. The only exceptions are the USAF SOF Center Wings. While durability improvements have been made over time to specific local areas of the center wing, the basic service life potential of this wing remains the same. Product improvements have been, and continue to be, made to the C-130 center wing in order to provide improved durability, reduced maintenance, and enhanced operational readiness for C-130 operators. The full service life potential of the center wing will only be reached if all applicable Lockheed Martin Aeronautics Service Bulletins, inspection and repair procedures are followed.
Lockheed Martin Air Mobility Support (AMS) is providing support for all operators in assessing C-130 center wing service life issues. Service Bulletins (SB) 82-788 and 382-57-84 for the Operational Usage Evaluation and Service Life Assessment and SB 82-790 / 382-57-85 for the Widespread Fatigue Damage Inspections provide evaluation, analysis and inspection recommendations. The results of the operator and Lockheed Martin AMS analyses will further define the need to perform center wing inspections. The wing inspection results, combined with the service life analysis, will help to identify options for the operator in maintaining a viable and fully effective C-130 fleet. These options then can be used in a trade study against the planned or desired out of service date of the aircraft to determine the best path forward for the operator.

Inspect and Repair

Some operators may choose an “Inspection and Repair” option. Inspect and repair involves performing the detailed center wing structural inspections as defined in SB 82-790 / 382-57-85. Any defects found during these inspections must be fully repaired in accordance with standard or specialized repair instructions. Upon completion, the aircraft can be released back into full operational service. These inspections must then be repeated at a recurring interval as determined by the service life analysis. This Inspect and Repair scenario must be repeated for the remaining life of the aircraft. While this approach minimizes initial costs, it will have a negative impact on aircraft availability and future maintenance costs. At some point, the center wing may become either very difficult to continue to repair or basically “unrepairable,” depending on the Equivalent Baseline Hours (EBH) currently on the wing and the expected remaining service life. For an aircraft center wing with high EBH, the Replacement option may be a more cost effective solution for an operator that expects to keep their aircraft in service for a number of years.

Refurbishment

A “Refurbishment” option is currently being considered by some operators. Refurbishment entails removing the current center wing from the aircraft. System components such as wiring and plumbing are then removed from the center wing in order to allow further structural disassembly. The center wing box structure is then disassembled in order to replace the lower surface fatigue susceptible components. The replaced components typically would include most of the lower surface major parts including skin panels, hat section stringers, spar caps, wing attach corner fittings, and wing attach rainbow fittings. Additional components replaced could include the upper wing attach rainbow fittings, the engine truss mounts and the beam webs. The center wing is then reassembled with these new components, the wing is reinstalled into the aircraft, and the system components are reinstalled into the wing. For ease of reinstallation, some customers may choose to install new system components rather than try and install the old wiring, plumbing, etc.

Refurbishment could slightly reduce the initial cost to the operator compared to replacement with a new wing. However, many of the costs associated with Refurbishment are the same as Replacement, such as wing removal and reinstallation, the costs of the new parts, and wing reassembly. The additional cost of the wing disassembly for the Refurbishment would somewhat offset the additional upper surface parts for the Replacement wing. Unfortunately, the initial cost savings of the Refurbishment scenario may be quickly offset by the continuing...
inspection costs required for all of the non-replaced wing components, plus the negative impact to aircraft availability because of these required inspections. Due to the procurement spans of the critical center wing lower surface components, the schedule span for the Refurbishment option is estimated to be nearly identical to the Replacement option. If a single aircraft is being refurbished, the Refurbishment schedule may actually be longer due to the added span required for the wing disassembly. The Refurbishment may only be the best option for an aircraft with high EBH that an operator will only keep in service for a few years.

**Replacement**

The “Replacement” option involves removing the existing center wing from the aircraft and replacing it with a brand new wing, with the option to include all new system components and wiring. The new Replacement wing includes all new lower surface, upper surface, beams, rib structure and wing joint components. The Replacement wing removal and installation tasks are easier than for a Refurbished wing since the existing wing does not have to be salvaged and the Replacement wing is new, which facilitates installation.

