Lockheed

VOL. 20, NO. 4, OCTOBER-DECEMBER 1993

service news

A Service Publication of Lockheed Aeronautical Systems Company

Incorporating the Hercules Operators Quarterly Newsletter

C-130 Ramp Hook Retainers

Previous Page Table of Contents Next Page

Lockheed

Service News

A SERVICE PUBLICATION OF LOCKHEED AERONAUTICAL SYSTEMS COMPANY

Editor
Charles I. Gale

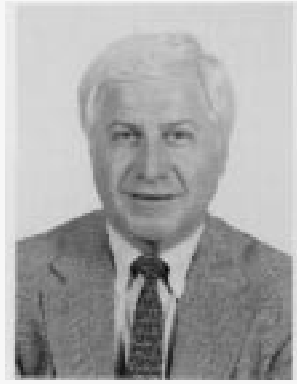
Art Director
Cathy **E. Howard**

Vol. 20, No. 4, October-December 1993

CONTENTS

Covers: Scheduled for delivery later this year, the first of eight new C-l 30 airlifters being built for the Wyoming Air National Guard is put through its paces over the Lockheed manufacturing facility at Marietta, Georgia. These new H-models represent the most advanced C-l 30s ever built, with new, high-tech navigational, defensive, and operating systems. Photos by John Rossino.

Focal Point



John Gaffney

Product Support: Commitment, Cooperation, Communication

The Lockheed Aeronautical Systems Company Product Support organization is determined to provide the highest level of service to each of our customers and every one of our airplanes. This level of support is focused toward our personal commitment to our customers, quick and open lines of communication to provide information and receive feedback from our customers, and full cooperation with our customers to develop a team approach to support.

The support arena has undergone vast change in recent years and LASC Product Support has had to evolve to keep pace and meet our customers' needs. This evolution has resulted in the customer becoming more and more prominent in the market place, competition intensifying, and change itself becoming constant.

Product Support has made changes and continues to make changes to respond to market conditions. Our customers indicated they wanted:

- A **"one-stop shop" for all support services. We have become** that "one-stop shop." Any element of support needed by a customer can be obtained from a single source within LASC Product Support.
- Competitive prices. We are finalizing teaming arrangements which will allow us to offer customers a full spectrum of parts-new, used, and overhauled-at competitive prices, all under the auspices of the original equipment manufacturer.
- Quick response times on requests for spare parts quotes. We had been able to respond on an average of 30 days. We have continued to reduce that time, and we have set a goal of reaching two days or less within the next six months.
- Continued superior delivery performance. Our spares delivery performance is above 99%, and we are aiming higher.

We are interested in your ideas. How are we doing? What can we do better? If you have any comments or suggestions, let me know. You can call me directly at l-404-494-31 11, fax me at l-404-494-751 8, or write me at LASC, Dept. 62-10, Zone 0213, Marietta, Georgia 30063. I look forward *to* hearing from you.

Sincerelv.

John L. Gaffney
Director,
LASC Product Support

PRODUCT SUPPORT LOCKHEED AERONAUTICAL SYSTEMS COMPANY

J. L. GAFFNEY – DIRECTOR

FIELD SUPPORT	SUPPLY SUPPORT	TECHNICAL PUBLICATIONS	RM&S DESIGN	CUSTOMER TRAINING
C. A. McLeish	**J. L. Bailey**	**A. G. Hunt**	**H. D. Hall**	**S. S. Clark**

Previous Page Table of Contents Next Page

C-130 RAMP HOOK RETAINER MISLOCATION

by MSgt David E. Crerar
Wyoming Air National Guard

The cargo ramp and door system of the Hercules aircraft is a purpose-built, ruggedly designed feature that is one of the many assets that make the C-130 the world's favorite multipurpose airlifter. Like the airplane itself, the ramp is highly versatile. Its design permits a wide range of adjustment during loading operations. Cargo can be transferred to and from vehicles of almost any height, and the ramp can be lowered completely for direct access from the ground.

This versatility extends to flight operations as well. The ramp is designed to be opened in flight to allow troops, vehicles, and supplies to be paradropped to wherever they are needed. When the ramp is closed and locked, it seals tightly for pressurization, and in effect becomes part of the fuselage structure.

Locking the Ramp

Proper functioning of the Hercules ramp system is in many ways dependent on the functions of its locking system. When a modern aircraft is pressurized and flown at altitude, its airframe normally undergoes a certain amount of distortion. This results in dimensional changes and alterations in the relative positions between the airframe components. The cargo ramp locking system of the Hercules airlifter is designed to accommodate such changes and still maintain positive ramp locking and good pressure sealing.

In order to lock securely, and also distribute the resulting structural loads to other parts of the airframe evenly, the entire system must be properly aligned and rigged. Complete ramp rigging procedures are spelled out in the appropriate maintenance documentation for the various models of the Hercules aircraft. T.O. lC-130B-2-2, for example, contains the procedure that applies to many C-130s operated by the U. S. Air Force, Air Force Reserve, and Air National Guard.

Although the details of the rigging procedure may vary from model to model, all start out with the fundamental assumption that the correct hardware is installed in the correct locations in the aircraft. Only when this is the case can the adjustments required in carrying out the ramp rigging procedure yield predictable results. Unfortunately, experience has shown that this assumption is not always justified.

Exercises on Location

Several years ago, we at the Wyoming Air National Guard (ANG) base in Cheyenne traced a number of operational difficulties involving missed block times and occasional ground and air aborts to cargo ramp misrigging. This prompted a special-emphasis maintenance campaign within the unit to investigate and solve the problem. The campaign was conducted on each aircraft during isochronal overhaul so that there would be adequate time available for a thorough study of whatever causes might be uncovered.

The findings of this program revealed first of all that none of our aircraft initially passed all the ramp rigging criteria as outlined in T.O. lC-130B-2-2, paragraph 7-52, Fig. 7-3. Secondly, we discovered that only two of the nine assigned aircraft had the correct cargo ramp hook retainers installed as per the part numbers shown in T.O. l-C-130B-4, Fig. 87.

Hookretainers werefoundindiscriminately installed at all ten ramp lock stations. The most common misplacement found was a side-for-side swapping of hook retainers at stations 2R and 2L. This is probably so because these hook retainers “look right” when in these positions. The locking lug angles of the hook retainers at station 6,4, and 2 on both the left and right sides must gradually tilt downward at increasing angles as one moves forward at each of these stations. The result has a rather odd appearance to the untrained eye.

Actually, the retainers are engineered this way to compensate for the diminishing radius of the curve of the longeron at these three stations. This arrangement is required because all ramp latches are set at a constant angle relative to the flat floor of the ramp. The hook retainers at stations 8 and 10, L and R are on a straight portion of the longeron. In these cases there is no difference in angle between the locking lugs and the retainer bases or the flats at the tops of mounting hole bosses.

As soon as the primary cause of our ramp rigging difficulties was recognized, the ramp hook retainers were measured to determine their true identity. After measurement, they were carefully marked with a felt-tipped pen and then installed in their correct locations. The locking system of each of the affected cargo ramps was then rerigged and the aircraft released for flight. Mission aborts and maintenance writeups involving the cargo ramp disappeared virtually overnight.

More Than Just Chance

In reviewing what we had learned in the process of solving this problem in our aircraft, it seemed to us unlikely that such a large proportion of the C-130 aircraft assigned to the Wyoming ANG should show this same discrepancy purely as a matter of chance. Sure enough, based upon our contacts with other C-130 organizations and the opportunities our maintenance personnel have had to examine aircraft belonging to other units, we believe that the problem of mislocated ramp hook retainers is widespread in the Hercules fleet.

It is not difficult to visualize the consequences of having cargo ramp hook retainers with incorrect characteristics installed at various stations up and down the sloping longerons. Such a situation is virtually guaranteed to frustrate all attempts to achieve a properly rigged cargo ramp locking system.

The result can be a plague of such discrepancies as warning lights, ramp locks that will not latch in flight, internal linkage rods bent from excessive ramp closure pressures, or locks that cannot be adjusted to the proper clearance. To better understand the nature of this problem, let us take a closer look at the retainers and the role they play in the system as a whole.

Introducing the Hook Retainers

The cargo ramp hook retainers are bolted to the sloping longerons on both sides of the ramp opening at the aft end of the cargo compartment (Figure 1). They serve as strike plates for ramp latches to engage when the ramp is closed and locked.

Of the five hook retainers on each sloping longeron, three have individual, distinct angles on the locking lug portion of the retainer to compensate for the slope of the longeron. Figure 2 shows an example of a ramp hook

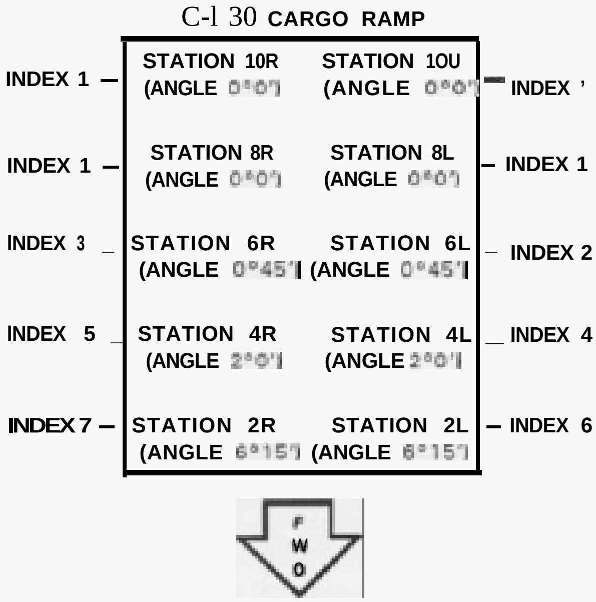


figure 1. Cargo ramp **hook retainer layout. The index numbers correspond to the part numbers shown in Fig. 3.**

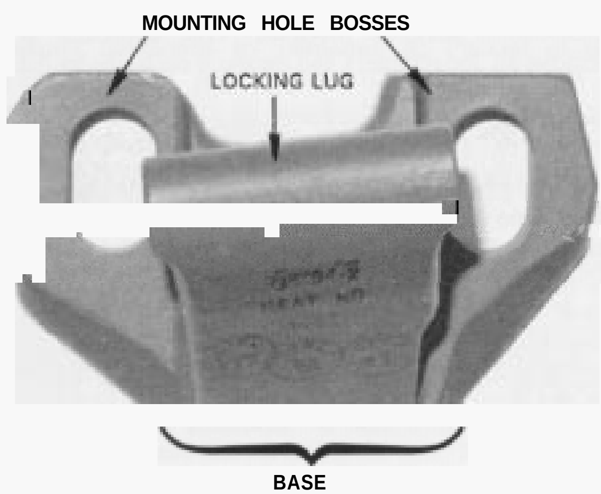


Figure 2. A current-production PN 3338394-2 hook retainer (index 7). It is used at ramp station 2R.

retainer designed for the 2R position. The locking lug in this case is angled 6°15' with respect to the mounting hole bosses to accommodate the curve of the longeron at its intended mounting location. As we have already seen, in the last two retainers on each side towards the aft end of the aircraft, the locking lug is parallel with the base of the retainer and the tops of the mounting hole bosses. These retainers have "no" angle and all are identified by the same part number.

