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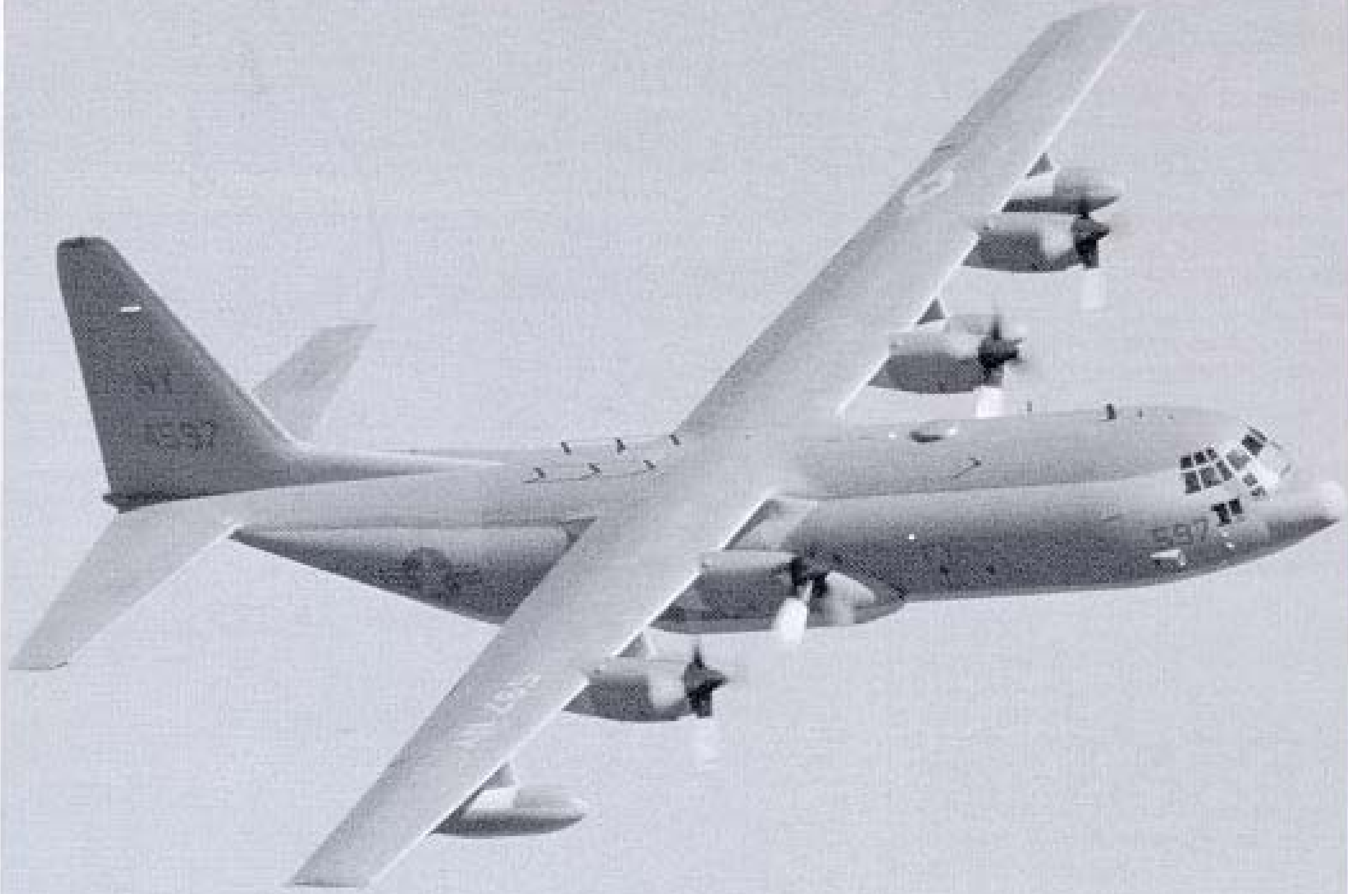
service news



A Service Publication of Lockheed Aeronautical Systems Company

Checking Engine Performance

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Lockheed service news

A SERVICE PUBLICATION OF LOCKHEED AERONAUTICAL SYSTEMS COMPANY

Editor
Charles I. Gale

Art *Director*
Anne G. Anderson

Vol. 19, No. 1, January-March 1992

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Photographic Support: John Rossino

Covers: This KC-130T-30 is one of two new "stretched" Hercules tankers delivered to the U.S. Marine Corps late last year. Barrel plugs forward end aft of the wing extend the fuselage 180 inches, providing a 30% increase in volume ever the standard configuration. The back cover shows the l00-inch forward plug during assembly. The two Marine tankers are the first stretched C-l 30s to enter the U.S. military inventory.

Focal Point

Syd Clark

Maintaining the Quality Advantage

Before a new Hercules aircraft leaves the LASC production facility in Marietta, Georgia. we make certain it has been built to the very highest quality standards modern technology can offer. All of our efforts are directed toward a single goal: ensuring that every customer's expectations about his Lockheed airlifter will be met, and even exceeded.

It is an approach that makes a difference you can measure. The first production C-l 30 is still on the job, 38 years after it was produced. During the intervening years, many other kinds of aircraft have been designed, built, and put info service. More than a few have already vanished from the scene, little more than footnotes to aviation history. The difference? It's simply a matter of quality. Quality that is designed-in and then built-in not only gives en airplane the ability to do its job today, but the potential for continuing to do it tomorrow.

A good beginning is therefore only part of the story; the rest has to do with exploiting the potential. How much of en aircraft's possible service life will be realized is largely a question of the care and maintenance it receives after delivery. This is where we can help. Supplying answers to the hows and whys of aircraft maintenance is what the Customer Training Systems Department is all about.

We have a proud record of performance in this arena. In some 40 years of offering customer training services, we have taught aircraft maintenance to over 10,000 technical and managerial personnel, and produced more than 400 items of maintenance training equipment. The fact that cur training facility is an integral part of a major aircraft manufacturing center offers special advantages for cur students. It helps ensure that the course content we include is fully in step with all of the newest developments in aircraft products end procedures.

We provide expert training in all of the major aircraft maintenance fields, and in a wide variety of specialty areas es well. To give just one example, with nearly 70 countries now flying the Hercules, maintenance training has taken on a distinctly international flavor. Customer Training Systems has responded to this global environment by offering comprehensive English language and basic technical skills programs tailored to satisfy the demands of the customers who need them.

Whether the requirement is for language skills, en aircraft structures update, or in-depth instruction on en advanced inertial guidance system, the Customer Training Systems Department stands ready to provide Lockheed customers with the very latest and very best in aircraft maintenance training. It's a great way to maintain the quality advantage!

