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A SERVICE PUBLICATION OF LOCKHEED-GEORGIA COMPANY, A DIVISION OF LOCKHEED CORPORATION

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Cover: The Lockheed-Georgia Company flight line in Marietta, Georgia. Over 1800 Hercules aircraft have now been built, in more than 40 different versions. These remarkable airlifters continue in full production; three new ones are rolled out at the factory each month.

Vol. 12, No. 4, October—December 1985

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LOCKHEED-GEORGIA COMPANY
MARIETTA, GEORGIA 30063

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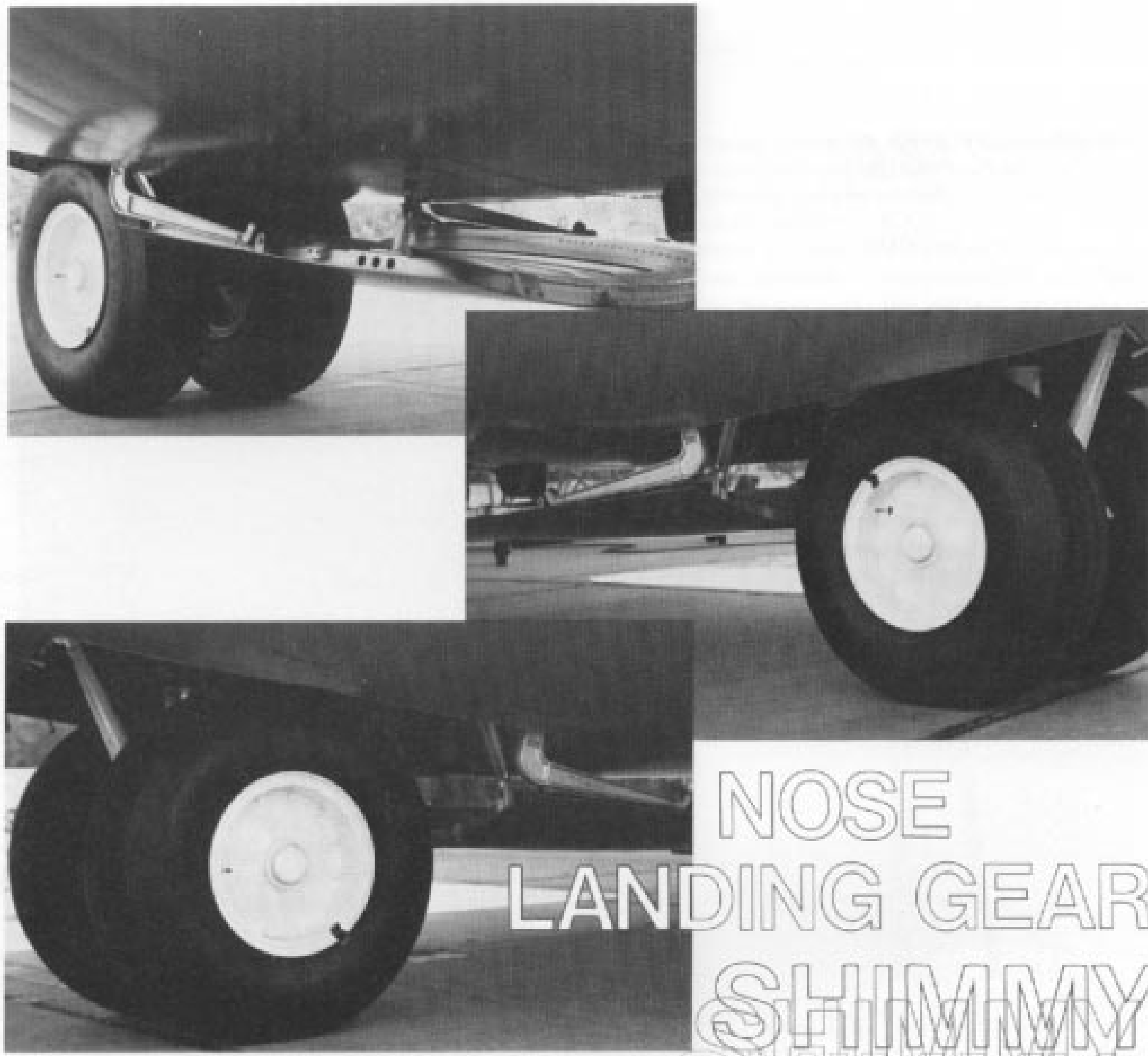