The ramp hook retainers installed in most Hercules aircraft currently in service belong to one of two series. The older has the base part number 3303580-x, and the newer 3338394-x (Figure 3). The main difference between them is that the parts belonging to the newer series have had l/10 inch of material removed from their bases so that they can be located lower on the longeron. This was done to accommodate clearance requirements in difficult situations. There is little visible difference between the two series (Figures 2 and 4), and both types are found in the supply system. An even older series with the base part number 354649-x is still listed in some parts catalogs, but is unlikely to be encountered except in older aircraft.The locking lug angles are the same for each of the individual ramp stations, regardless of which series is involved.

C-l 30 Hook Retainer Application Guide

Index	Old PN	New PN
1	3303580-7	3338394-7
2	3303580-5	3338394-5
3	3303580-6	3338394-6
4	3303580-3	3338394-3
5	3303580-4	3338394-4
6	3303580-l	3338394-1
7	3303580-2	3338394-2

figure 3. Two quite similar series of ramp hook retainers are currently in service. Either or a mix may be used.

Ramp hook retainers that are not located in their intended positions but randomly intermingled can become hidden obstructions to successful ramp rigging. The reason "hidden" is the operative word here is that it is virtually impossible to identify any of the hook retainers simply by looking at them, or connect the appearance of a retainer with its intended location on the longeron. Put another way, all of the ramp hook retainers look pretty much alike, and even experienced technicians will be hard-pressed to distinguish one from the other without finding a part number or making some careful measurements (Figure 4).

Unfortunately, the prospects of locating a part number on ramp hook retainers already in service are not very good. During fabrication, the individual retainers are painted and then ink-stamped with the applicable part number. They are then installed in the airplane at the factory according to these numbers.

Most of the numbers do not, however, survive long enough to be much help for identification purposes later on. In the case of new aircraft, the hook retainers often receive another coat of paint before leaving the factory. This obliterates the original part numbers even before the aircraft enters service. In older aircraft, the hook retainers will generally have been removed, bead-blasted, and repainted at some point during corrosion control work. This means that any retainer which by chance escapes an early repainting prior to the initial delivery of the airplane is likely to regain its anonymity during normal rework activities.

Figure 4. Locking lug angles range from small to zero. "Eyeball" identification is next to impossible.

Mix and Match

With no part numbers visible, it is easy to lose track of the intended positions of the ramp hook retainers whenever they are removed. Even if the original positions are correct, any lapse in the identifying procedures used during maintenance can result in hook retainers being reinstalled in the wrong locations.

It would be helpful if some method could be found to ensure that the part numbers or some other key identifier would always remain legible, but this is easier said than done. No impression stamping is allowed on the hook retainers. They are made of heat-treated forged steel, and must be able to withstand very significant stress loads when the aircraft is pressurized. Any marking procedure that could reduce their structural strength would be unacceptable.

This brings us to the question of how to proceed in cases where the original part numbers are no longer visible, but problems in achieving a properly rigged ramp locking system suggest that hook retainer mislocation may be involved. One approach is to remove all the retainers and measure each one by hand.

Identifying "Anonymous" Retainers

The key measurement that must be established to determine the identity of individual retainers is the angle of the locking lug relative to the top of the mounting hole bosses. A simple, although not necessarily ideal, local procedure that will accomplish this consists of inverting the hook retainer being checked on a smooth, flat table top so that it touches the three points described by the two mounting hole bosses and the locking lug (Figure 5).

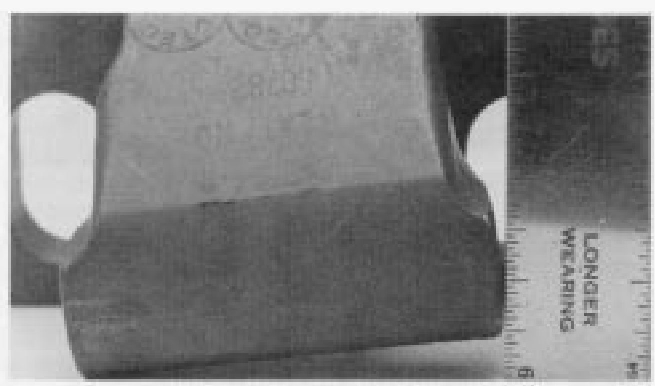


Figure 5. Manual measurement is useful, but tedious. This 2R retainer shows a 7/32~inch (0.219") gap.

This will reveal either no gap or a gap of three possible dimensions at one end of the locking lug. Note that the end displaying the gap will always be the end facing forward when mounted in the aircraft. The gaps for the various hook retainers are shown in Figure 6.

RAMP STATION 2 - L & R	7/32" (0.219")
RAMP STATION 4 - L & R	0.057 - 0.060"
RAMP STATION 6 - L & R	approx. 0.014"
RAMP STATION 8 - L & R	0.00"
RAMP STATION 10 - L & R	0.00"

Figure 6. Check for these gaps when using the manual method to determine hook retainer identity.

Measuring ramp hook retainers manually in this manner is the most accurate field method, but it is also the most time-consuming. Perhaps the main disadvantage is the fact that the retainers have to be removed from the airplane before they can be measured. Even if all check out perfectly, they must be reinstalled exactly as removed or the technician may face the task of going through the complete ramp rigging adjustment procedure before the aircraft can be returned to service.

A much better approach is offered by a new tool recently developed by Benjamin R. Puckett of the Warner Robins Air Logistics Center. This tool is designed to identify all seven styles of hook retainers with the retainers mounted in the aircraft. This means that no disassembly is required unless and until a mislocated retainer is discovered.

Plans for this ramp hook retainer identification tool have been released to permit local manufacture by interested parties. For the convenience of Service News readers, Mr. Puckett presents most of the drawings in reduced format in the following article. Sufficient information is provided to allow an experienced machinist to build and assemble the tool. A complete set of drawings may be obtained by contacting Ben Puckett at the telephone numbers or address given on page 10.

Checking Your Aircraft

If the aircraft assigned to your organization have experienced a succession of ramp rigging problems that have defied solution or explanation, it will be well worth the effort to have the ramp hook retainer identification tool locally manufactured and check for possible hook retainer mislocation. A good plan is to inspect all the aircraft in your fleet before undertaking any repairs. This allows you to itemize which retainers, if any, will be needed so that parts can be ordered in advance and be available when the fix phase is started.

The first step in inspecting an aircraft for mislocated ramp hook retainers is to lower the ramp until it touches the ground. This permits access to the all of the retainers. A piece of cloth padding or polyurethane foam strategically placed between the end of the ramp and the ground will help prevent scratching of the exterior surfaces.

Using the Tool

The second step is to use the hook retainer identification tool to catalog the retainers actually present in your aircraft. The tool is designed to measure the angle between each retainer's locking lug and the flat surfaces on the tops of the mounting hole bosses. The result of this measurement is read off the tool's scale plate in the form of a station designation (Figure 7). In other words, if the angle detected by the tool is correct for a retainer in the 2R position, 2R will be shown on the scale plate. If it is correct for a retainer intended for the 2L location, that will be indicated, and so on.

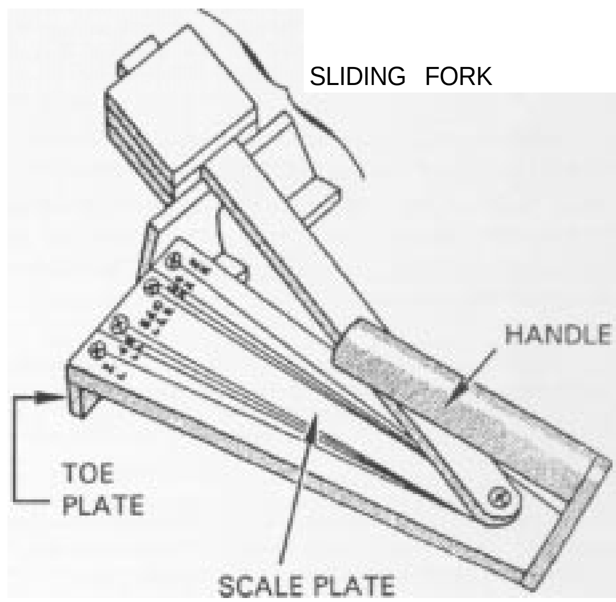


Figure 7. The design of the identification tool's scale plate makes it easy to distinguish between R and L retainers.

The actual angles being measured are shown in Figure 1. Note that although the same angles are shown for corresponding positions on each side of the aircraft, the retainer locking lugs on the left and right sides are angled in the opposite directions. The use of the tool makes it easy to distinguish between right and left retainers since the R and L indications are displayed on opposite sides of the scale plate centerline.

Making the Measurements

Successful results with any shop aid depend upon both the quality of the tool itself and skill with which it is used. As far as the tool is concerned, the importance of careful fabrication and strict adherence to the specified tolerances cannot be overemphasized. A high

Previous Page Table of Contents Next Page

degree of precision is a must in constructing this device. Some of the angles being measured are extremely small, and a poorly made product will be worse than useless if employed for such purposes.

When you are ready to begin the actual measurements, start at the forward end of the ramp at ramp station 2L and work aft to ramp station 10L. Then move back forward to ramp station 2R and work back again to the aft end of the ramp.

Place the tool on the hook retainer under test, first positioning the two locating fingers on the retainer's mounting hole bosses. Be sure that the tops of the retainer's bosses are clean and smooth, free from lumps of sealant and beads of paint. Accurate measurements require that the sliding fork be held firmly and securely on the tops of the retainer's mounting hole bosses while the technician slides the toe plate down into contact with the retainer's locking lug. The author is shown demonstrating the technique in the photograph that appears on page 3.

With the toe plate absolutely flat on top of the locking lug, read the ramp station location shown on the face of the scale plate. As with most other things, experience counts. A little time spent perfecting your skills in handling the tool will pay big dividends in terms of improved accuracy.

Mark each hook retainer with the station number and letter that is indicated on the scale plate. Use a wide, felt-tip permanent marker (or equivalent) of a contrasting color.

After all 10 hook retainers have been identified and marked, assess what the existing resources are. A complete shipset will be required before the aircraft's cargo ramp can be properly rigged. A shipset is a set of all the part numbers required, and in the correct quantity, to fully equip one aircraft. A listing of a complete shipset is shown in Figure 8.

Figure 8. **A complete shipset consists of all the ramp hook retainers listed below.**

4 EA INDEX 1	STATIONS 8 & 10 (ALL)
1 EA INDEX 2	STATION 6L
1 EA INDEX 3	STATION 6R
1 EA INDEX 4	STATION 4L
1 EA INDEX 5	STATION 4R
1 EA INDEX 6	STATION 2L
1 EA INDEX 7	STATION 2R

If it has been determined that a complete shipset is in place, the basics to begin the rigging procedure exist. If not, the missing parts must be ordered.

Points to Remember

The ramp hook identification tool is intended to be used as a shop aid. It is simply a guide that can assist you in determining if any of the ramp hook retainers in your aircraft are located in the incorrect positions. No hook retainers should be condemned or relocated on the basis of the tool readings alone. Retainers that appear to be mislocated should be removed and rechecked. Use the manual method described earlier, or better still, have your machine shop check the retainer with precision measuring equipment.

New hook retainers drawn from supply will ordinarily display part numbers. While this might inspire a certain level of confidence, it is still a good idea to measure all new parts before installing them. This will guard against the possibility of mis-identification. Most of the ramp hook retainers in the supply system have been manufactured by sub-contractors and subjected to only spot sampling. Parts that look enough alike to fool experienced aircraft maintenance technicians can also confuse machine-shop workers.