Sincerely,

S. S. Clark

'Manager,
Customer Training Systems Department

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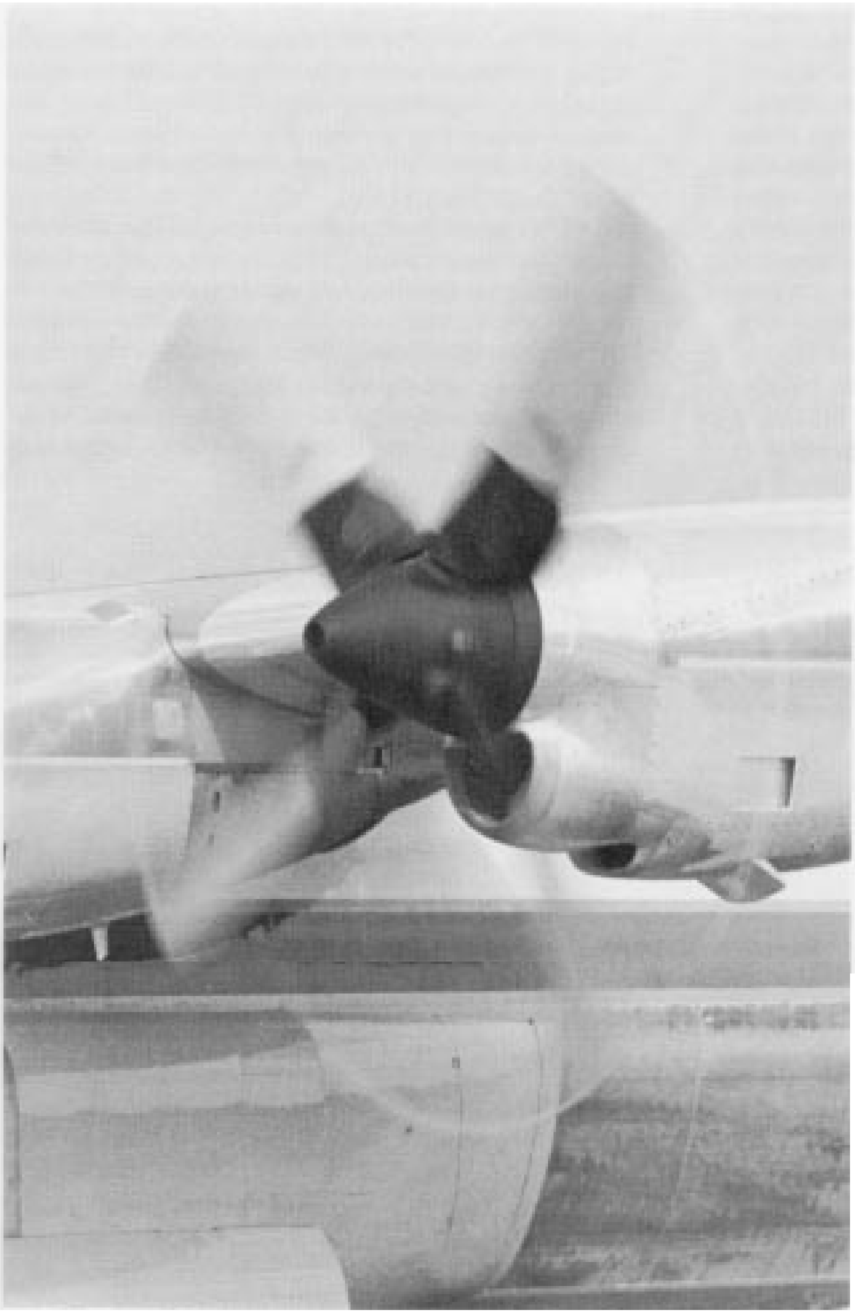
Checking T56 Engine Performance

by Roy **H. Webber,** *Staff Engineer*
Support Equipment/Automatic Test Systems Department

Periodic evaluation of T56 engine operation by the use of performance checks can be highly beneficial to the Hercules operator.



All gas turbine engines gradually lose efficiency over time. Compressors erode, seals wear, and turbines deteriorate because of the effects of heat and sulfidation. The engine performance check provides a systematic way of monitoring the operating efficiency of an engine as the service hours accumulate.

Regular checks of engine performance help reduce costs by identifying the less efficient, low-performance engines that are wasting precious fuel. The checks can also detect potential trouble developing in an engine before it shows up in the form of an obvious malfunction. This can prevent small, inexpensive problems from turning into big, costly ones. Periodic checks can also help avoid enroute breakdowns which could delay cargo and strand a crew at a remote airport while engine repairs are being carried out.

Performance Check Intervals

Neither Lockheed nor Allison Gas Turbine Division, the manufacturer of the 501/T56 engines used on all Hercules aircraft, recommend a specific interval for making engine performance checks. However, the test should always be undertaken if the engine instruments appear to be indicating abnormal values when the takeoff power check is performed, or there is reason to believe that an engine is not able to produce takeoff power.

Otherwise, it is up to the individual operator to use his own judgment regarding when these tests should be undertaken. This allows each Hercules operator to tailor the engine performance checking cycle to best fit the requirements of his particular operation.

Even though Allison and Lockheed do not specify any particular period, both recommend, as a minimum, that a performance check be accomplished and recorded after installation of a new or newly overhauled engine. This establishes a set of baseline values to which subsequent performance runs can be compared.

Some operators who have particularly strong maintenance programs routinely carry out performance checks on each new engine they receive, including those acquired during the delivery of a new airplane. This ensures that complete historical data will be available on every power plant in their inventories.

Understanding Performance Checks

The engine performance check measures engine operation in terms ofpercent efficiency. This should not be confused with the theoretical concepts of thermal efficiency as used in engineering and thermodynamics. As applied here, percent efficiency is a measure of the power output of the engine under test when compared to that of a new engine. An engine whose efficiency rating is 100% is one that is capable of fully meeting Allison's specification for the performance of a new engine under the same physical conditions.

In practice, most brand-new engines are able to exceed this specification. It is not uncommon for new engines to yield results of 106% or 107% efficiency duringaperformancecheck. Overhauled engines seldom achieve scores that are quite so high, but they still exceed the basic requirements. Most newly rebuilt T56 engines are able reach about 102% efficiency Engine performance will gradually fall off after installation and use, but in most cases engines may be continued in service until their performance efficiency level has dropped below 95 % .