NOSE LANDING GEAR SHIMMY

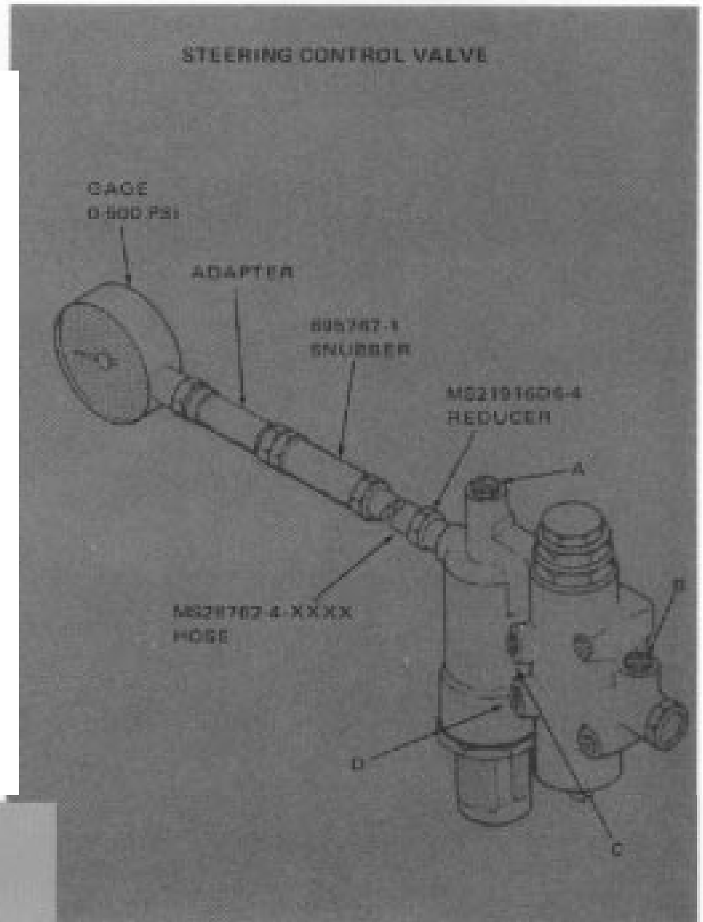
by **Bob McRay,** *Service Representative*

Most maintenance personnel know that there are at least fifteen items on a Hercules aircraft nose landing gear that can cause or contribute to nose wheel shimmy. The problem is how to go about isolating the shimmy to an item, component, or area without expending considerable time and effort on costly trial and error adjustments and replacements.

One method that has been used quite successfully in the field requires the assistance of a flight crew, but entails only a taxi run during which a couple of observations arc made and recorded. It is accomplished as fo11ows:

Taxi the aircraft at a speed just sufficient to allow the nose wheels to bc lifted off the ground (just a few seconds will do), and make these notations:

1. Did the shimmy stop while the nose wheels were off the ground or did it continue?



2. During taxi run with the wheels on the ground, did the steering wheel pointer move back and forth rapidly during shimmy or was it relatively steady?

Note that if repeated taxi runs are necessary, the brakes should be allowed to cool between runs. It is also worth noting that the taxi check operation may not always be necessary. Some flight crews will make these checks for you when the problem first occurs and record their findings in the flight forms.

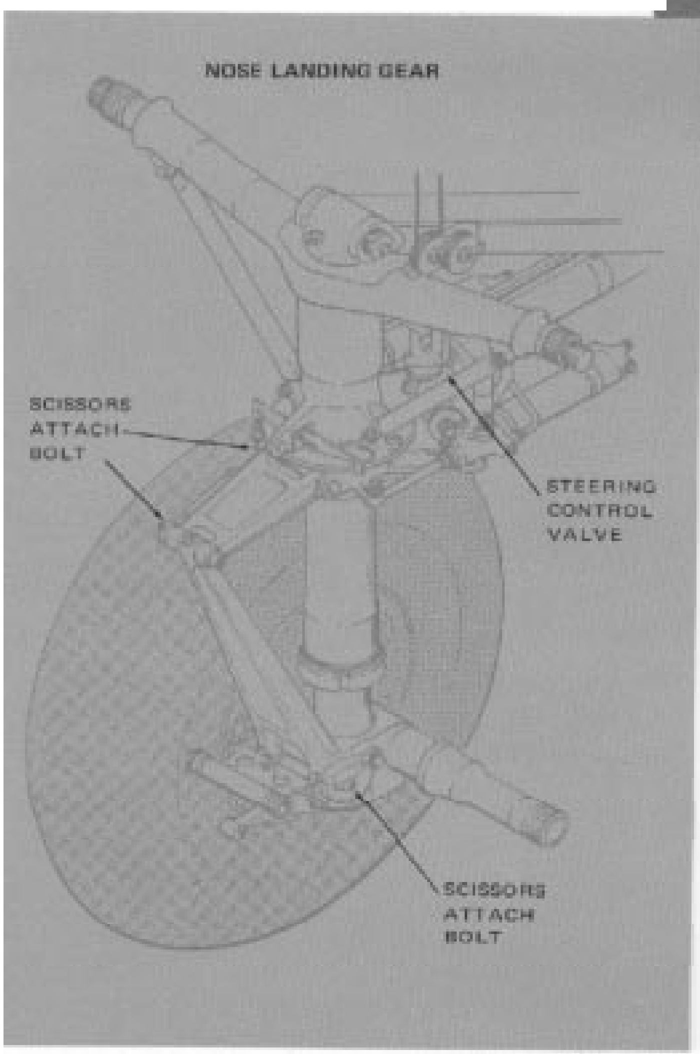
With the taxi runs completed, return to the work area and look at your notes.