While the initial cost of the Replacement wing is slightly more than the Refurbishment wing, there should be significant maintenance savings with the Replacement wing scenario. Because the entire wing is new, no structural inspections are required for many years. With Refurbishment, continued structural inspections and maintenance of the 30+ year old wing are required for the majority of the structure, especially the upper surface and rib components. The Replacement wing will provide higher aircraft availability due to the decreased maintenance time and costs. Additionally, aircraft maintenance can be scheduled to coincide with the delivery and installation of the new wing, thus reducing the aircraft out of service span. The Replacement Center Wing option may be the most cost effective solution for operators who desire to keep their aircraft in service for more than five years.

Lockheed Martin AMS is currently working with the United States Air Force (USAF), under a three phase program, to produce Replacement Center Wings. Phase I is under contract for the Non-Recurring Engineering (NRE) and one kit for the MC-130H Enhanced Service Life (ESL) wing. The ESL wing is specifically designed for very severe mission usage typical of the USAF Special Operations Forces. Phase II is also under contract for the NRE for the Standard Replacement Center Wing for the HC-130N and HC-130P, with an option for the C-130H. This contract includes production of up to 11 Center Wings, either Standard or ESL, for the HC-130N, HC-130P, C-130H and MC-130H. The Phase III contract, planned for mid-2006, will be for continued production of Standard and ESL Center Wings.

**Summary**

Lockheed Martin AMS is prepared to assist all of our operators as they assess the impact of the center wing service life issues. Once the operators’ fleet is fully assessed via the Operational Usage Evaluation and Service Life Assessment, the operator can better determine the most cost effective solution to their center wing issues. Lockheed Martin AMS can support the evaluation, provide detailed analysis of fleet service life, assist or perform structural inspections and repairs, help the operator evaluate a refurbishment program, or provide replacement center wings designed for the operators’ specific aircraft configuration. Whether the plan is to Inspect and Repair per the Widespread Fatigue Damage Inspection requirements, evaluate a potential Center Wing Refurbishment, or decide to join the Center Wing Replacement program, Lockheed Martin Air Mobility Support is available to provide appropriate support, as required.
Lockheed Martin Authorized Hercules Service Centers are a specific group of highly qualified maintenance operations, located around the world, providing regional sustainment support to Hercules owners and operators. These Service Centers are specifically authorized to perform certain maintenance and support tasks for their designated customers. They provide and maintain facilities, equipment, spare parts, ground support equipment (GSE), and qualified personnel to provide Hercules maintenance support. Service Centers perform depot level and drop-in maintenance for transient Hercules civil or military aircraft (and in some cases the P-3 Orion aircraft) in accordance with policies and procedures set forth in Lockheed Martin Aeronautics publications, instructions, and other data and documents. As an Authorized Service Center, these regional maintenance operations have established relationships with Lockheed Martin Aeronautics and, in many cases, have Lockheed Martin Field Service Representatives (FSRs) on-site.

Lockheed Martin is very selective in designating Service Centers. Normally, these businesses have had significant prior Hercules maintenance experience and are well equipped to provide ongoing Hercules support. Typical requirements include:

- The company must have adequate facilities to handle the appropriate aircraft.
- A cadre of maintenance personnel from each of their specialty skills must satisfactorily complete specialist maintenance training.
- The company must obtain and maintain the data required to support the level of work to be undertaken.
- Lockheed Martin service representation is required during the start-up process and remain on-site until the company becomes self-sufficient.
- The company must obtain and maintain the minimum aerospace GSE and spare parts necessary to be responsive to customers’ needs.

Becoming a Service Center generally involves a considerable investment. In addition to the required investment in spares and GSE, the company must invest in specialized technical data and documentation, specialized maintenance training, and in many cases FSR representation. For additional information on Service Centers, go to the Air Mobility Support web site, http://www.lockheedmartin.com/ams; or if you have questions about Hercules Service Centers, contact Gary Sims at (770) 494-9142 or by email at gary.l.sims@lockheedmartin.com.
In 1995, the Argentine government privatized the former Area Material Cordoba, and Lockheed Martin Aircraft Argentina, S.A., (LMAASA) was formed. The facility was founded in 1927 and has produced over 1,300 aircraft of 30 different types. The term of the privatization of the facility is for 25 years with two additional ten-year options.