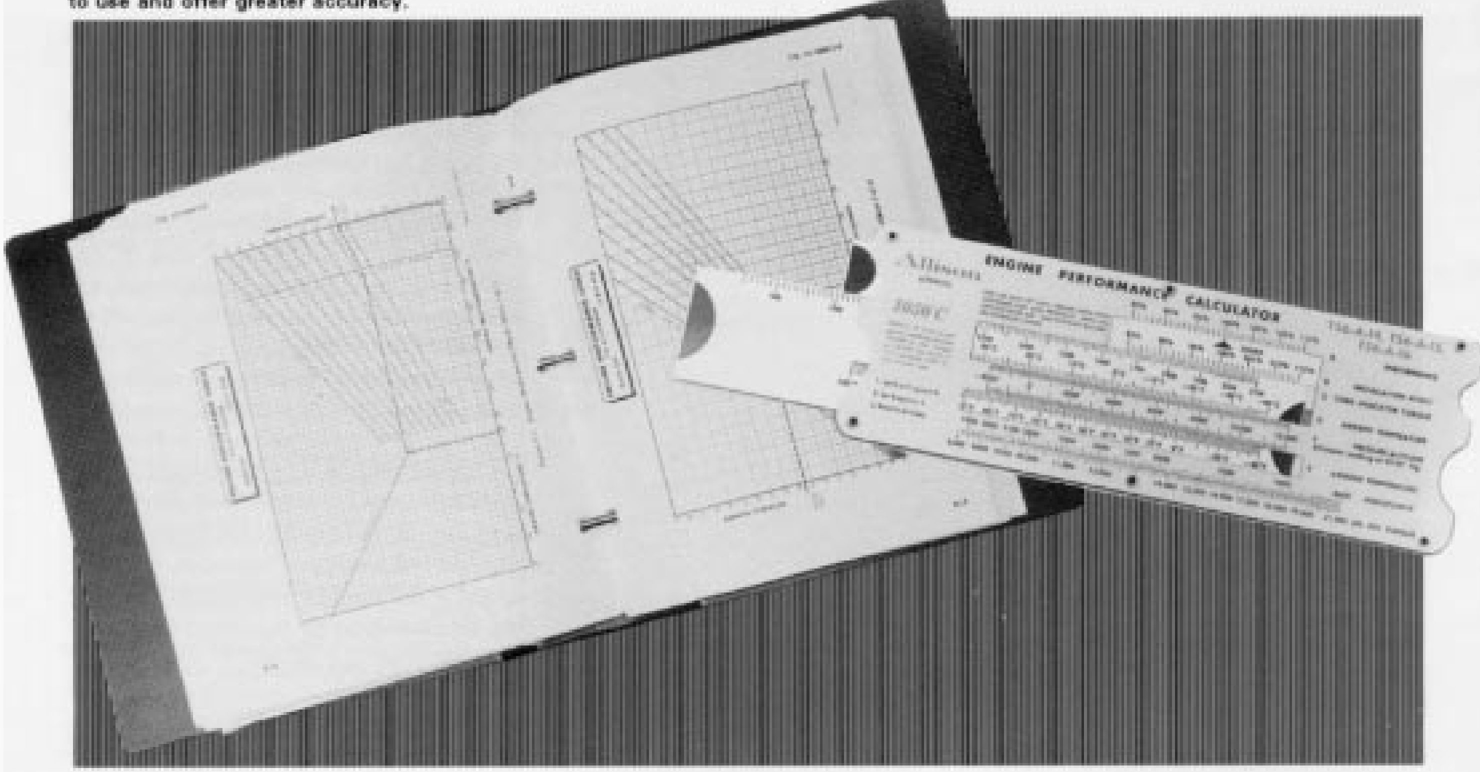
A Question of Method

The Allison performance efficiency rating for a new engine is based upon test cell data. In order to obtain comparable values for an installed engine, appropriate data are collected from the engine being tested and then adjusted mathematically.

Over the years, four different methods of making the engine performance check have evolved. Each may be regarded as representing an improvement over the method immediately preceding it, but all remain authorized procedures. They all require that the same data be taken; the differences lie mainly in the equipment used and the amount of automation employed in converting the data to a performance figure. Done properly, all will give similar results with only minor variations.

The first three methods are covered in the engine maintenance manuals, but the fourth and latest method was developed only recently. It will be included in future updates of the technical handbooks. In addressing

Figure 7. Traditionally, engine performance checks have involved the use of printed charts or slide rules, but the newer methods are easier to use and offer greater accuracy.



the particular capabilities of the most recent approach, it will be helpful to first review the strategies used by the earlier methods.

Method **1: the Charts**

This method involves the use of printed charts, or nomographs, included in the technical manuals, to convert the measured data into a performance figure. Although somewhat tedious, many operators have grown accustomed to using this method and still prefer it.

The main disadvantage to using this approach is that it requires the user to enter a variety of data onto charts, interpret the results, and then manually carry out a series of calculations to arrive at a figure for the performance efficiency of the engine being tested. Each of the many steps involved offers opportunities for making errors which could nullify the value of the results.

Method 2: the Slide Rule

This method, which was introduced in the 197Os, uses the Allison PN 6799970 slide-rule calculator to convert the measured data to a performance figure. The mathematical equations, or algorithms, built into the slide-rule calculator are exactly the same as those that are used to make up the charts of method 1. The resulting calculations should, and do, yield the same results as if the charts had been used. The slide-rule calculator simplifies the process and makes the procedure somewhat more convenient to use. The main disadvantage is once again the problem of accuracy. The slide rule must be used properly and the various data points interpolated correctly if valid results are to be obtained.

Method 3: an Electronic Breakthrough

This method was introduced in the early 1980s. After the engine data are collected, a Hewlett-Packard HP-41CV hand-held programmable calculator is used to make the conversion from raw data to an engine performance figure. The necessary algorithms are contained on magnetic cards which are pre-programmed by Allison. The cards are read into the calculator with a magnetic card reader that attaches to the calculator.

The algorithms built into the magnetic cards remain the same as those used for the first two methods, but the use of the programmable calculator in this method helps eliminate the human lapses which can degrade the accuracy of the results when the first two methods are used. Another improvement introduced with this method is the use of a digital electronic thermometer. This device is provided with the hardware kit to make more accurate temperature measurements possible.

The principal drawback to the method employing the HP-41CV calculator is that the procedure for entering data and using the calculator is not particularly user-

figure 2. The PN 3403218-l Engine Performance Calculator Kit contains an HP-48SX calculator, Allison PN 32051184 PROM module, accessories, and full instructions.

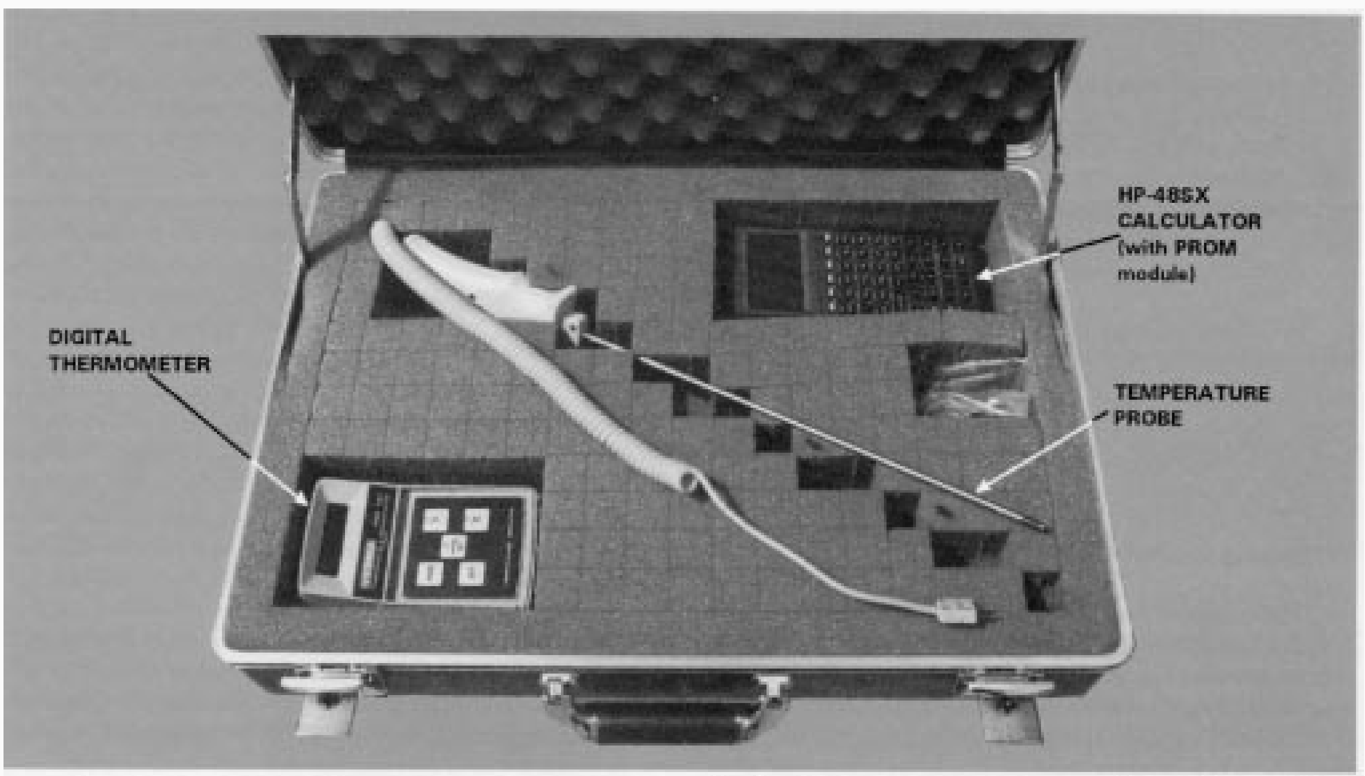


Figure 3. The ambient air temperature must be measured as accurately as possible for valid engine performance results. Be sure to take temperature readings in a shaded area.

friendly. Special care and concentration are needed until the operator has performed the procedure often enough to become familiar with the various keystrokes required.