• **If the shimmy continued with the wheels off the ground,** wheel or tire imbalance is indicated. Check for worn spots on the tires and any other condition on the wheels or tires that may contribute to an unbalanced condition. Note that recapped tires, if used in your organization, should hc highly suspect. It is sometimes a difficult task to balance recapped tires.

There is also a possibility that there may be water in the tires. If your facility uses compressed air to service the tires rather than dry nitrogen, a faulty compressor dehydrator filter could introduce water into the tires. This problem can result in some tricky troubleshooting since sustained vibration would most likely occur only when the water is frozen. This could happen after a flight at high altitude of a duration sufficient to freeze the water and result in vibration upon landing. Similarly, during operation in cold climates, the problem would show up repeatedly during takeoffs and landings. Note that a brief period of severe vibration may be noticed upon touchdown during landing even if the water is in the liquid state. It takes a couple of tire rotations to disperse the water equally around the inside of the tire. This is a handy fact to keep in mind when troubleshooting these problems.

• **If the shimmy ceased at nose wheel liftoff,** then the observations noted in item 2 during the taxi run must be considered:

• If *the* shimmy ***produced*** *no noticeable movement at the steering* ***wheel*** *pointer with wheels on the ground,* looseness caused by excessive wear in mechanical com-



ponents is indicated. First check the torque arms (scissors). The upper, lower, and center attach bolts and bushings are subject to wear. If the wear is excessive, it will cause a violent shimmy at all speeds up to liftoff. Special attention should be given to the fact that even though one bolt or bushing location may be found to be within wear tolerances, it is the sum of the wear on all the associated bolts and bushings that must be of concern. Next check the steering actuator rod end bearings for wear and bolts for security of mounting. Last, and this will require jacking the nose of the aircraft, check for worn wheel bearings and correct axle nut torque.

- *If thesteering wheelpointer did move buck and forth during the shimmy,* a problem involving the steering control valve is indicated. Here is why. The steering control valve is unique in that it will accept steering commands from either the steering wheel or from the nose gear, permitting certain types of shimmy to be transmitted back through the valve to the steering pointer. Since the pointer is connected directly to the steering control valve shaft by the rocker arm and cables, it will be displaced anytime the shaft is displaced. Steering wheel pointer movement during shimmy narrows our check to two areas: tires and control valve.

- **Check the tires.** Uneven tire pressure and dissimilar or faulty tread designs tend to make a tire move in irregular patterns. This uneven movement is transmitted through the scissors to the control valve and, as speed increases, so does the uneven movement or shimmy.

- **Next, check the steering control valve itself.** The relief valve could be malfunctioning. One method of checking the condition of this valve is to remove the plug (item 4, Figure 3, T.O. 4SA3-26-3) in the manifold side of the steering valve and install an MS21916D6-4 reducer, MS28762-4 hose, P/N 695767-l snubber, appropriate adapter, and a O-500 psi pressure gage (see illustration). Disconnect the scissors and, using hydraulic pressure from the auxiliary system, rotate the steering mechanism by turning the steering wheel at a very slow but constant rate of turn from center to extreme. This should take approximately 10 seconds. Pressure on the gage should be maintained at 70 + 20 psi, the spring accumulator pressure setting.

Pressure readings outside these limits indicate a sticky or leaking relief valve assembly. Since the valve is an integral part of the spring-loaded accumulator, repair requires replacement of the complete steering control valve.

In summary:

I. Shimmy with wheels off the ground means tire or wheel imbalance.

2. Shimmy with wheels on the ground and no pointer movement indicates bolts, bushings, and bearings worn.

3. Shimmy with wheels on the ground with pointer movement could be a result of steering control valve problems, uneven tire pressures, tread imperfections, or dissimilar tread designs.

Troubleshooting shimmy problems can be complicated and time-consuming undertaking if not approached systematically. But if you first review the fundamentals of nose gear and steering mechanism operation, and then apply the steps described in this procedurc, you should be able to solve most nose landing gear shimmy problems you encounter quickly and effectively.