The locking lugs of retainers in the 6L and 6R positions are designed to have an angle of just 45 minutes of arc (0 0 45') with respect to the base of the retainer. This is a very small angle and difficult to measure in the field, even under the best of conditions. The manufacturing tolerances of +/-20 minutes called out in the blueprints add to the challenge of getting a meaningful measurement.

As a further complication, it must be recalled that in practice, the measurements must be taken at the tops of the mounting hole bosses. The base of the retainer, from which the locking lug angle is actually determined, is not accessible in the installed position. The permitted tolerance between the base of the retainer and the tops of the mounting hole bosses could bring another +/-20 minutes into play. When all this is added up, the technician could find himself in the position of attempting to measure an angle of 45 minutes with a tolerance of +/-40 minutes. This would clearly be a job for the precision equipment in a well-equipped machine shop.

It may therefore not always be possible to distinguish between a 6L retainer (0" 45') and an 8L retainer (0" 0'), for example. By way of consolation in such cases, it should be noted that given the other variables in the system, such small differences in ramp hook retainer angles are unlikely to prove significant obstacles to achieving a properly rigged cargo ramp.

Ready to Rig

Once all the ramp hook retainers have been positively identified and a complete shipset is available for every aircraft whose cargo ramp requires rerigging, the fix phase of the operation can begin. Detailed cargo ramp rigging instructions will be found in the authorized technical manuals for your aircraft.

The importance of following the prescribed rigging procedures in their entirety from start to finish cannot be overemphasized. It is not possible to work just certain areas of the rigging procedure piecemeal and achieve the desired results. Do not become discouraged by the lengthy nature of this project. Strict adherence to the published procedures will reap big rewards in the form of a smooth-working, tight-sealing, properly rigged C-130 cargo ramp.

Credits

This article would not have been possible without the interest and enthusiastic assistance of a number of individuals in the Wyoming Air National Guard, Warner Robins Air Logistics Center, and Lockheed Aeronautical Systems Company. A better example of the value of full and open cooperation between local military air organization, air logistics center, and aircraft manufacturer would be hard to imagine.

While recognizing the impossibility of doing full justice to all who so willingly provided their help, the author and *Service News* would like to extend special thanks to David Baldwin of the Wyoming Air National Guard, Ben Puckett and Captain Russ Burley of the Warner Robins Air Logistics Center, and Gene Covington, Dennis Coover, and Jim Taylor at Lockheed for their invaluable help in support of this effort. □

MSgt David Crerar can be reached at the 153rd Airlift Group/DOLF, Wyoming ANG, 217 Del Range Blvd. Cheyenne, WY82009-4799. The voice telephonenumber is l-307-772-6362; fax is l-307-772-6000.

TESTING THE TOOL

Thanks to the generosity of Dave Crerar and Ben Puckett, we at Lockheed were given the opportunity to examine and test the fully functional prototype of the ramp hook retainer identification tool described in this issue of *Service News*. It is the prototype that is shown in the photographs accompanying the following article, which also helps explain why a few of the features shown in the final drawings do not appear in the photographs.

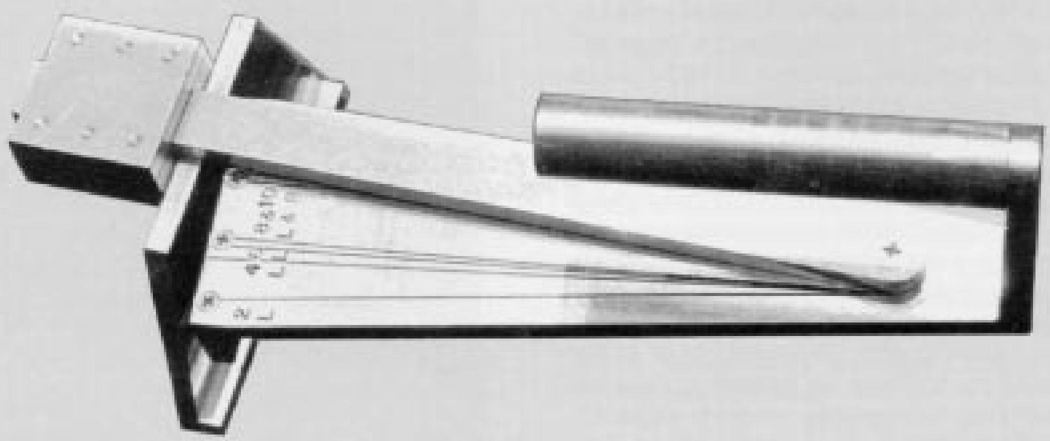
Studies conducted by Tim Gilbert and J. J. Barnes of LASC's Tool Inspection Department confirmed the fundamental soundness of the tool's concept and design, but also tended to underscore the critical importance of precision in fabrication and assembly. The tolerances must be very close because the angles being measured are so small. A simple accuracy check that can be applied during final assembly of the tool consists of inserting a flat piece of l/4-inch machine steel between the sliding fork and the toe plate, and then checking the position of the indicating beam. It should read exactly on the centerline of the scale plate.

Practice in using the tool, and care in setting up the proper conditions for accurate measurements are also important. Keep in mind that the tops of the retainer mounting hole bosses must be smooth and flat, and free from irregularities caused by paint or sealant. If it is necessary to scrape off paint to get a clean surface, be sure to retouch the area when you are done to prevent corrosion from getting a foothold. Severe wear or surface damage on the retainer's locking lug can also interfere with obtaining good readings.

Finally, it is worth recording that there is nothing like one good idea to inspire another. Lockheed engineers are now developing a digitally-based ramp hook identification tool that will be described in a future issue of *Service News*. The digitally inclined may contact Roy Webber at l-404-43 l-67 16 for further information.

-Ed.

Making a C-130



Ramp Hook Retainer Identification Tool

by Benjamin **R.** Puckett, *Design Engineer*
Warner Robins Air Logistics Center

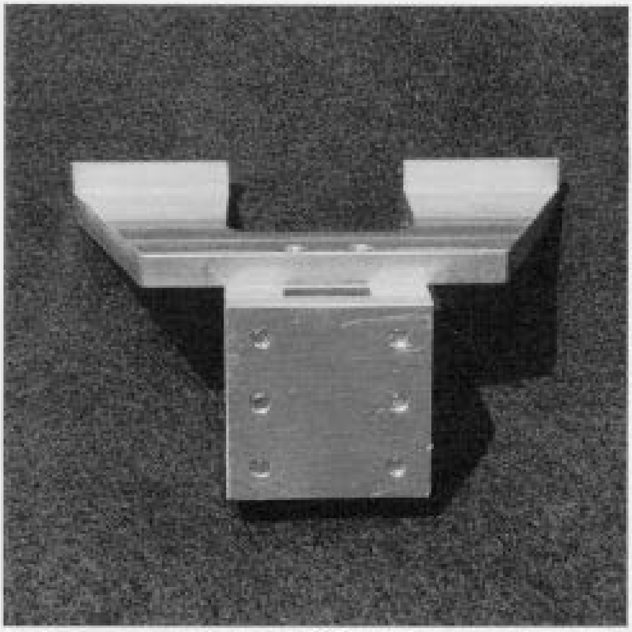
The requirement for the design of the Ramp Hook Retainer Identification Tool is to provide the Hercules technician with a simple, quick, and accurate method of determining if the ramp hook retainers are installed in the correct positions. Use of the tool provides a visual means of establishing the properties of each individual hook retainer. These include determining whether the retainer is intended to be installed on the left or right side of the aircraft, and its proper position on the sloping longeron. The tool is designed to be used with the hook retainer installed on the longeron, and can identify an individual retainer whether or not it is physically located in the correct position.

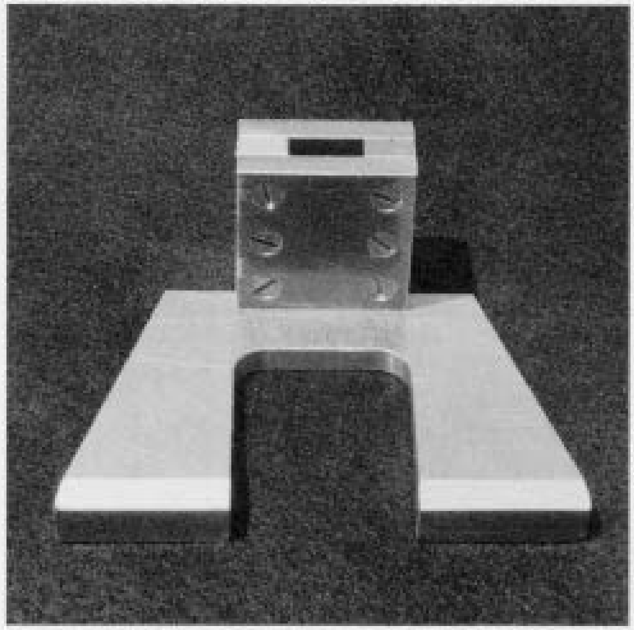
As with any tooling fixture, extreme care must be used to ensure that the tool is manufactured correctly. Successful fabrication of the tool requires close attention to detail, and it is essential to maintain the critical tolerances throughout the assembly process.

One of the areas where a high degree of accuracy is especially important is in **the** location and scribing of the angled lines on the scale plate, which require an accuracy of +/-5 minutes of arc. For the prototype, this was accomplished by designing the tool with the prescribed angles-obtained from the hook retainer engineering drawings-and then mirroring the scribe lines along the longitudinal axis of the scale plate, thus creating a right and a left scale. Also highly sensitive to inaccuracies are all the perpendicular interfaces, which must be assembled to a tolerance of +/- 0.002 inch. These include the fork/sliding block and toe plate/scale plate attach points. Remember that any error introduced during manufacture will result inerroneous readings and seriously degrade the usefulness of the tool.