Method 4: an Electronic Upgrade

A new and enhanced method for making engine performance calculations has been developed during the past year. This engine performance calculation method offers some significant improvements over the previous approaches.

The main impetus for the development of the new method is the fact that the HP-41CV is no longer available from Hewlett-Packard. It was necessary to adapt the engine performance program to Hewlett-Packard's newest scientific calculator, the HP-48SX. A number of other improvements were also made in the process.

Developing the New Method

The improved method was developed as a joint Allison-Lockheed project. Taking advantage of the enhanced capabilities of the HP-48SX, the program now uses on-screen prompts to define the user inputs to the calculator. The new method is thus much more user-friendly, since the technician no longer needs to read the keystrokeentry requirements from separate instructions, as is the case in method 3. The new program also features a significant reduction in the number of keystrokes required.

Somechanges were made in the program algorithms as well; this results in greater accuracy at temperatures below 0°F. The new algorithms were developed after years of experience in computerized testing of engine performance at the Allison factory. These same tests, incidently, also confirmed the validity of the older algorithms for the more moderate temperature ranges.

Another improvement was to incorporate the installation effect (always 100% in the case of the Hercules aircraft) into the algorithms, eliminating a step in the data entry sequence. Also, if the operator desires to measure performance for more than one engine, a simple keystroke, prompted by the display, allows this to be done without having to re-enter pressure altitude and outside air temperature.

The new calculator, together with appropriate software, and instructions, is contained in the PN 3403218-l Engine Performance Calculator Kit, which is available from Lockheed. Further details and ordering information will be found at the end of this article.

Figure 4. Pressure altitude is also a critical parameter. Averaging the readings obtained from two flight station altimeters reduces the chances of error.

Operators currently using the older method designed around the HP-41CV should feel comfortable about continuing to employ it. The new system is easier to use, but the only significant difference between the older method and the new one from the standpoint of accuracy is the greater precision at low temperatures.

Performance Checks-General Requirements

Skill, care, and accuracy are the keys to successful engine performance testing regardless of which method is used, and it is helpful to review the basic general principles that apply. Note that the values given in the discussion below are applicable only for a T56-A-15 engine being tested with new PN 3403218-l kit. Different numbers may apply when other members of the 501/T56 engine family are under test, or if one of the older performance calculation methods is employed.

1. The Hercules is a powerful airplane. When testing engines, always operate two symmetrical engines (and only two) at the required power level at the same time-for example, No. 1 and No. 4. Observe all engine run safety requirements described in the authorized technical manuals and your organization's regulations. See also the article "Engine Run Safety" in Vol. 18, No. 2 of ***Service News*** magazine.

2. Be sure to calibrate the tachometer, torquemeter, and turbine inlet temperature indicator of the affected engine before doing a performance check.

3. The ambient temperature should be measured as accurately as possible, in a shaded area under the wing. A precision mercury thermometer, or a digital electronic thermometer, are the instruments of choice. Let the thermometer stabilize fully before use. A 2.8°C error (5°F) results in a 2% error in the engine performance calculation.

4. Obtain and record the pressure altitude. This should be the aircraft altimeter reading when 29.92 inches of mercury is set in the "Kollsman window" of the altimeter. Average the readings of two altimeters on the flight deck. A 300-foot ***error*** in the altitude reading will result in a 1% error in calculated performance.

5. Start the APU, position the brake select switch to EMERGENCY, ensure that the auxiliary hydraulic pump is turned on, and set the parking brake. Do not depend on chocks to hold the aircraft. Only the brakes can hold the airplane once engine power is applied.

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6. Start and warm up the engine to be checked and the symmetrically opposite engine. Leave the APU running and the APU generator on line. Engine RPM should be adjusted as close as possible to 100% (13,820 RPM). A 1% variance in RPM can affect performance calculations by up to 0.9%.

7. Set the engine bleed air switch to the CLOSE/OFF position. Turn off the engine-driven hydraulic pump on the engine being tested.

8. To make the performance check, advance the power lever toward TAKEOFF until 1050°C TIT or 19,600 inch-pounds of torque (4289 hp) is reached, whichever occurs first. Read and record the indicated torque and TIT. Remember that application of power beyond authorized limits can damage the aircraft or wing structure.

9. Read the torquemeter as accurately as possible. A 200 inch-pound error will result in a 1% error in calculated performance.

10. Accuracy in TIT readings is just as important. A 5°C mistake in reading the TIT indicator will result in a 1% performance calculation error.

Calculation **and Interpretation**

Using your authorized technical manual and one of the methods outlined above, take the required data and determine engine performance in accordance with the instructions for the method used. Be sure to recheck all calculations for accuracy.

If the performance calculation indicates that engine performance efficiency is less than 95 %, one **or** more of the maintenance actions shown above may restore performance to within limits. If these maintenance efforts cannot restore performance, the engine should be removed for overhaul.

Easier, More Accurate Checks

Engine performance checks should be an integral part of Hercules fleet maintenance. It is well worthwhile for every operator to see to it that an approved technique for carrying out these checks has been mastered, and that the checks are being performed on a regular basis. The payoff will be safer, more reliable flight operations, and an extension of service life between engine overhauls.

The recently developed engine performance checking method featuring the HP-48SX electronic calculator makes performance checking easier and more accurate than ever before. Operators interested in using the new method should obtain the complete PN 3403218-l Engine Performance Calculator Kit, which may be ordered from Lockheed. The kit includes an HP-48SX