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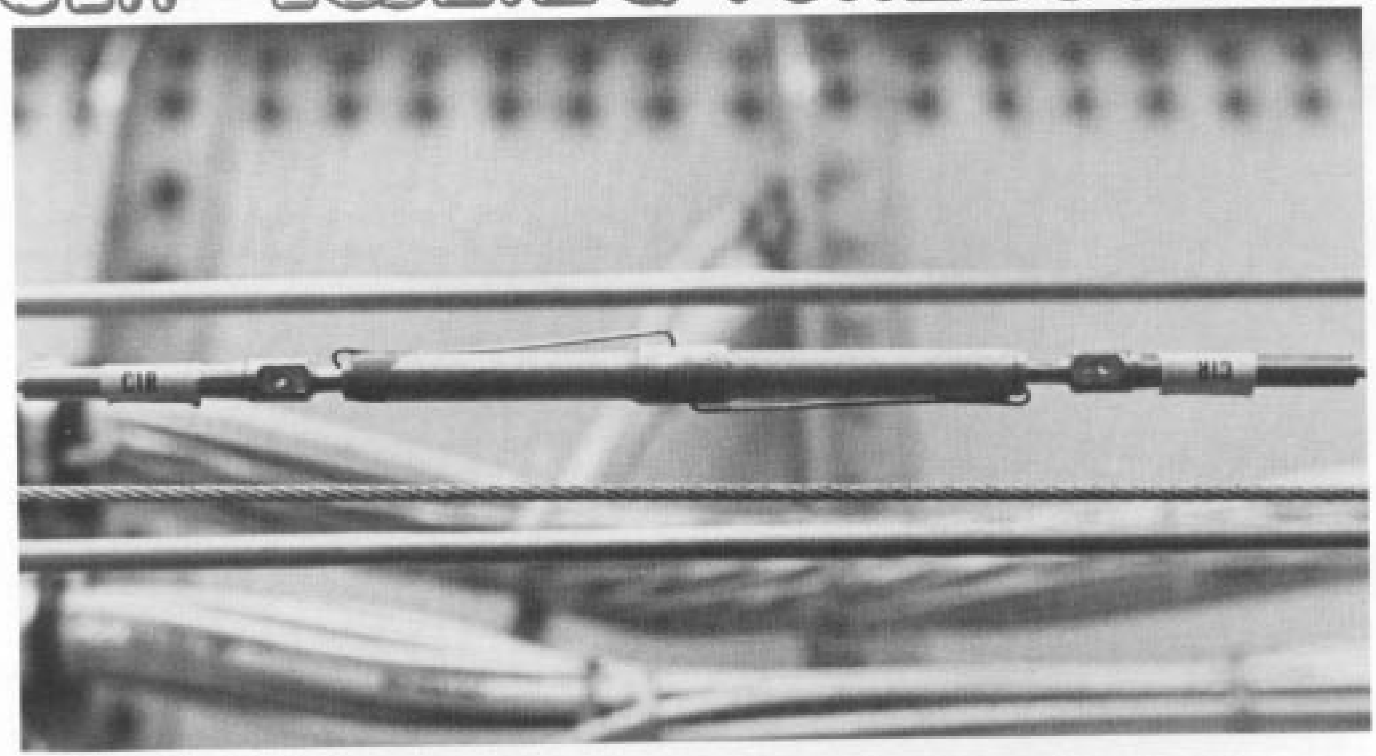
CLIP-LOCKING TURNBUCKLES



The MS21251 turnbuckles bodies (see Figure 1) now used on control cables are designed to be safetied with clips rather than safety wire. The clip-locking method is certainly easier to use and saves time and discomfort when making rigging adjustments in some of those hard-to-get-to parts of the aircraft.

Safely Wire, nr Clip?

Since the advent of the clip-type safety on turnbuckles, the question has been raised occasionally whether it is permissable to use clips to safety turnbuckles on the earlier-style turnbuckles which used safety wire as a **locking** device. The answer to this question is an emphatic NO. This is because the earlier-style turnbuckles are not designed to use the clips. Only the P/N MS21251 turnbuckles have been specifically designed for the locking clips.

Using Locking Clips

There are a couple of things to keep in mind when using locking clips:

1. Locking clips are for one-time use only, the same as safety wire. They are not to be reused.

2. It is permissible to insert both locking clips in the same hole of the turnbuckle body or in opposite sides as shown in Figure 1.

Prior to installation of the locking clips on a turnbuckle, both threaded terminals are to be screwed into the turnbuckle body an equal distance. In addition, proper thread engagement must be verified by checking to see that no more than three threads of either terminal are exposed outside the turnbuckle body. Staying within these limits, adjust the turnbuckle to its locking position by aligning the slot indicator notch on the turnbuckle body with the slot indicator groove on the terminals. Then insert the end of the locking clip into the terminal and body until the U-curved end of the locking clip is over the hole in the center of the body. Press the locking clip into the hole as far as it **will go.** The curved end of the locking clip will expand and latch in the turnbuckle body slot.