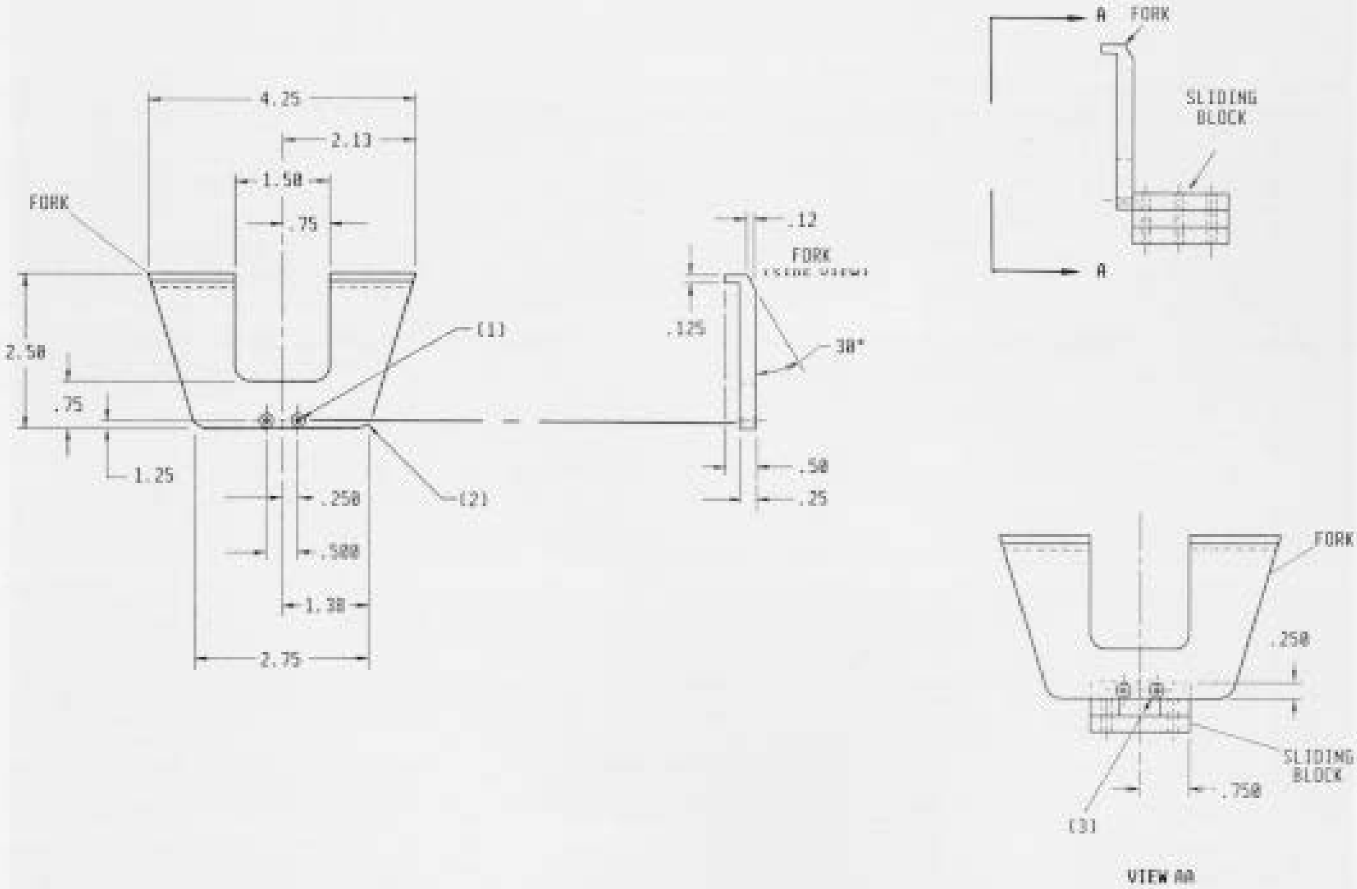
Use of the completed tool is quite straightforward, and is described in detail in the preceding article. In principle, the tool operation involves establishing the relative angle between the individual hook retainer's locking lug and the top of its mounting hole bosses. With this accomplished, the technician can determine if the retainer is installed on the correct longeron and at the proper ramp station.

The prototype tool was fabricated from 6061-T3 aluminum alloy; however, any stable material (steel, phenolic, etc.) is acceptable. The following pages contain drawings and photographs intended to assist those who may be interested in locally manufacturing this useful shop aid. The drawings have been reduced in size to permit reproduction in a magazine format, but should be adequate for an experienced machinist. Readers desiring a full set of plans can obtain them by contacting the author at the following telephone numbers: (l)-912-926-3737;fax(l)-912-926-0970.The mailing address is: WR-ALC/LB, Attn: Ben Puckett, 265 Ocmulgee Court, Robins AFB, GA 31098-1647.