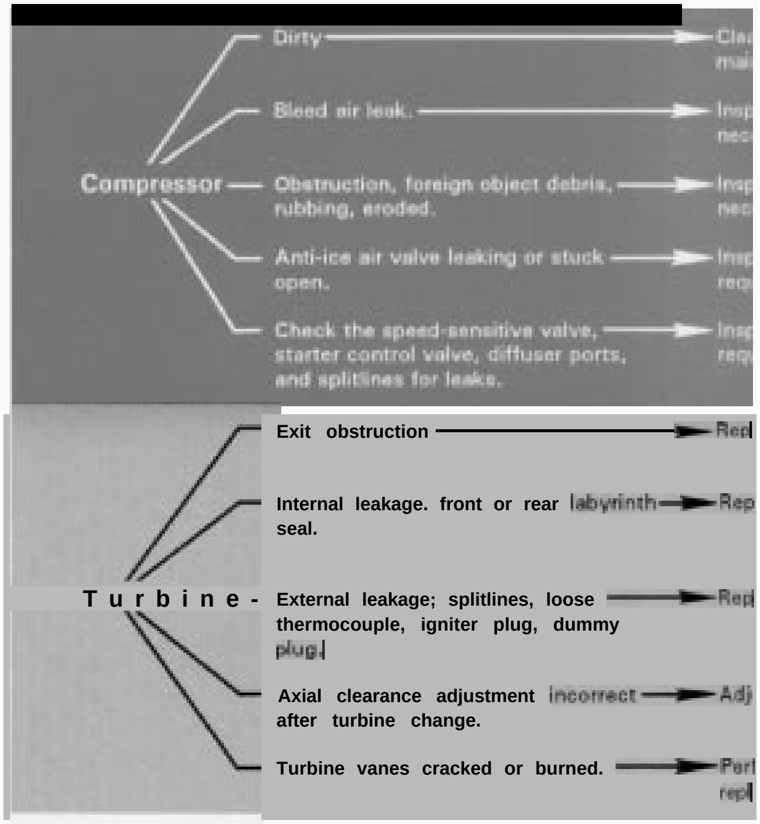
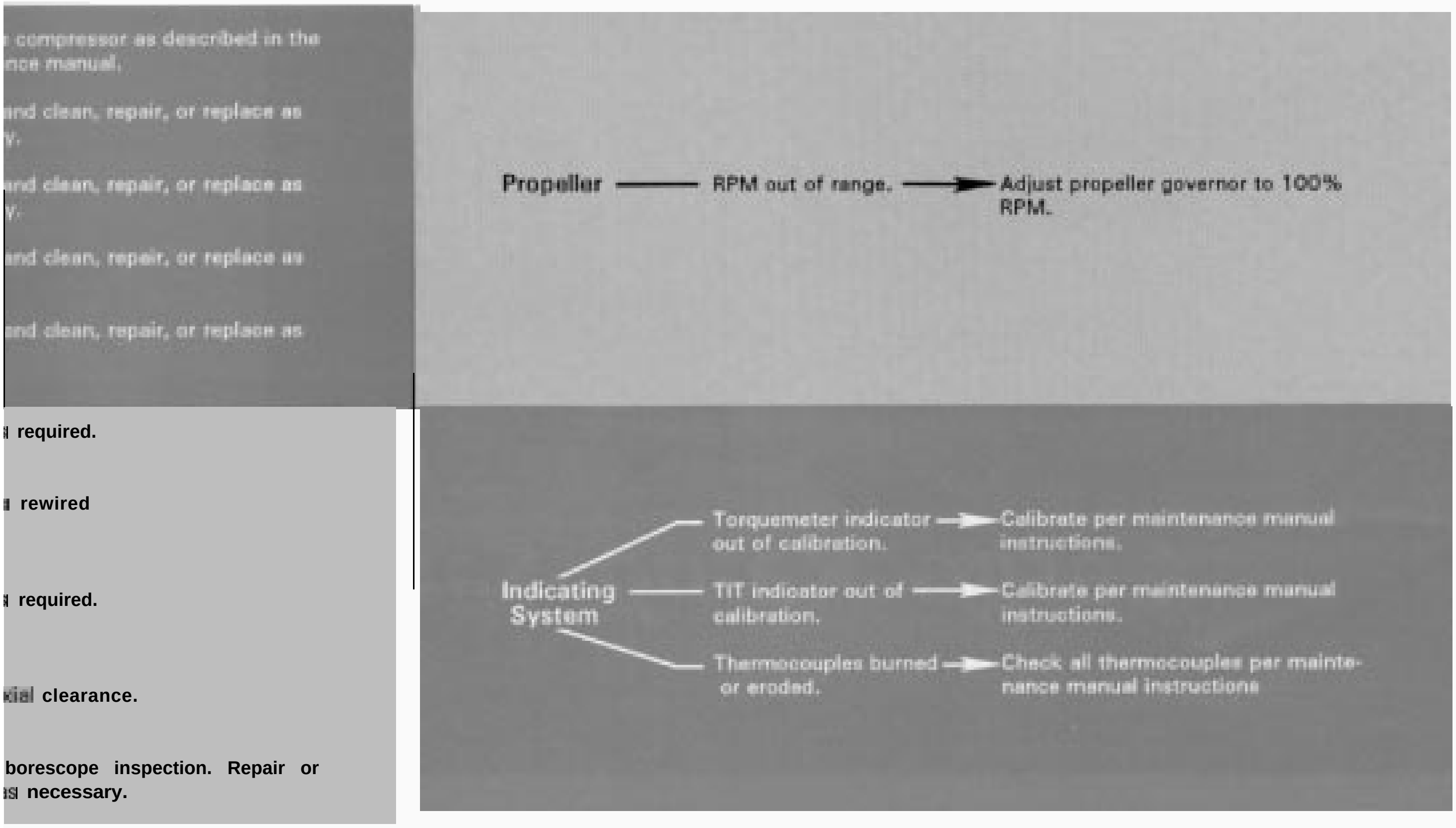
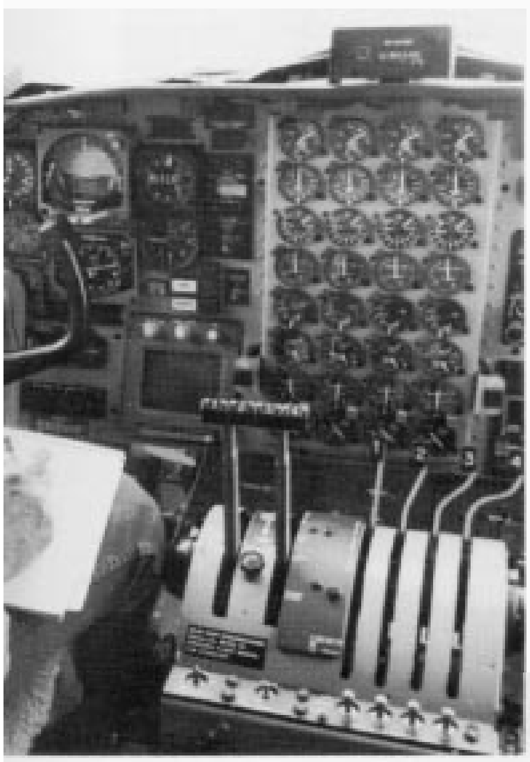


Figure 5. The HP$ performance check before.

LOW ENGINE PERFORMANCE CHECKLIST



electronic calculator makes engine easier and more accurate than ever



calculator, an Allison PN 32051184 PROM Module, a digital thermometer, and instructions. All the kit mateti-als are packaged in a handy briefcase-type container.

The HP-48SX electronic calculator is programmed for carrying out the engine performance check by using the PROM module included with the kit. The Allison PROM Module is designed for checking engine performance on military and commercial C-130/Ll00aircraft, and also on P-3, CP-140, Convair 580, E2, and C2 aircraft. It will check T56 engines of the following dash numbers: A-l, A-14, A-14LFE, A-15, A-l5LFE, A-16, A423, A425, A426, A427, and 501D-22 and 22A.

Also included in the Allison PROM module are the algorithms for doing a check called minimum power, which is used to calibrate the engine torquemeters. Further data about the operation of this kit and ordering information are available from: Customer Supply Business Management, Dept. 65-l 1, Zone 0577, Lockheed-LASC, Marietta, GA 30063; Telephone 404-494-4214; Fax 404-494-7657; Telex 804263 LOC CUST SUPPL.

The author and the Service News staff wish to thank Tom Allen, Bob Mangham (page 6), John Leckie (pages 8-9), and photographer Lamar Hawkins for their valued assistance in the preparation of this article.