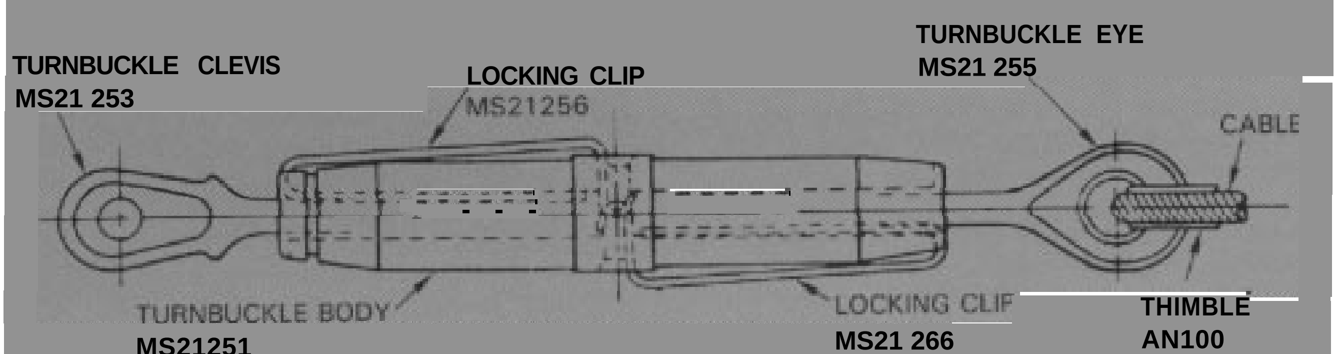
To check proper seating of the locking clip, attempt to remove the U-shaped end from the body hole using only your fingers. Do not use tools to pry on the clip when making this check because the locking clip could become permanently distorted.

Turnhuckle & Clip Part Numbers

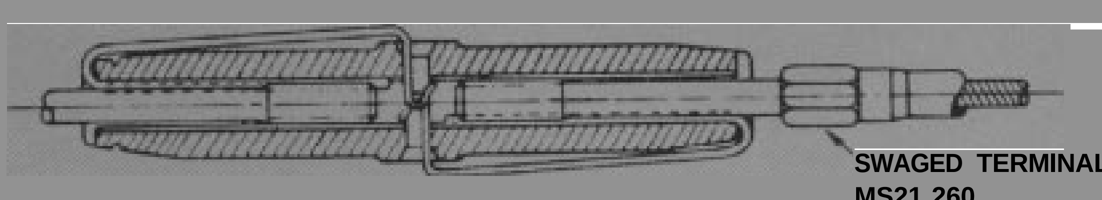
The basic turnbuckle body and locking clip part numbers are MS21251 and MS21256 respectively. To find the correct dash numbers for specific applications, refer to the chart at right.

Nominal Cable Dia. (inches)	Thread UNF-3	Locking Clips MS21256	Turnbuckle Body MS21251
1/16	No. 6-40	-1	-2S
3/32	No. 10-32	-1	-3S
3/32	No. 10-32	-2	-3L
1/8	1/4-28	-1	-4S
1/8	1/4-28	-2	-4L
5/32	1/4-28	-1	-5S
5/32	1/4-28	-2	-5L
3/16	5/16-24	-1	-6S
3/16	5/16-24	-2	-6L
7/32	3/8-24	-2	-7L
1/4	3/8-24	-2	-8L
9/32	7/16-20	-3	-9L
5/16	1/2-20	-3	-10L

Figure 1.



Typical Turnbuckle Assembly



Method of Assembling Locking Turnbuckle Body and Terminals

HOW TO
RELEASE A LOCKED PROPELLER BRAKE

by Dare1 A. Traylor, Service Analyst

The function of the propeller brake is to prevent aerodynamic forces from causing a feathered propeller to rotate the engine in a direction opposite its normal rotation. It also serves to decelerate the engine and propeller during normal shutdown.

The propeller brake has three modes of operation:

- Applied operation is the normal static condition for the brake. It is spring-loaded to this position. The brake is applied as engine RPM and oil pressure decay during a normal shutdown.

- Released operation occurs when starter torque overcomes spring force and disengages the brake members. This happens at engine start, and the brake is then held released by oil pressure until shutdown.

- A locked propeller brake condition occurs when a force is applied which tends to rotate the propeller in the direction opposite to its normal rotation. This ordinarily occurs only through the action of aerodynamic forces on a feathered propeller in flight, since the blade angle in feather is slightly greater than true aerodynamic feather. Normally, an engine that has been feathered in flight will rotate without incident during an air start or ground operation. Occasionaly, however, a propeller brake may remain locked, preventing the engine from rotating normally during start attempts. The most common reasons for this occuring are:

  1. Application of excessive force in the reverse direction of rotation by overzealous personnel checking for proper propeller brake operation.

  2. Insufficient oil pressure to the prop brake after engine start, causing the brake to be applied after starter disengagement. This results in considerable heating of the propeller brake components. After shutdown, the uneven cooling and contraction of the inner and outer brake cones can cause the prop brake to lock.

  3. High airspeeds in flight with a feathered engine. This tends to drive the propeller opposite its normal direction of rotation, and forces the propeller brake friction surfaces together ever more tightly, which may result in severe locking of the prop brake.

A locked propeller brake can prove quite a challenge to the maintenance personnel whose job it is to get the brake released and return the aircraft to operational status promptly. Although it only happens occasionally, knowing the proper techniques for releasing a locked propeller brake is almost certain to prove useful. Sooner or later most Hercules aircraft maintenance personnel have occasion to deal with this problem.