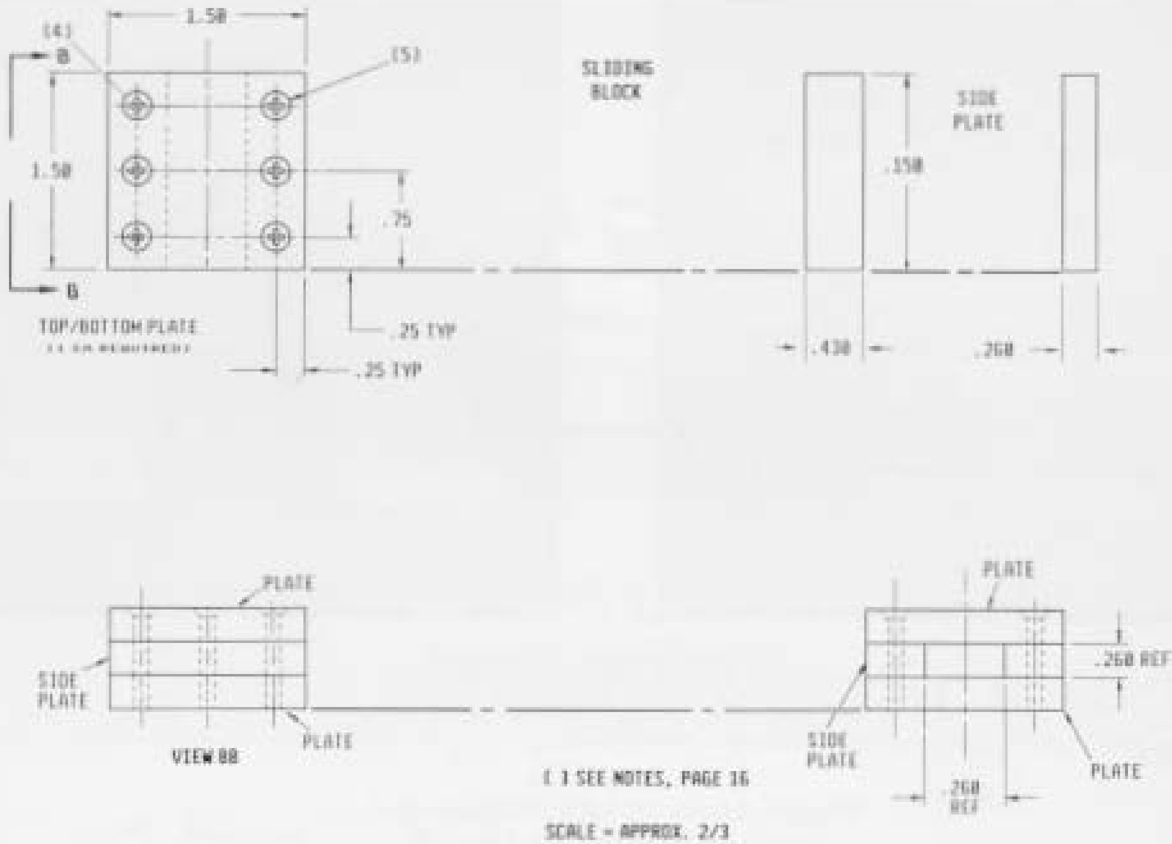


SLIDING FORK ASSEMBLY

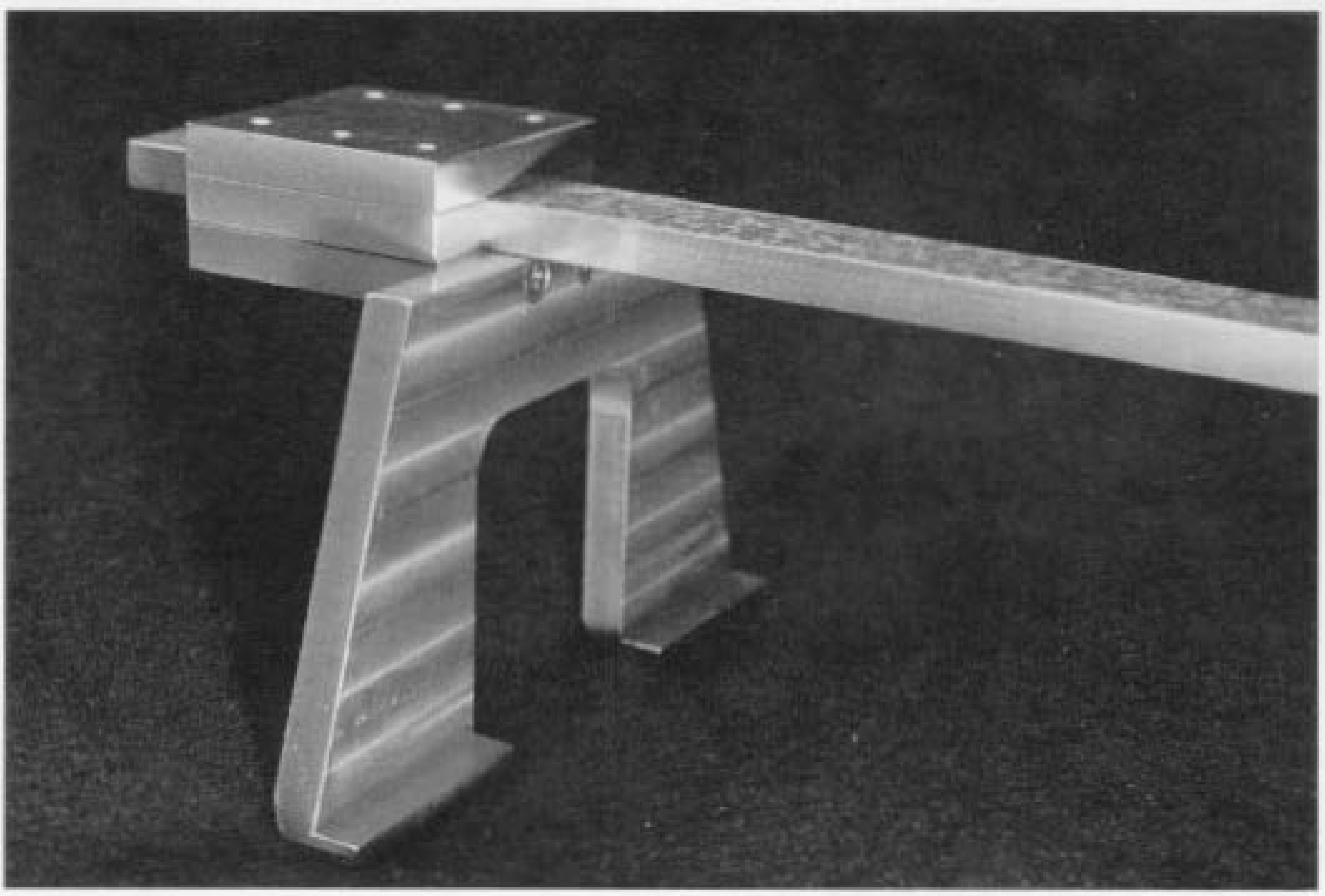


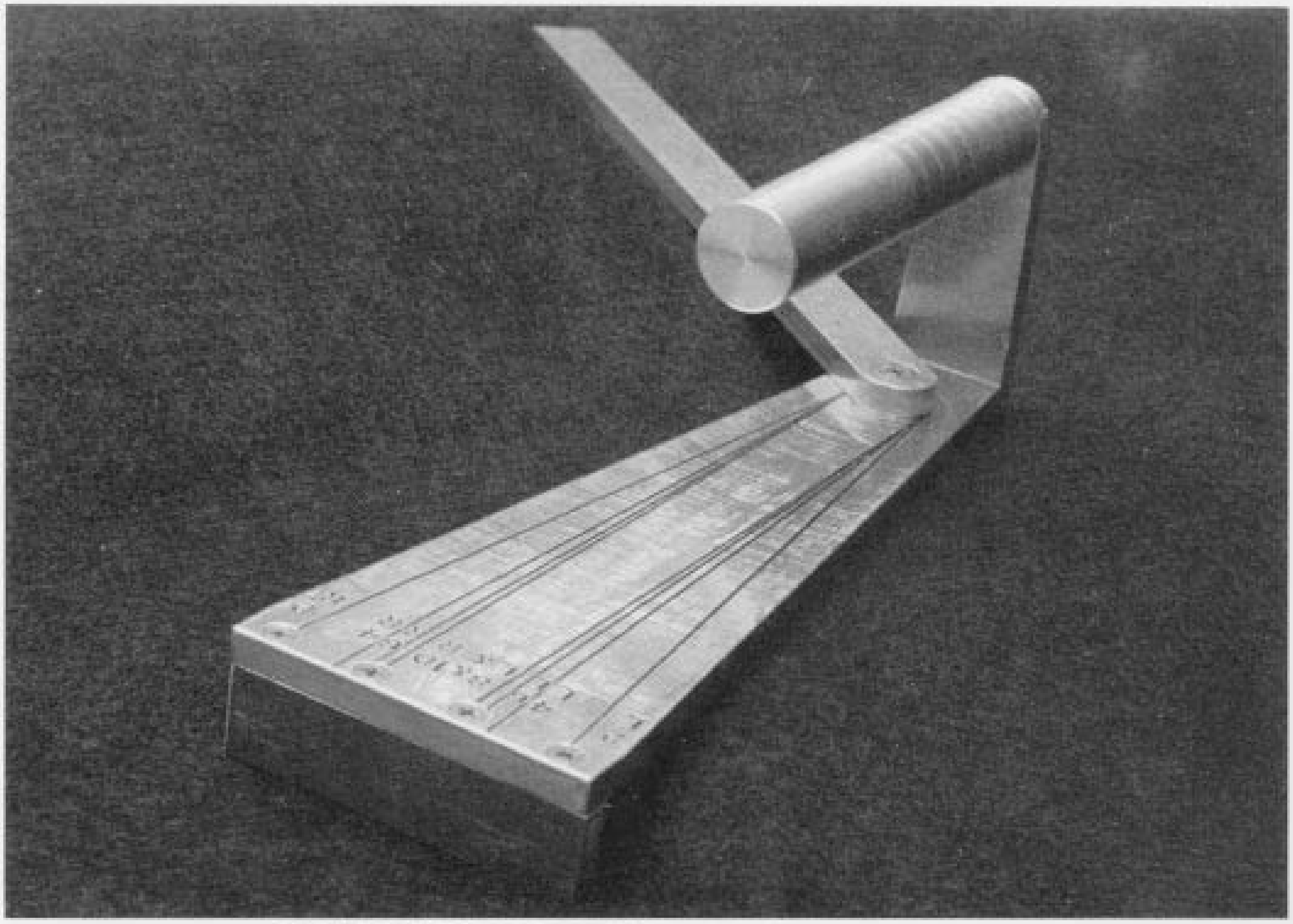
( ) SEE NOTES, PAGE 16

SCALE = APPROX. 1/3

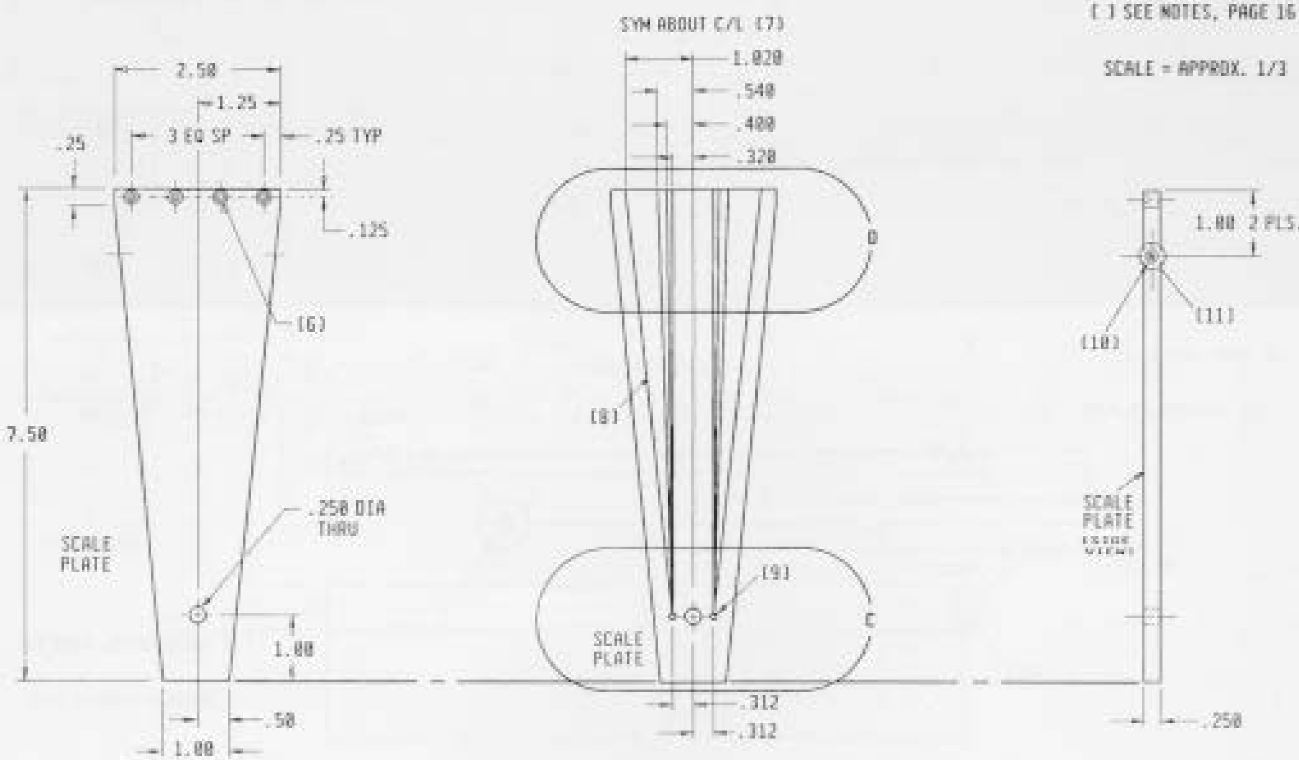


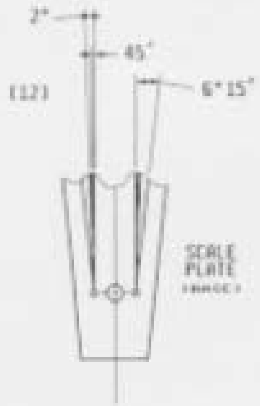
SLIDING FORK MOUNTED ON INDICATING BEAM



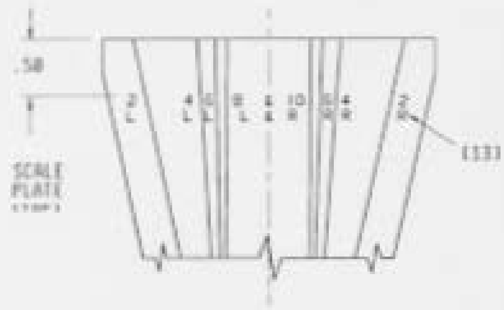


SCALE PLATE, INDICATING BEAM, POST, AND HANDLE

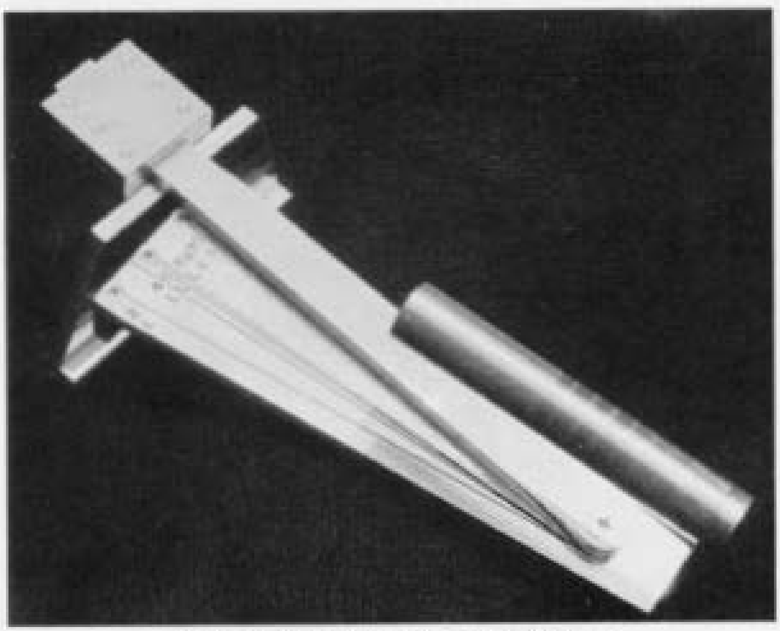




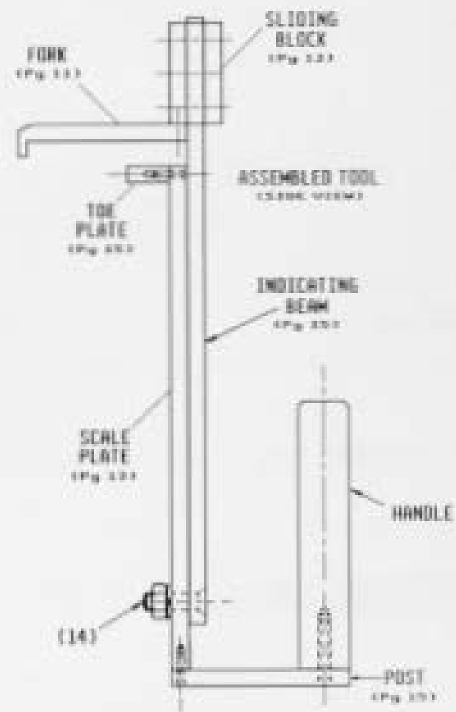
VIEW C

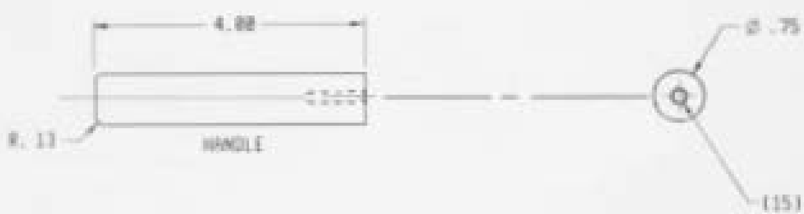


VIEW D



ASSEMBLED TOOL, TOP VIEW

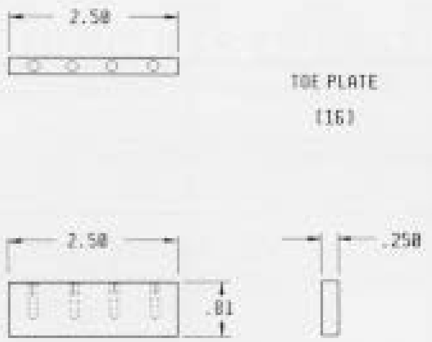


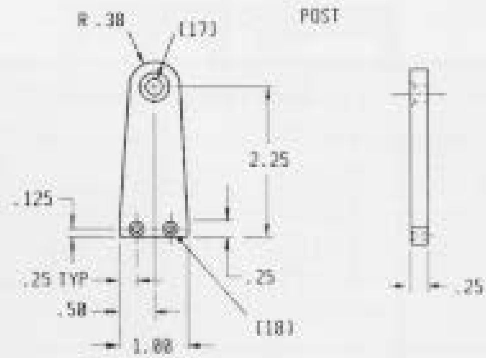


( ) SEE NOTES, PAGE 16

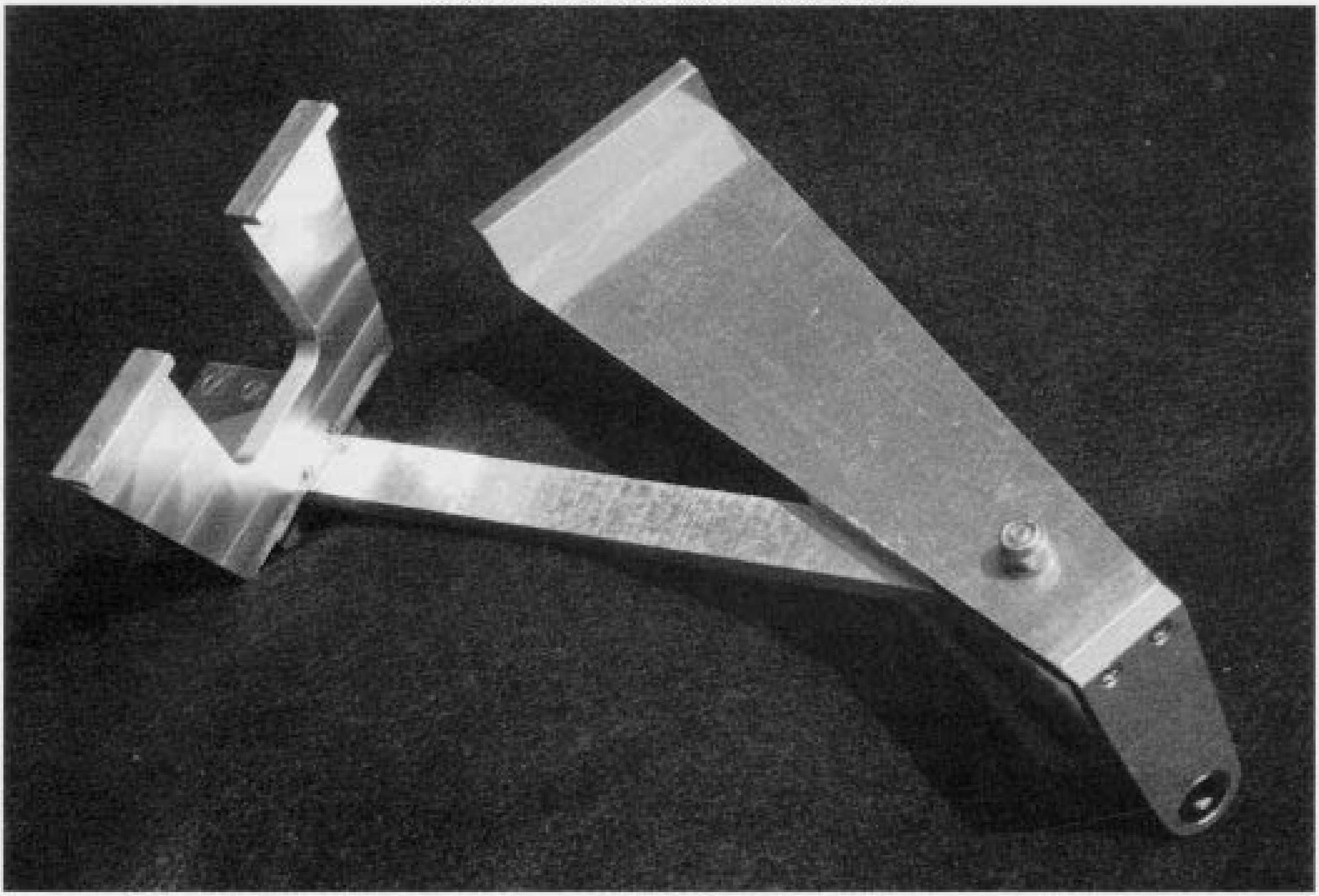
SCALE = APPROX. 1/3

Previous Page Table of Contents Next Page





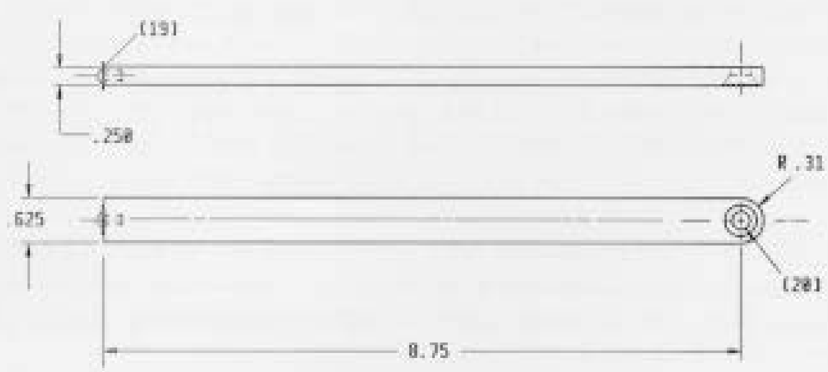
ASSEMBLED TOOL, BOTTOM VIEW



INDICATING BEAM

( ) SEE NOTES, PAGE 16

SCALE = APPROX. 1/3



Previous Page Table of Contents Next Page

NOTES

1	.I2O DIA. THRU; CSINK 100° TO .218 DIA.; 2 HOLES.
2	.25 RAD., 4 PLACES.
3	TAP DRILL SLIDING BLOCK AS SHOWN; LOCATE FROM HOLES IN FORK; .50 DEEP; CSINK 100" TO .112 DIA; TAP .I 12-40 UNC-3B; .38 DEEP; 2 HOLES. FASTEN FORK TO BLOCK WITH 2 EA. MS24693-S6 SCREWS.
4	C-CLAMP PLATES TOGETHER, MAINTAINING .610 X .260 SLOT DIMENSIONS, THEN DRILL AND TAP. CSINK 100° TO .260 DIA.; TAP .I 38-32 UNC-3B THRU 6 HOLES.
5	FASTEN SLIDING BLOCK PARTS TOGETHER WITH 6 EA. MS24693-S30 SCREWS.
6	.120 DIA. THRU; CSINK 100" TO .218 DIA; 4 HOLES.
7	USE THESE DIMENSIONS IF UNABLE TO USE ANGLES SHOWN ON NEXT PAGE.
8	ETCH LINES APPROX .OlO - .015 DEEP AS SHOWN.
9	CENTER PUNCH INDEX MARK - 2 PLACES.
10	TAP 6-32 UNC-3B; .31 DEEP FOR STOP SCREWS: 2 PLACES (1 EACH SIDE).
11	INSTALL STOP SCREWS, USING 2 EA. NAS6OI-4 SCREWS AND 2 EA. AN960D6 WASHERS.
12	USE THESE ANGLES FOR POSITIONS OF ETCHED LINES ON SCALE PLATE (PREFERRED METHOD).
13	METAL DIE STAMP .I 25 HIGH DIGITS LOCATED APPROX. AS SHOWN.
14	MS24693-S297 SCREW; AN935-416 WASHER; MS21042-4 NUT (SEE NOTE 20).
15	TAP DRILL HANDLE 1 .OO DEEP; CSINK 100' TO .250 DIA; TAP .250-28 UNF-3B; .88 DEEP. .
16	TAP DRILL TOE PLATE .50 DEEP; LOCATE FROM HOLES IN SCALE PLATE; TAP .I 22-40UNC; .38 DEEP; 4 HOLES; FASTEN TO SCALE PLATE WITH 4 EA. MS24693-S6 SCREWS.
17	,265 DIA THRU; CSINK 100° TO .44 DIA. FASTEN HANDLE TO POST WITH 1 EA MS24693-S287 SCREW.
18	.120 DIA THRU; CSINK 1 OO" TO .219 DIA; 2HOLES; TAP DRILL SCALE PLATE .50 DEEP; 2 HOLES; LOCATE FROM HOLES IN POST. FASTEN POST TO SCALE PLATE WITH MS24693-S6 SCREWS; 2 EA.
19	TAP 6-32 UNC-3B .31 DEEP; INSTALL 1 EA. NASGOI-4 SCREW AND 1 EA. AN960D6 WASHER.
20	.265 DIA THRU; CSINK TO 100" TO .44 DIA. INSTALL INDICATING BEAM, USING SCREW, WASHER, AND NUT SHOWN IN NOTE 14.

HERCULES OPERATORS UPDATE

Conducted by **Dave Holcomb,**
Service Analyst
Lockheed Western Export Company

UPDATE

CURRENT-PRODUCTION OUTER WINGS

The C-l 30 is a story of success in evolution. Over two thousand C-l 30 Hercules airlifters now have been built. There have been some 37 models and derivations since the first production C-l 30 rolled out in 1954, almost 40 years ago. Incidentally, that very same C-l 30A is still in active service as a gunship for the USAF.