The Argentine Ministry of Defense also signed the first five-year contract for the maintenance, modification and modernization of the Air Force fleet in 1995. This contract was followed by a second one, signed in July 2000 which, besides the maintenance of Air Force aircraft, included the manufacture of 12 AT-63 attack-trainer aircraft.

The experience gained by Aircraft Argentina and its new capabilities, such as the modernization of test benches for JT8D testing, provides LMAASA with the ability to offer extensive maintenance, modification and state-of-the-art upgrades for commercial airlines. Aircraft Argentina offers a one-stop-shop with exceptional post-sales service.
UPDATES

SB82-788, Basic Dated March 17, 2005, Errata Dated May 4, 2005, WING — OPERATIONAL USAGE EVALUATION AND SERVICE LIFE ASSESSMENT  Basic Issue - Fatigue cracking of wing primary structure on full scale durability tests conducted by Lockheed Martin Aeronautics Company and also discovered on some aging in-service aircraft have indicated a need to ensure adequate inspection requirements are established to continue safe operation. Operators of aging center and outer wings are strongly recommended to have their usage evaluated to determine if further action is warranted to maintain structural integrity. Errata Notice – Clarification of the calculation of effective cargo weight.

SB382-57-84, Basic Dated March 28, 2005, WING — OPERATIONAL USAGE EVALUATION AND SERVICE LIFE ASSESSMENT  Basic Issue - Fatigue cracking of wing primary structure on full scale durability tests conducted by Lockheed Martin Aeronautics Company and also discovered on some aging in-service aircraft has indicated a need to ensure adequate inspection requirements are established to continue safe operation. Operators of aging center and outer wings are strongly recommended to have their usage evaluated to determine if further action is warranted to maintain structural integrity.


SB82-786/382-53-62, Basic Dated March 21, 2005, FUSELAGE - INSPECTION OF UPPER AFT SECTION OF LEFT AND RIGHT LONGERON AT FS 737  Basic Issue - This Service Bulletin was issued to inspect for stress corrosion cracks in the upper left and right aft longeron at FS 737. Several instances of cracked longerons and adjoining parts have been found.

SB82-783/382-57-83, Basic Dated March 18, 2005, WING — INSPECTION OF CENTER WING LOWER SURFACE PANELS AT THE RAINBOW FITTING FOR FATIGUE CRACKS  Basic Issue - Fatigue cracking occurred on the wing durability fitting test and has been reported by numerous operators on service aircraft. In addition some of the wing shims have been found to be loose. This bulletin inspects for fatigue cracks that may initiate in the lower surface panel fastener attach holes and radii adjacent to the cutouts for the corner fittings and wing mate bolt access, and propagate in approximately a chordwise direction.

SB82-782, Errata Dated March 3, 2005, ELECTRICAL POWER — INSTALLATION OF BATTERY CHARGER  Errata Notice – Corrected the time to accomplish the work to 24 man-hours.

SB82-771/382-57-82, Revision 1 Dated February 24, 2005, WINGS — INSPECTION OF CENTER WING UPPER AND LOWER RAINBOW FITTING FOR CRACKS  Revision 1 - This revision adds a requirement for a recurring inspection.

SB82-746/382-53-60, Revision 1 Dated March 14, 2005, FUSELAGE — INSPECTION/REPAIR OF 362010-6 SKIN LOCATED UNDER AIR CONDITIONING INLET  Revision 1 - This revision was issued to revise the airplane effectivity, weight and balance, and administrative changes.

SB82-557/382-57-55, Revision 2 Dated March 23, 2005, WING — REMOVAL OF DOUBLERS FROM CENTER WING LOWER SURFACE, CWS 62 TO CWS 68  Revision 2 - This revision was issued to add pertinent information to clarify the intent of the Service Bulletin.