Cargo Ramp Savvy

by R. S. (Biff) Barger, *Field Supporr Representative, Senior Airlift Field Service Department*

The cargo ramp of the Hercules airlifter is an exceptionally versatile part of a remarkably versatile aircraft. Its unique design allows cargo loading from truck-bed height, and it can be lowered to the ground to allow easy access for roll-on equipment. When closed and locked, the ramp becomes part of the aircraft structure and seals for pressurization. Cargo can also be carried on the ramp, in effect increasing the capacity of the cargo compartment.

This ten-foot square platform is a real workhorse, and relatively little attention is required to keep it on the job. No mechanical system can endure forever without an occasional repair, but most ramp problems are reasonably straightforward even when they do occur. Usually there is obvious physical damage or clearly malfunctioning components, and this simplifies the maintenance effort. Occasionally, however, a ramp problem turns up that proves a bit more challenging. Here are three problems involving the ramp that fall into that category. They can test the skills of even the most practiced troubleshooter:

- Excessive side-to-side movement of the ramp.
- An open ramp with hooks extended.
- A hook at ramp station 10 not engaging its hook retainer.

The first complication that arises when one of these problems is encountered is that the usual technical reference sources may fail to offer much assistance. There is a reason for this. As good as they are at providing mechanical details and troubleshooting techniques, the maintenance manuals do not attempt to offer much insight into the complexities of the man-machine interface. And the human factors are often very much involved in ramp maintenance questions.

None of these are mechanical problems inherent in the ramp itself. Rather, they have to do with the way the equipment is operated and the special requirements of its design. A close look at each of these situations will help explain why these problems occur, and how best to correct them.

Excessive Side-to Side-Movement

The next time you see the ramp open and the aerial delivery system (ADS) support arms disconnected, grab an actuator rod and rock the ramp sideways. You will be amazed by the amount of movement present. It's enough to make you think the ramp bushings are worn or even missing. Note that this apparent excessive movement occurs only when the ADS arms are disconnected, or when the ramp is in a position other than horizontal. When connected and fully extended, the arms act as sway braces which restrict such movement.

In fact, the ramp hinge was designed to be a non-rigid installation to ensure that no binding or undue stress would be present when the ramp is closed and locked. There must be a certain amount of play to ensure proper opening and closing. Also, uneven loads on the ramp could cause problems if brought to bear on a "hard point" ramp hinge configuration. For these reasons, the bushings are installed in a slotted configuration that will allow the necessary play.

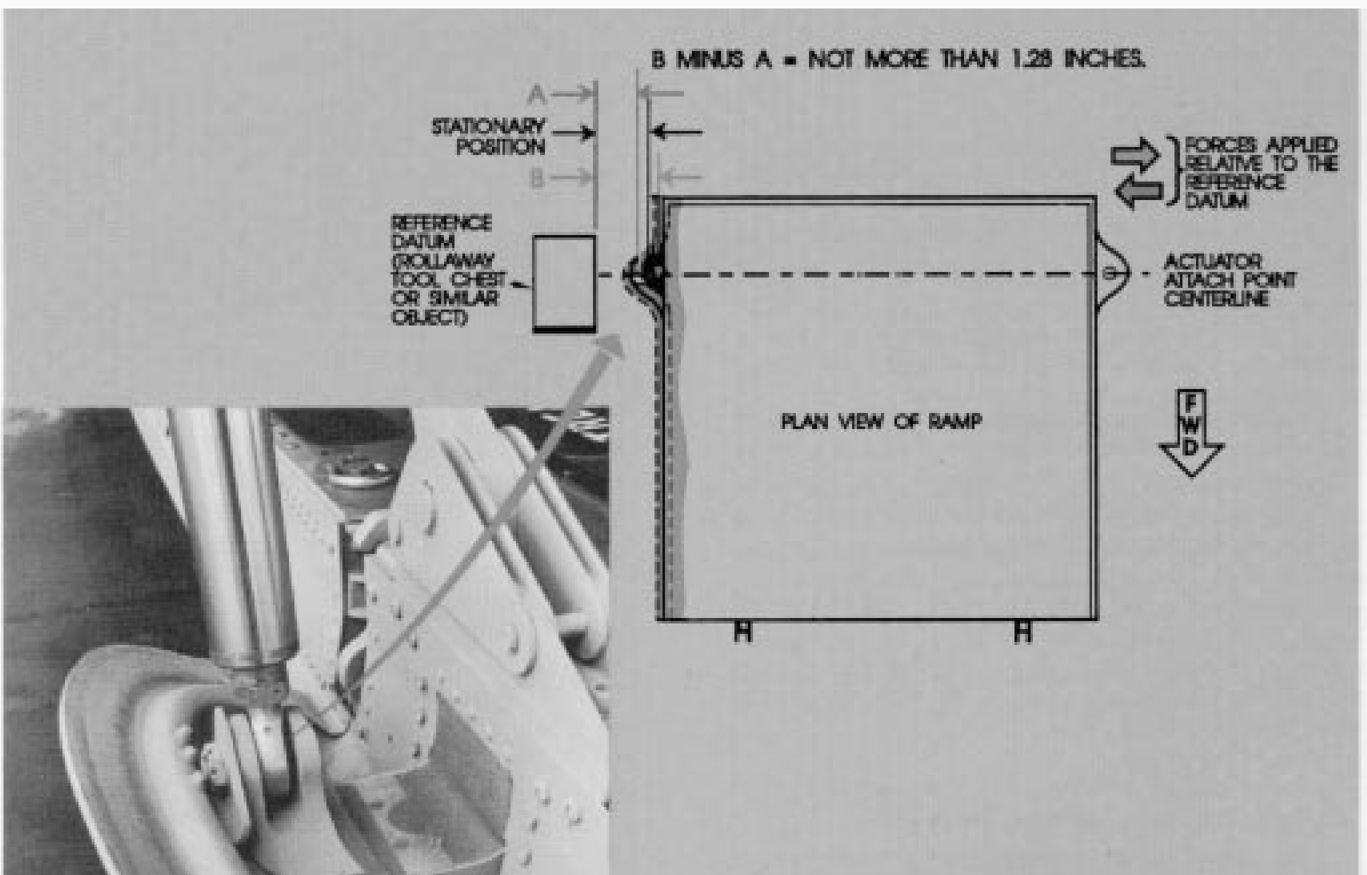
The maintenance manuals do not provide instructions for checking the ramp play while the ramp is installed on the aircraft. No guidelines have been published setting allowable limits on the amount of play attributable to bushing wear because experience has shown that the ramp attach bushings are not often subject to serious wear. Data pertaining to permissible wear of the bushings themselves are found in the applicable structural repair manuals such as SMP 583 or T.O. lC-130A-3. Unfortunately, the procedures described for determining the wear require that the ramp be removed from the aircraft to perform an inspection.

Several Hercules operators have inquired if it would be possible to devise a method of checking the condition of the slotted bushings without removing the ramp. This question was put to Lockheed engineering for consideration, and a study was undertaken.

Engineering review has determined that the allowable lateral movement of the ramp is 1.28 inches. This value must be measured at the centerline of the actuator attach point on the ramp with the ramp in the horizontal position. If the lateral movement falls within this maximum limit, and the ramp locks satisfactorily and there are no pressurization leaks, ramp hinge bushing wear can be considered acceptable.

One method of measuring the lateral movement is to place a rollaway tool chest or similar object beside the ramp to be used as the reference datum. Have an assistant push the ramp toward the tool chest and measure from the tool chest to the centerline of the actuator attach point. Then have him pull the ramp away from the tool chest for the second measurement. The difference between the two measurements should be 1.28 inches or less.