Over 60 countries now operate the Hercules aircraft. Improvements in the C-l 30H over the C-l 30E were as dramatic as those of the C-l 30E Hercules over the original C-l 30A; and since the first C-l 30H aircraft, the improvements in the current production C-l 30H have been just as impressive.

Since it was initially designed, the C-l 30 Hercules aircraft has been undergoing improvement. Moreover, the aircraft continues to evolve, with various design changes and innovations being integrated almost daily to make the aircraft better and more user-friendly. The list of improvements is quite lengthy, and we will be able to touch only on one area in each installment of the *Hercules Operators Update.*

The first area we will discuss concerns manufacturing improvements and recommended protective finishes for current-production outer wings. The following material should give a better understanding of the evolutionary development of the presently installed outer wing.

Beginning with this issue, Service News *is pleased. to bring its readers a new section called the 'Hercules Operators Update." The Update has its origin in the* Hercules Operators Quarterly Newsletter **(HOQ),** *a publication which has been distributed on a timited basis to attendees of the Hercules Operators Conference. Hercules operators from all over the world gather in Marietta every two years to attend this symposium.*

Once we had a chance to review the contents of the **HOQ, we** *realized that the maintenance updates and news notes contained in this quarterly* ***would find*** *broad interest among our readers. Fortunately, we were to able persuade the editor, Dave Holcomb of Lockheed Western Export Company, to allow us to incorporate his newsletter into* Service News *magazine as regular feature. This will help ensure that the valuable information contained in the* **HOQ** *reaches the worldwide audience it deserves.*

– Ed.

EXTERNALLY MOUNTED FUEL QUANTITY PROBES

A milestone in jet aviation was achieved by the design innovations and processes incorporated to control corrosion caused by microbial infestation in integral fuel tanks. Integral fuel tanks in aircraft beginning with Lockheed serial number LAC 4542 have been equipped with an automatic water removal system and a special protective coating system to combat microbial corrosion.

Following the introduction of these features, the primary threat to the integrity of the integral fuel tanks has been the worker who enters the tanks to repair leaks or replace a fuel quantity probe. Too often, protective finishes are damaged from tools and improper footwear-and carelessness. Too often, entry into a tank produces fuel leaks and corrosion, necessitating more entries and more repairs.

Lockheed's approach to reducing the necessity for human beings to enter integral fuel tanks is twofold; namely, to improve the integrity of the fuel sealing processes during production, and to mount the fuel quantity probes externally on the upper surface of the wing. Externally-mounted probes can be replaced and serviced from outside the tank (see Figure 1).