A locked propeller brake is indicated when the propeller cannot be rotated either with the engine starter or manually. When this occurs, the maintenance technician is faced with the choice of finding a way to release the brake from the outside without damaging the engine, or disassembling the reduction gearbox to free the propeller brake components.

It is clear that the first option is by far the preferable one. Here are some suggestions for a systematic approach that will increase the likelihood of sucessfully releasing a locked propeller brake without disassembling gearbox components.

1. First try the simplest solution. Use a rope, tie-down strap, or something similar that will not cause damage to the propeller, and apply force in the direction of normal propeller rotation (see Figure 1).

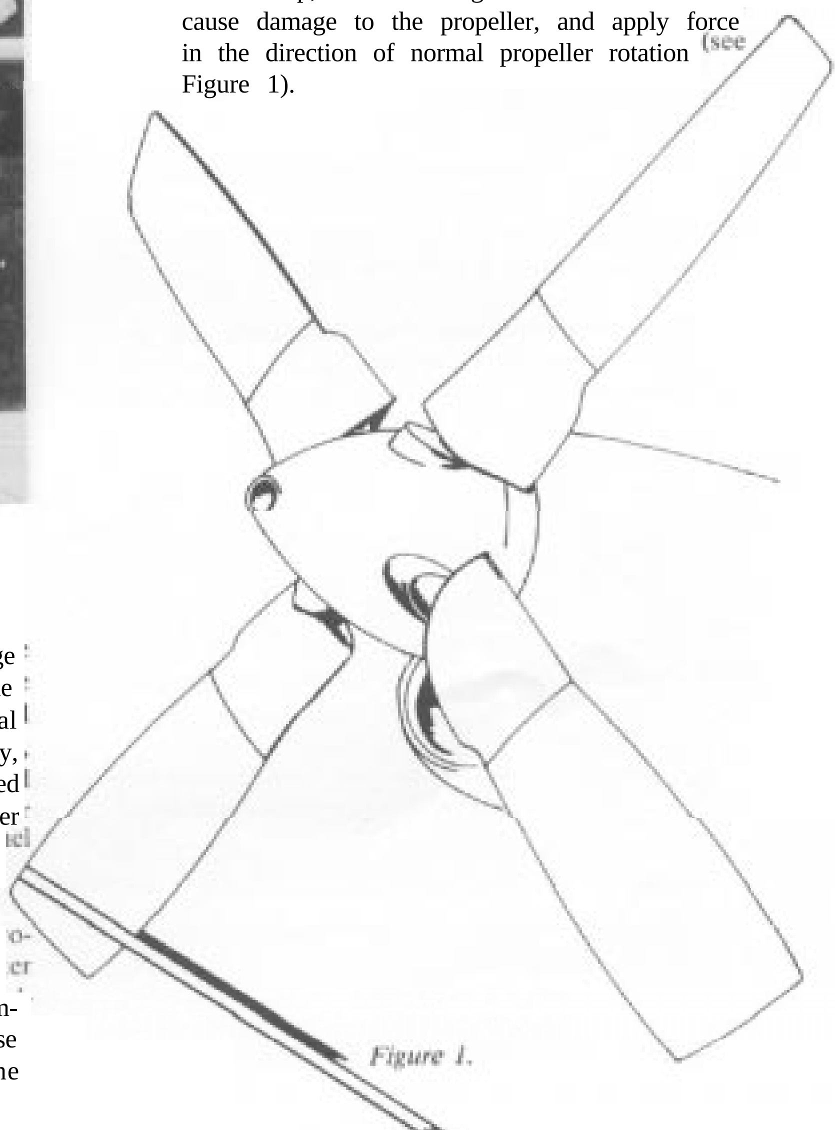


Figure 1.