Note the use of the word accurate in the discussion above. Accurate measurements are especially important here because ramp play can be very deceiving. The technician given the task of rocking the ramp during the



The condition of the slotted bushings can be checked by measuring the maximum ramp lateral movement with reference to a "fixed" object.

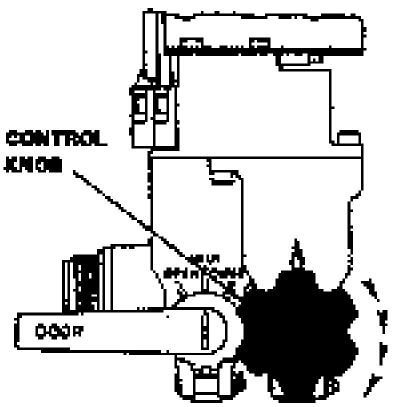
wear check will nearly always declare that the movement feels much greater than 1.28 inches; four or five inches is sometimes the estimate. Don't rely on guesswork; measure it to be sure.

Ramp **Open With Hooks Extended**

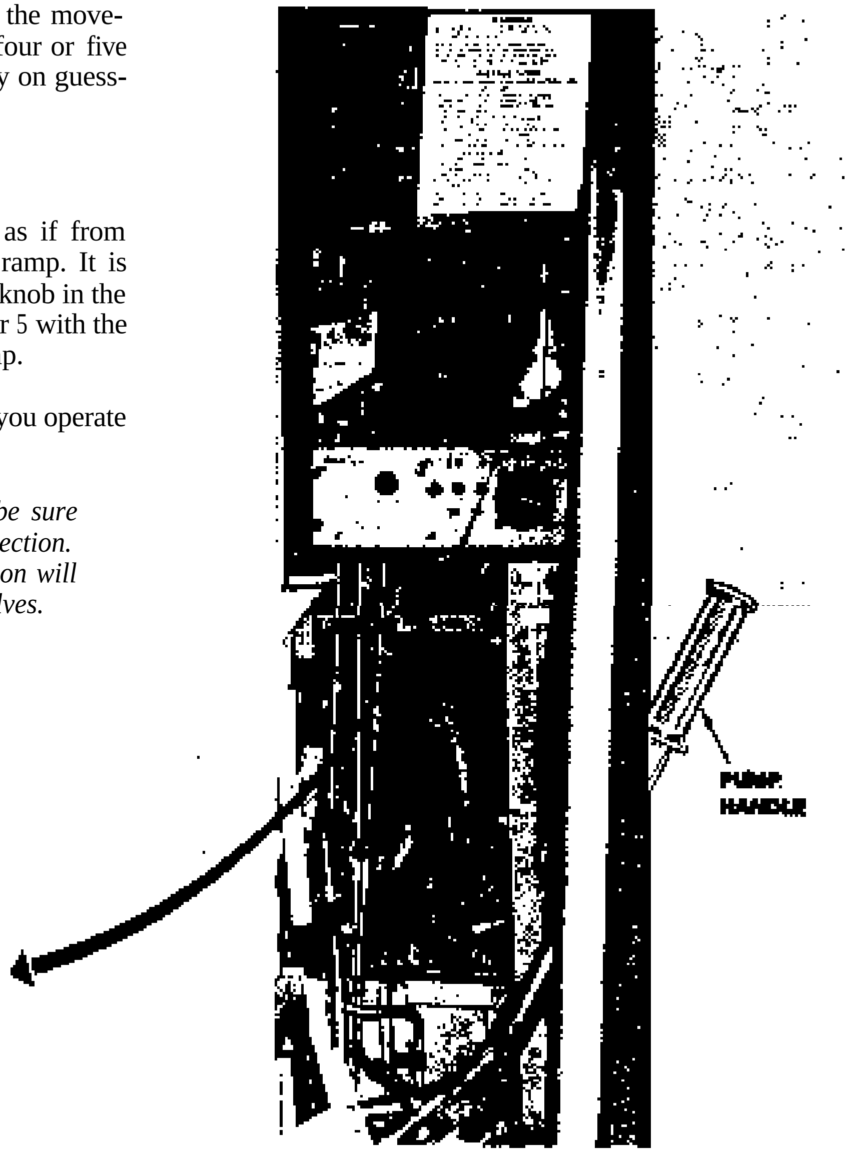
This condition may suddenly appear, as if from nowhere, during manual operation of the ramp. It is usually caused by rotating the ramp control knob in the wrong direction or selecting position number 5 with the ramp open and then operating the hand pump.

Here is a good rule to follow whenever you operate the ramp manually:

> *When using the manual ramp control, be sure to rotate the knob only in a clockwise direction. This will ensure that the indicated position will remain in sequence with the internal valves.*



The ramp control knob should only be rotated in a clockwise direction to maintain proper valve sequencing.



The manual ramp control panel and the hand pump are located just aft of the left paratroop door.

Failure to follow this sound advice could cause the hooks to extend with the ramp open. This is a situation which can have serious consequences if not handled properly. If the ramp is closed with the hooks extended, the sloping longerons will be damaged.

Do not use the auxiliary hydraulic pump and electrical control switches when attempting to correct this condition. Things tend to happen too fast when you use the auxiliary hydraulic pump. Stay with the manual control valve instead.

The ramp manual control is a round knob which may be placed in six positions. These are:

1. Unlock the ramp	4. Raise the ramp
2. Lower the ramp	5. Lock the ramp
3N. Neutral	6N. Neutral

This list makes the appropriate corrective action appear obvious: simply select position number 1 and operate the hand pump until the hooks retract. Unfortunately, this usually doesn't work. What normally does occur, much to the surprise of the operator, is that the ramp starts rising and the hooks remain extended. If this operation is not terminated, the ramp will continue to move toward closed until the hooks strike the sloping longerons.

What is the cause of this strange behavior? The answer is really quite simple. The design of the hooks and hook retainers requires that the ramp be raised a small amount to initiate unlocking. This lifts the weight of the ramp off the hooks. When position number 1 is selected, fluid is ported to the "close" side of the ramp actuators and to the "unlock" side of the lock actuator. The two ramp actuators have large-diameter pistons to enable them to lift the weight of the ramp. In compari-

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son, the lock actuator is quite small. It must move control rods, connecting rods, hook push rods, and bellcranks to extend and retract the hooks. This is a big undertaking for such a small actuator. The result is that in most situations, raising the ramp turns out to be the path of least resistance.

The ramp therefore moves upward, and will continue to do so until it contacts the fuselage and can travel no further. The path of least resistance is now transferred to the lock actuator and the hooks begin to move. This is fine as long the hooks start from the retracted position. But if they are already extended, the aircraft structure will be damaged when the hooks contact it.

To retract the hooks with the ramp open, the path of least resistance must be shifted to the lock actuator. The best way to accomplish this is to add weight to the ramp. Adding the required amount of weight is easy. Have four people (the bigger the better) stand on the aft edge of the ramp while you select position number 1 and operate the hand pump. The heavily loaded ramp will resist movement, and the hooks will retract instead. The ramp can then be closed in the normal manner.

Hook at RS 10 Not Engaging Retainer

The failure of a hook at ramp station 10 to engage its hook retainer is a problem which shows up most frequently when the ramp is loaded with cargo and the aircraft is parked after completing a turn.

The hook at ramp station 10 may fail to engage if the ramp is heavily loaded and the aircraft is parked in a turn.