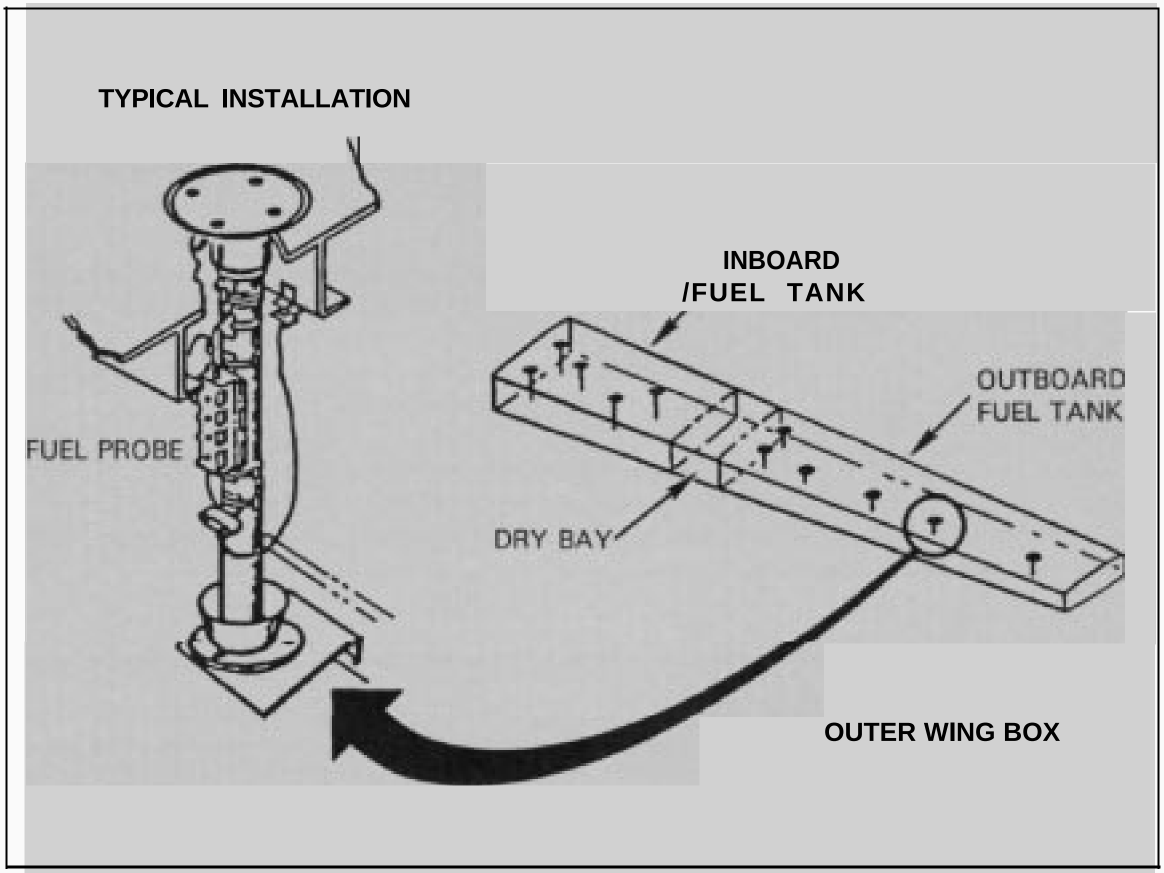


Figure 1. Mounting fuel quantity probes externally reduces the need for personnel to enter the tanks, reducing both downtime and maintenance costs.

Starting with LAC 4992, all production outer wings have the fuel quantity probes externally mounted. A total of 40 internally-mounted fuel probes have been replaced by 22 externally-mounted fuel probes, 11 in each outer wing. The results are fewer corrosion problems and a significant reduction in fuel system maintenance man-hours per flight hour.

HERCULES OPERATORS UPDATE

INTERFERENCE-FIT FASTENERS

Hi-tigue interference-fit pins with fuel sealing nuts are installed in the outer wings for general panel-to-panel, panel-to-beam cap, and beam cap-to-web attachments. These attachments afford improved fuel sealing and fatigue resistance for the structure which makes up the integral fuel tanks (Figure 2).

The unique feature about the Hi-tigue pin is the slightly raised bump around the shank adjacent to the threads, the feature that creates the desired interference fit for enhancing fatigue resistance. A Teflon seal in the Hi-tigue nut augments the features of the interference-fit pins to prevent fuel leakage. The practice of using the Hi-tigue interference-fit pins with the fuel sealing nuts was initiated at Lockheed serial number LAC 4992.

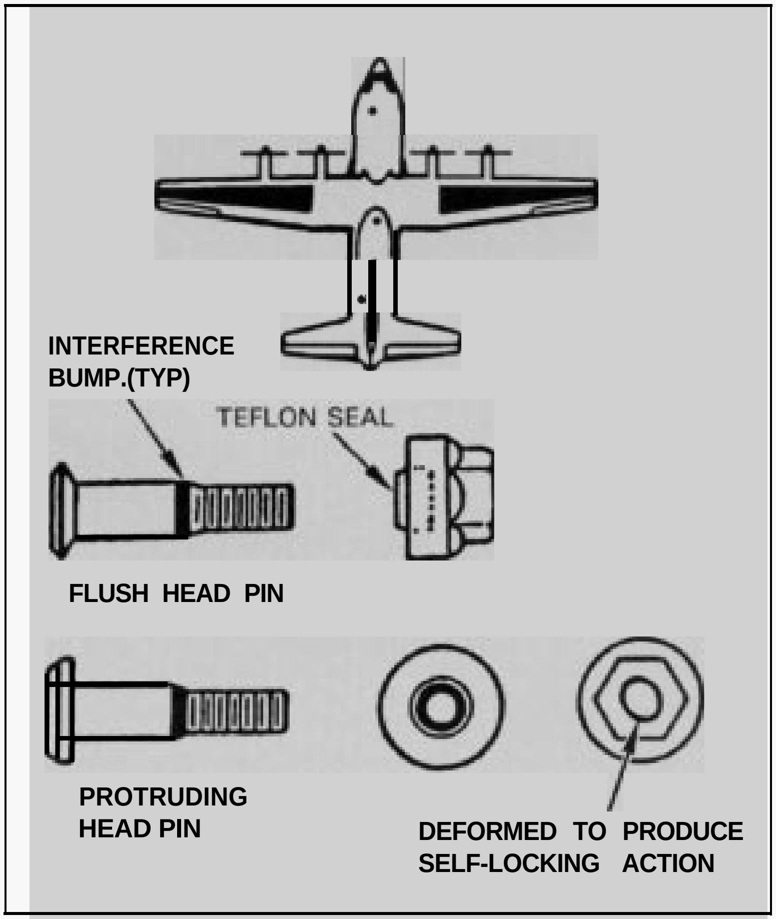


figure 2. Improved interference-fit fasteners are used in the outer wings for better fuel sealing and enhanced fatigue resistance.

Tapered interference-fit fasteners are used in locations that are fracture and fatigue critical, such as the attachments for the rainbow fitting. All pins are installed wet with corrosion-inhibitive polysulfide sealant. Once installed, the fuel sealing nuts are overcoated with polysulfide sealant. A flexible polyurethane finish is applied over the polysulfide sealant.

CLAD-ALUMINUM WEBS ON WING BEAMS

Wash rack personnel generally agree that few areas on the airplane are harder to clean than the soot-covered surfaces of the wing beams. Soot tends to embed in the paint, often making removal of this carbon residue laborious and difficult. If not removed, however, the carbon will, in time, penetrate the protective coating on the webs and establish a galvanic cell with the high-strength aluminum alloy. The result is pitting and exfoliation corrosion.

To afford an extra measure of protection to the wing beam webs, Lockheed now uses clad 7075-T6 aluminum alloy sheet for webs instead of nonclad sheet (Figure 3). Cladding is recognized as paramount protection for high-strength aluminum alloys because of its sacrificial nature. This change from nonclad to clad went into effect at LAC 4827.

As on the bare aluminum webs, the clad aluminum webs are sulfuric acid anodized, given a sodium dichromate treatment, and then painted with standard finish system.

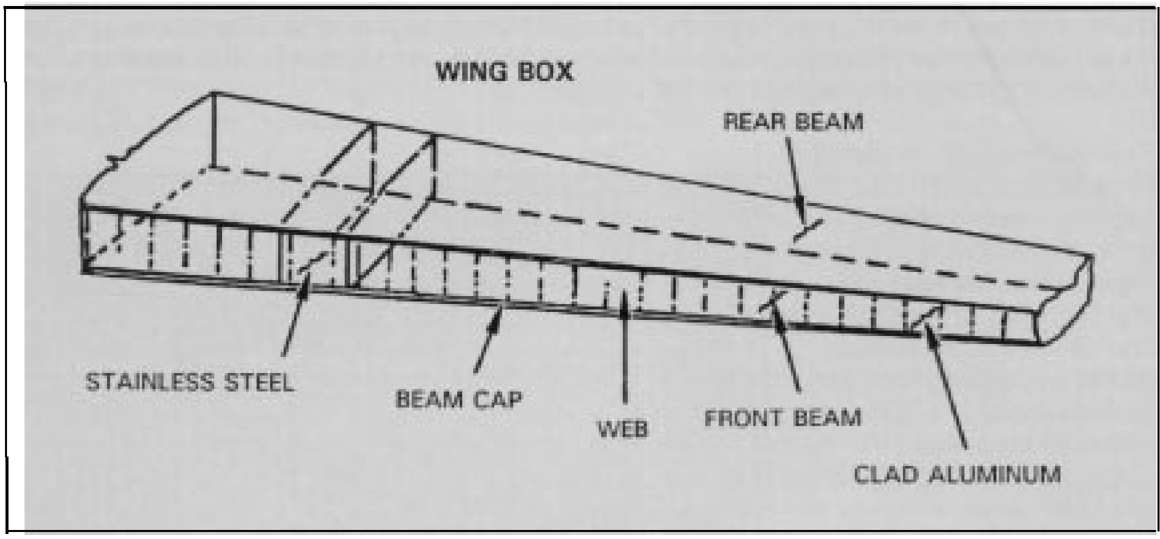


Figure 3. Using clad 7075.T6 aluminum on the wing beam webs helps provide increased corrosion resistance.

WING FLAP SKINS

One of the most corrosion-prone areas on any aircraft is in the engine exhaust path where the carbon and sulfuric acids collect on the structure. A section of each C-130H wing flap is in the impingement path of engine exhaust emissions. To resist the heat and corrosive products of engine exhaust gases, the exposed section of the flap skins on the C-l 30H prior to LAC 4992 was made of commercially pure titanium sheet 0.025-inch thick.

A shortage of titanium sheet required that Lockheed find a substitute material. Starting with LAC 4992, The production skin for this location was heat- resistant 2219-T8 1 aluminum alloy. Sheet thickness was increased to 0.032-inch. Meanwhile, stainless steel sheet was being evaluated in-service on several operators' aircraft.

Stainless steel sheet of 301 alloy proved successful in both resisting corrosion and fatigue cracking during the service evaluations. It proved better than either titanium or aluminum alloy 2219-T81. Effective on Lockheed aircraft serial number LAC 5091 and up, the affected skins are 0.025-inch stainless steel (Figure 4).