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CONTINUATION OF SERVICE BULLETIN UPDATES

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SB82-775/382-24-24, Revision 1 Dated March 23, 2005, ELECTRICAL POWER – INSPECTION FOR CHAFING OF THE ESSENTIAL DC BUS WIRING AND RELOCATION OF THE CIRCUIT BREAKER WIRE BUNDLE LOCATED BEHIND THE COPILOT’S SIDE CIRCUIT BREAKER PANEL. Revision 1 - This revision was issued to correct a discrepancy in the accomplishment instructions.

SB82-789/382-53-63, Basic Dated May 10, 2005, FUSELAGE - INSPECTION AND VERIFICATION OF PROPER TORQUE OF 341088L/R RAMP ACTUATOR FITTING HARDWARE. Basic Issue - Lockheed Martin Aeronautics Company has received reports of loose fasteners attaching the Ramp Actuator Fitting to the aircraft structure. Loss of attachment of the fitting could potentially result in inability to operate the ramp. This Service Bulletin directs an inspection and verification of proper torque of the ramp actuator fitting attachment bolts.

SB82-744/382-38-02, Revision 2 Dated May 17, 2005, WASTE WATER – INSPECTION AND REPAIR OF TOILET WASTE DRAIN, AFT FUSELAGE. Revision 2 - This revision was issued to correct part number of screw and administrative changes.

SB82-785/382-26-09, Basic Dated July 11, 2005, FIRE PROTECTION - REPAIR OF PORTABLE FIRE EXTINGUISHER MOUNT BRACKET ASSEMBLY. Basic Issue - The purpose of this bulletin is to add a channel doubler to ensure the fire extinguisher bracket holder is able to withstand 16 Gs forward load of force without the portable fire extinguisher bottle separating from its bracket holder mount.

SB82-790/382-57-85, Basic Dated August 4, 2005, WING – CENTER WING LOWER SURFACE GENERALIZED CRACKING AND WIDESPREAD FATIGUE DAMAGE INSPECTION REQUIREMENTS. Basic Issue - This Service Bulletin contains the inspection requirements for detection of generalized fatigue cracking and the possible onset of widespread fatigue damage of the center wing lower surface structure.

SB82-752/382-53-61, Revision 3 Dated August 4, 2005, FUSELAGE – INSPECTION OF WING-TO-FUSELAGE ATTACH ANGLE FITTING. Revision 3 - This revision was issued to add a visual inspection of all wing-to-fuselage attach angles and to verify the existence of any repairs.
Timely updates to the SMP515C Maintenance Program are becoming more and more critical to economical and safe operation of the Hercules aircraft. Given that the SMP515C is constantly changing with the incorporation of new inspection techniques and processes, revisions to inspection areas (due to the aging nature of the aircraft, and better ways of economically maintaining the aircraft and its components), it is important the program be updated.

Lockheed Martin Air Mobility Support (AMS) is now able to deliver the SMP515C Maintenance Program electronically to selected customers through the Enterprise Data Collaboration System (EDCS/Livelink). Typically, operators have maintained currency of their SMP515C through a revision service or periodic update process. This is effective for many customers; however, there are those that may need to be more quickly advised as key inspection cards change. The EDCS/Livelink capability can provide an operator with an online library of their SMP515C that is always current. As inspection cards are revised, subscribers of this service are notified of changes, and the cards are updated in the EDCS/Livelink library for review.

Operators interested in this type of capability should consider a number of issues. Specifically, (1) operators needs to consider how the updates to the inspection program are going to be reviewed and assessed for specific applicability; (2) how are these updates going to be disseminated to the maintenance organizations and when; (3) who are the right people to have access and receive notifications from this system; and (4) do these people have the necessary internet communications capabilities to access the system?

There will be demonstrations and discussion of this capability at the Hercules Operators Conference in October 2005. If you are not able to attend this conference, forward any questions to Sally Liquori, at sally.a.liquori@lmco.com