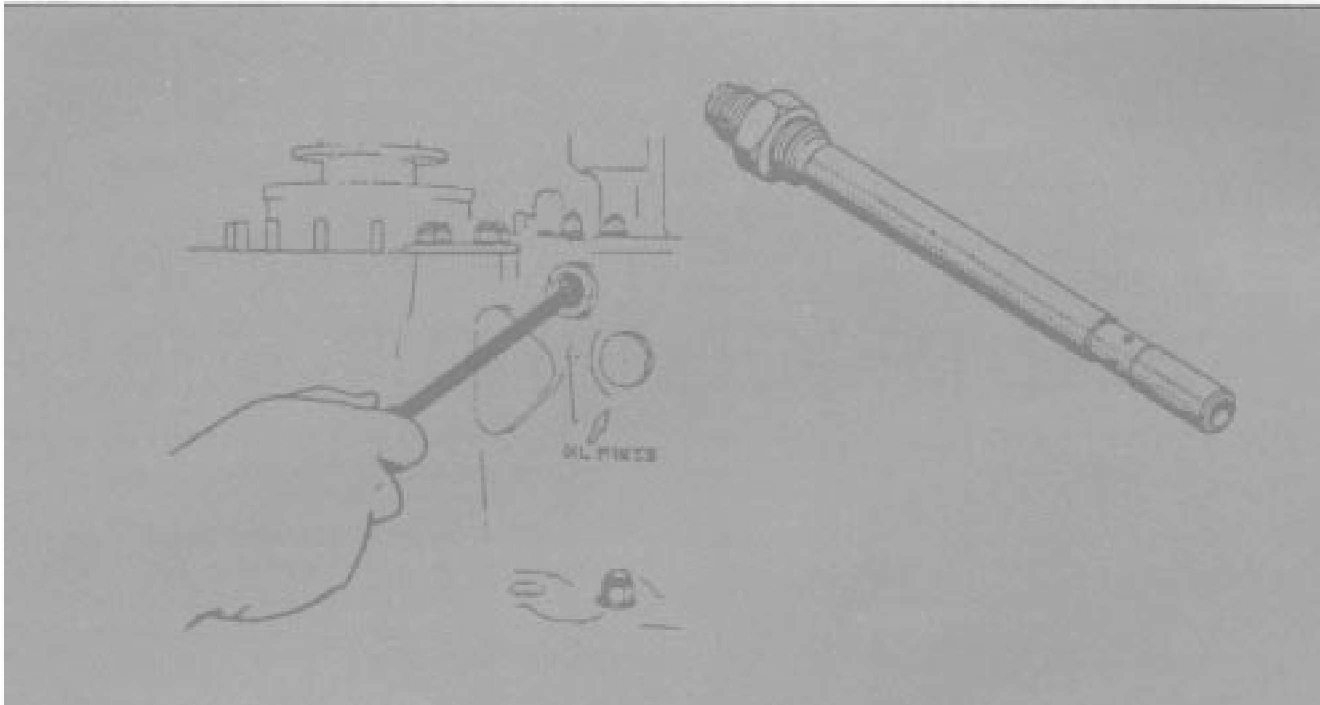


Figure 2.

2. If this does not achieve the desired results, it will be necessary to use the prop brake release tool shown in Figure 2. This tool is available under two different part numbers, depending on whether it is intended for military or commercial use. The military version is P/N 6796089, while the commcrcial version is P/N 6797062.

Using the prop brake release tool, apply shop air (90-100 psi) to the propeller brake oil chamber. The pressure applied to this oil chamber substitutes for the engine oil pressure that separates the inner and outer cones of the prop brake during engine operation. It is also advisable to introduce some oil into the prop brake through the prop brake release tool according to the instructions in the maintenance manual under "Propeller Brake Flushing." This action will lubricate the brake friction surfaces and helical splines as well as reduce the bleed-off rate of the shop air. Note that this step must be done in conjunction with the action in Step 1 above to be effective.

If the combined efforts of Step 1 and Step 2 do not free the brake, go to Step 3.

3. Obtain a starter shaft turning tool, P/N 6796182, shown in Figure 3. Remove the starter from the gearbox, insert the tool into the starter drive shaft, and apply torque to the starter drive shaft in a clockwise direction. Do not exceed the following torque limits:

- 501.D22/D22A and T56-A-15LFE engines, 500 foot-pounds.
- All T56 military engines, 400 foot-pounds.

The starter shaft turning tool is designed to be turned with a l/2-inch "breaker bar"; however, experience suggests that breaker bar failure may occur before propeller brake release is achieved. For this reason, it is a good idea to weld a 3/4-inch adapter to the starter shaft turning tool so that a 3/4-inch breaker bar can be used.

If the prop brake is locked tight enough to require all three steps simultaneously, coordinated surging forces are recommended over steady forces or uncoordinated surging forces. Excercise caution when performing these operations so that balance and footing may be maintained when brake release occurs. This will help avoid the possibility of damage to the aircraft and injury to personnel.

When the brake has been released, a complete check of the system, including on-the-ground and inflight feathering should be performed to verify proper propeller brake operation. The magnetic sump plugs should also be inspected for excessive metal particles after a 30-minute ground run, and after the first flight. If no abnormalities are noted, the engine should be considered fully serviceable.