Moving the aircraft in a straight line for two revolutions of the main tires may permit all hooks to engage properly.

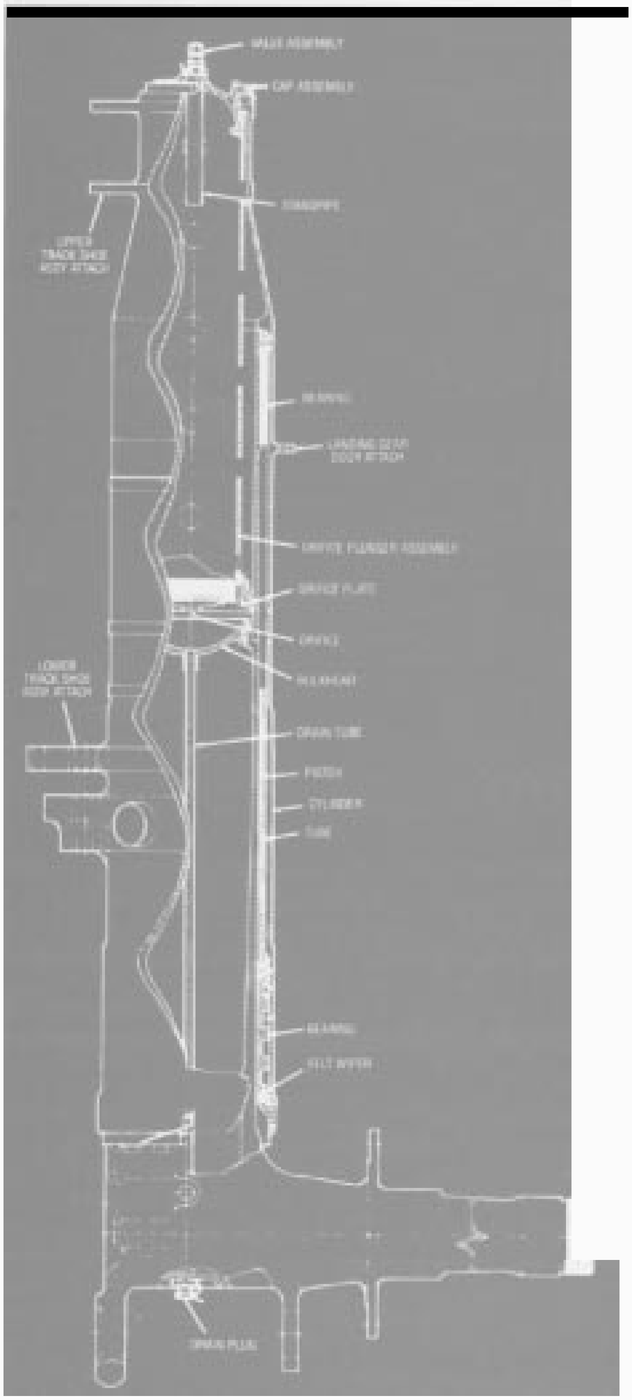
When the Hercules aircraft is towed-or taxied in a turn, the main landing gear tires are deflected laterally. Before stopping the aircraft, it is always best to proceed forward in a straight path for several more feet to avoid leaving the tires deflected and under stress while the aircraft is parked.

It's important to remember that lateral deflection can affect more than just the tires; it can also produce a deformation of the fuselage. If the aircraft does not proceed in a straight path far enough before being parked, a slight twist will remain. This makes it difficult for a heavily loaded ramp to align properly and engage both ramp station 10 hook retainers.

Before you get the tool box and start making adjustments when this happens, get out the tow bar and reposition the aircraft. Moving the aircraft in a straight path for about two revolutions of the main tires should be more than enough to take out the twist. Then try closing the ramp again. If it still will not lock properly, it's time to make those adjustments.

service news

Mixing MLG Shock Struts



by **Tom Zembik,** *Service Analyst*
Airlift Field Service Department

Hercules operators often ask about possible restrictions or other problems that could be involved in using hard and soft **MLG** struts on the same Hercules aircraft. The question arises because although current production Hercules are normally equipped with soft struts, hard struts are still in widespread use. In fact, several operators have a mix of aircraft, some equipped with hard struts and others with soft. In such cases, varying quantities of both types will ordinarily be represented in the operator's spares inventory. If one kind runs short, it may appear convenient to release an aircraft for flight even though it is not equipped with struts that are all of the same type.

Lockheed engineering cautions that such mixing of strut types is not advisable. It should only be done in case of an emergency situation, and then only for a one-time flight. If conditions seem to warrant mixing the two types of struts, the soft strut (450 psi) should be placed in the aft position, and the hard strut (215 psi) in the forward position and serviced to 285 psi. The sink rate during landing should also be monitored carefully; in no case should it exceed 300 feet per minute.

Hard vs. Soft

The pressure values given above may seem puzzling to the non-specialist because the soft strut is seen to require higher inflation pressures than the hard one. By way of clarification, it should be recalled that "soft" or "hard" in the case of Hercules MLG strut types refers to the strut's performance as a shock absorber rather than to its inflation pressure.

Viewed in this light, the soft strut is appropriately named. Despite its higher inflation pressure, the greater air volume and other design characteristics of the soft strut ensure that it transmits significantly less stress to the airframe during landings and taxi operations than does the hard strut. Although the two types have somewhat different operating characteristics, hard struts are nearly identical in design and appearance to soft struts, and one type may be converted to the other with relatively minor modifications. "Understanding Struts," an article published in *Service News,* Vol. 13, No.2 (April-**June** 1986) provides a detailed look at the subject of hard and soft struts.

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If you are unsure whether your Hercules has hard struts or soft struts, there are several ways to find out. One way is to examine the data plate on the strut to see the part number or servicing pressure. This information can then be compared with information in the appropriate illustrated parts breakdown or maintenance manual to provide an answer. Unfortunately, you cannot depend on the color of the data plate itself as a designation for hard ***or soft*** struts. All struts manufactured in the last decade or so, hard or soft, have data plates that are red in color.

Checking the Numbers

The following table may be of some help. It contains a list of C-130 MLG part numbers and indicates which of the strut assemblies are hard struts and which are soft.

Basic PN	Dash Number	Soft/Hard
695001	(none)	hard
695001	-6	hard
695001	-9	hard
370438	-1	hard
370438	-5	hard
370438	-7	hard
370438	-13	hard
370438	-21	soft
388058	-1	hard
388058	-7	hard
388058	-9	soft
388058	-19	soft
3316498	-1	soft
3316498	-7	hard

Another way to distinguish hard struts from soft struts is to manufacture a piece of wire approximately seven inches long with a small hook at one end. Jack the aircraft and deflate the strut to be checked, following all procedures and safety precautions described in the authorized aircraft maintenance manual. Now remove the servicing valve from the top of the strut and insert the wire hook into the opening far enough to hook the bottom of the standpipe. Mark the wire at the valve boss and take a measurement. If the measurement is 5.79 inches, you have a soft strut. If the value is 3.06 inches, you are dealing with a hard strut.

Update on the New Lockheed -

Outflow and Safety Valve Tester

The Outflow and Safety Valves Test Set described in ***Service News,*** Vol. 18, No. 1 (January-March 1991), was originally listed only under its Lockheed part number, 3403248-l.

The unit has now received a National Stock Number (NSN) as well. It is NSN 4920-01-354-l 265. This should simplify the ordering process for many C-130 maintenance organizations.

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

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