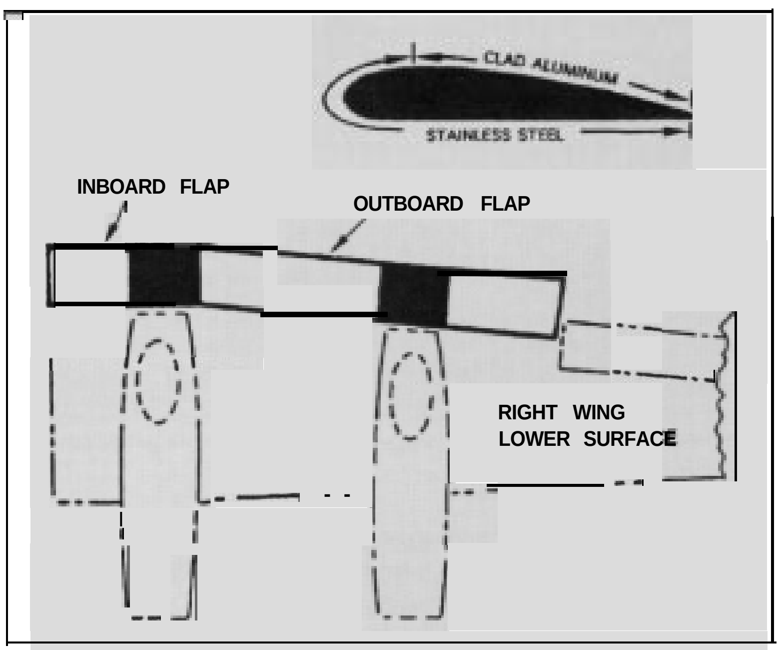


Figure 4. Wing flap skins of stainless steel sheet of 301 alloy are more resistant to fatigue cracking and corrosion than either aluminum or titanium.

Previous Page Table of Contents Next Page

C-130 SPECIAL TRAILING EDGE PANELS ON THE LOWER SURFACE OF THE WINGS

Prior to LAC 4934, a titanium heat shield covers the trailing edge panel on the lower surface of the wing directly behind each engine. The panel is a structurally bonded assembly consisting of an 0.012-inch outer skin and an 0.020-inch inner skin (see Figure 5).

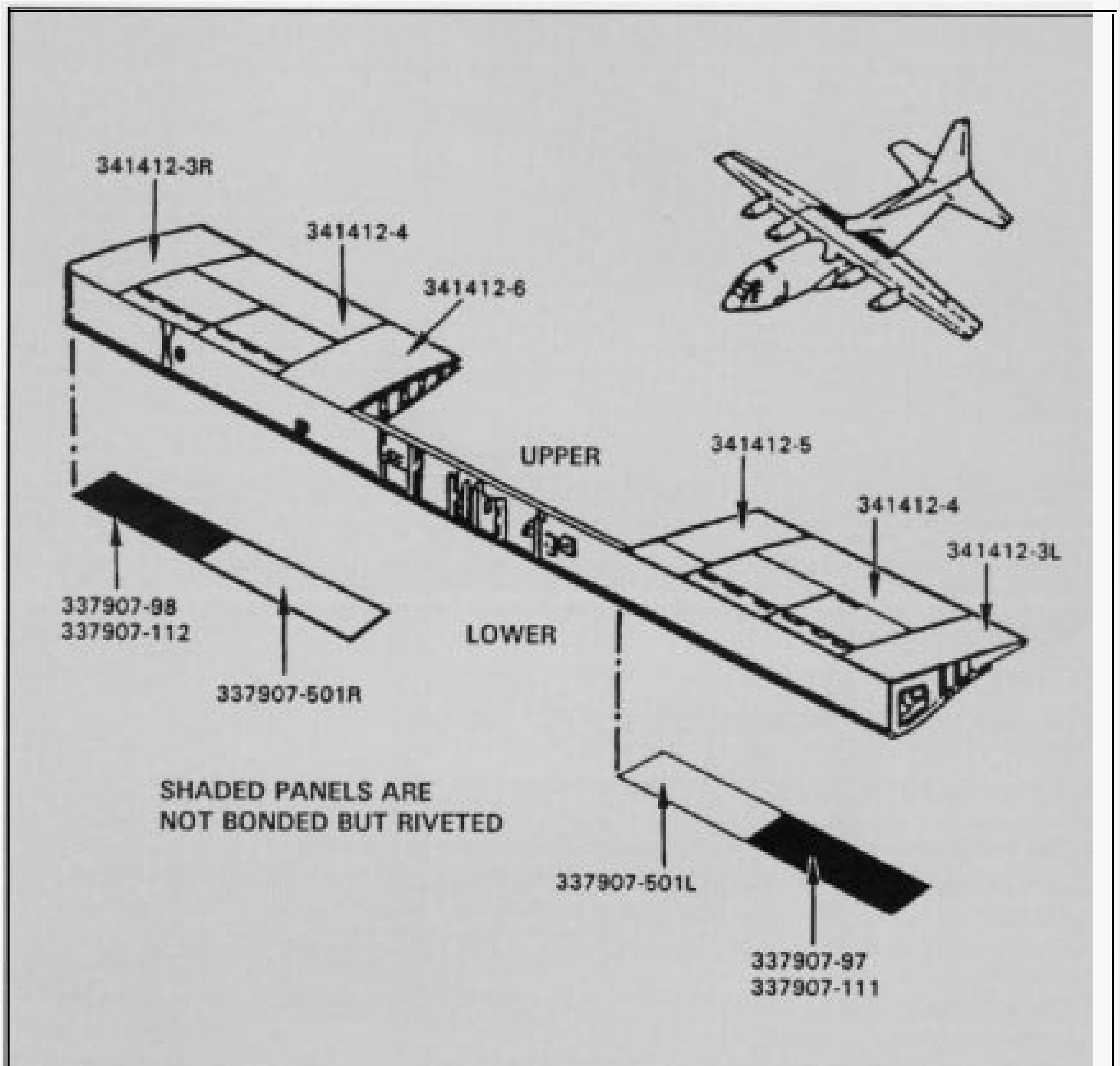


Figure 5. Riveted wing panels made of 2219-T81 aluminum alloy used at specific locations along the center wing trailing edge resist corrosion, disbandment.

Because of the shortage of titanium sheeting, Lockheed changed the design of the panels covered by the titanium to a thicker assembly and removed the titanium heat shield. Clad aluminum alloy 2219-T81 sheet 0.032-inch thick replaced the 0.012-inch outer sheet of 7075-T6. The gage on the clad 7075-T6 inner skin was increased to 0.020 inch.

Service history has shown there is a susceptibility for the panel to disbond. To avoid disbondment, Lockheed has redesigned the assembly, using corrosion inhibitive sealant in the interface and rivets for attachment strength. This change was effected at LAC 5071 (Figure 6).

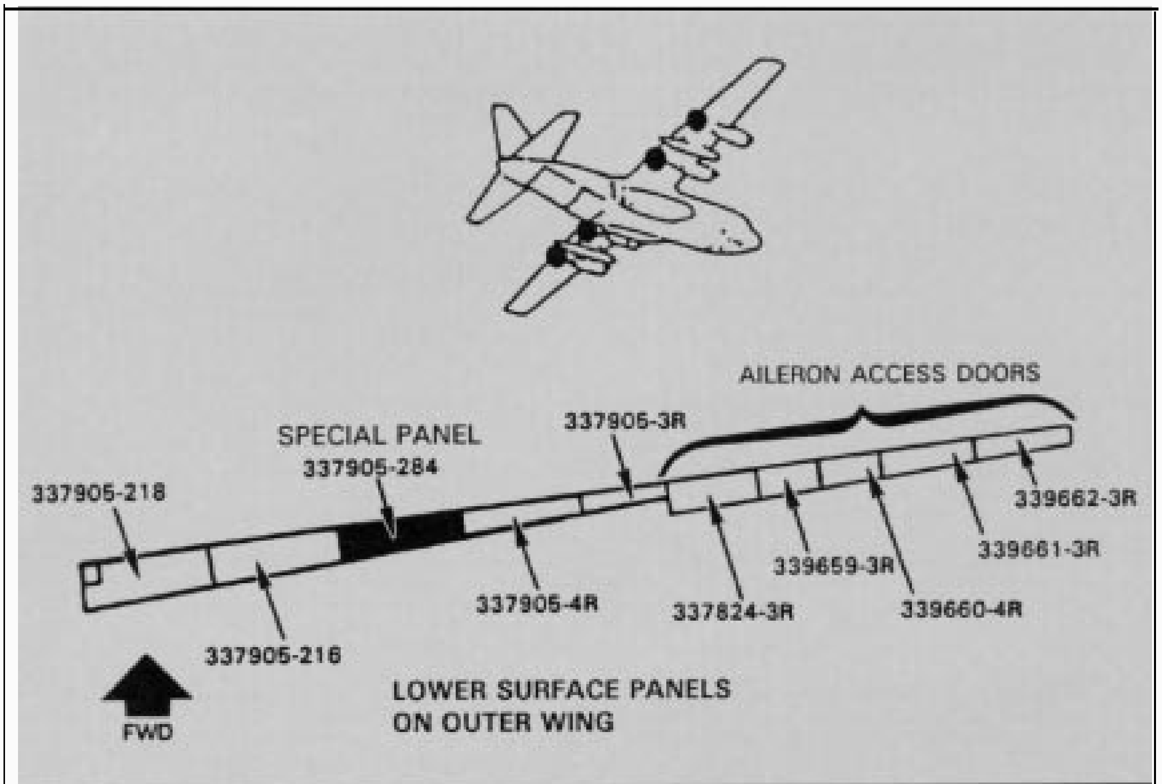


Figure 6. Similar riveted panels of corrosion-resistant 2219-T81 aluminum alloy are also used at critical locations in the outer wing.

OTHER PRODUCTION IMPROVEMENTS FOR THE NEW OUTER WING

A sampling of other introduced improvements follows:

- Skin Planks – Integrally stiffened panels have been reprofiled, thickened and given an over-aged temper to improve stress corrosion resistance and to increase fatigue life. The material was changed from 7075-T6 to 7075-T73. Minimum panel thickness was increased from 0.040 inch to 0.080 inch.

- Beam Caps -Three changes were made in these components. The extrusions were changed from 7075-T6 to 7075-T73; the cross-section was increased in fatigue-critical areas; and shot peening was added to the fabrication process.

- Rainbow Fittings -These wing joint attach fittings were reprofiled and the material changed from 7075-T6 to 7075-T73.

- Kingpin Risers – Made from 7075-T73 alloy, the risers were redesigned from extrusions to net forgings.

- Bulkhead Webs -At OWS 0.0, the integrally extruded panel of 7075-T6 was revised to an assembly composed of a web of clad 7075-T6 sheet and stiffeners of 7075-T6 extruded angles attached by rivets. Bulkhead assemblies at OWS 144.5, 214.2 and 562.5 are made the same as the new bulkhead at OWS 0.0, except that the angle-shaped stiffeners are attached by the weldbond process.

- Front and Rear Beam OWS 0 Splice Joints-The splice tees used on earlier wings were changed to back-to-back angles made from 7075-T73 extrusions.

- **Rear Beam Vertical Stiffeners at OWFS 28.17, 100.18, 241.60, and Flap Track Rib -To improve corrosion resistance, 7075 alloy stiffeners were changed from the -T6 condition to -T73. Material thickness was increased on the lower half of the tees to enhance fatigue life.**

- **Leading Edge Hinges and Hinge Pins-Many corrosion and cracking problems associated with hinges were eliminated when the piano-hinge halves were changed from 7075-T6 to 7075-T73 and the hinge pins from stainless steel wire to titanium alloy wire. The titanium wire is coated with Teflon, so lubrication of the piano hinge is no longer necessary.**

MAKING IMPROVEMENT A "ROUTINE"

Lockheed has made it a practice to incorporate design and configuration improvements routinely and continuously in this versatile airplane. When the state of the art in any area is advanced to the point that it becomes cost-effective for the Hercules program, the older, less efficient technology is replaced by the new.

Dave *Holcomb may be reached at Lockheed Western Export Company, P. 0. Box 12 I, Marietta, GA 3006 1. The voice telephone number is l-404-43 l-6549. The fax number is l-404-43 l-6556.*

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

Previous Page Table of Contents Next Page