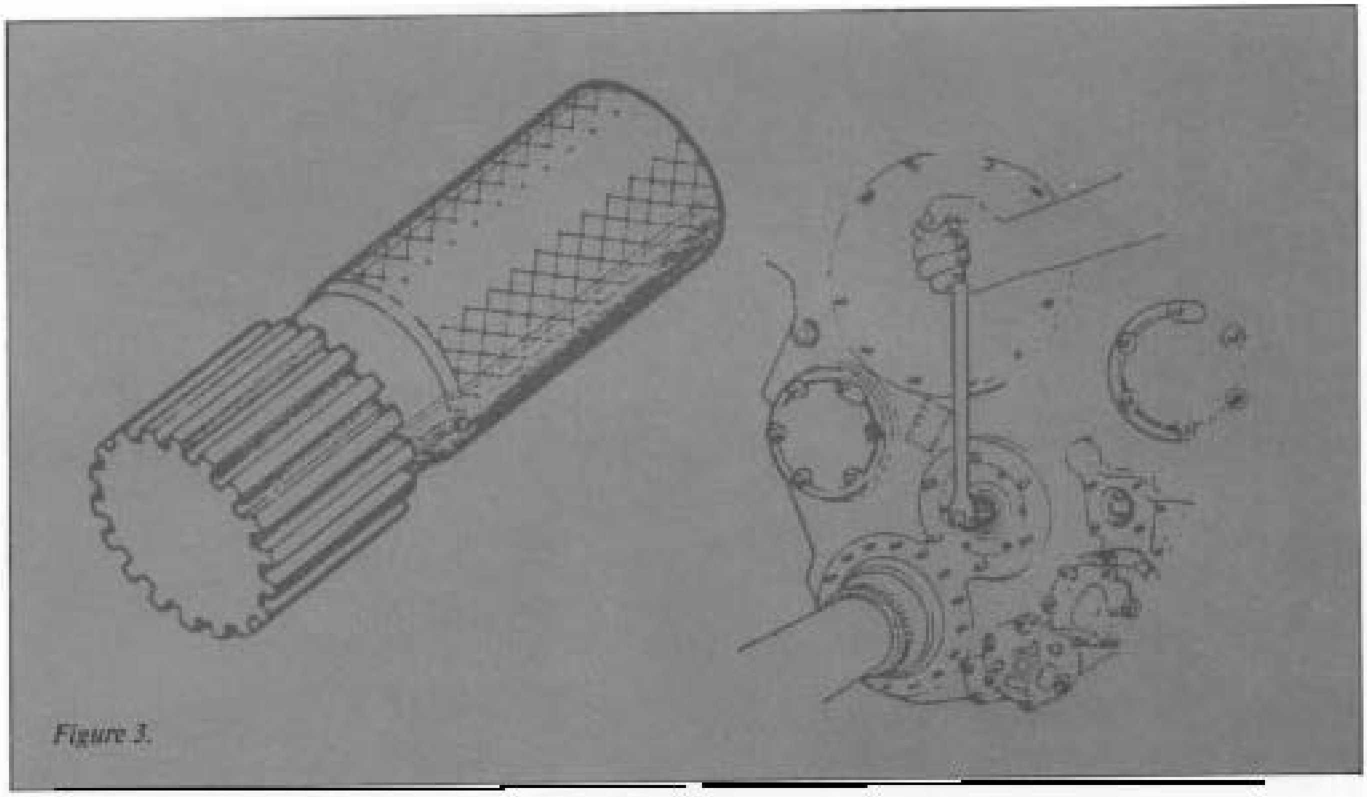
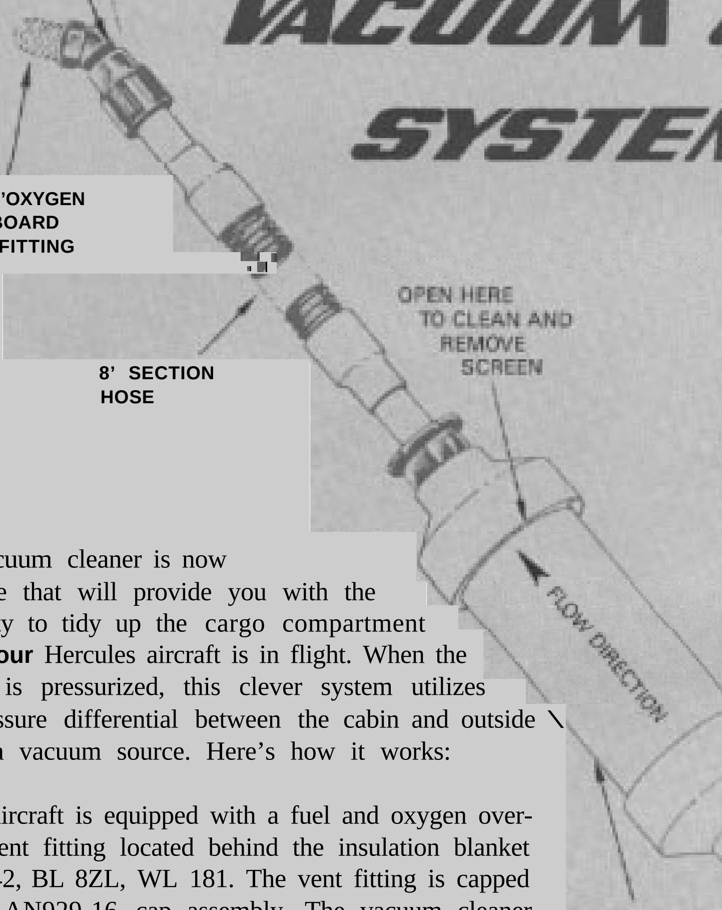
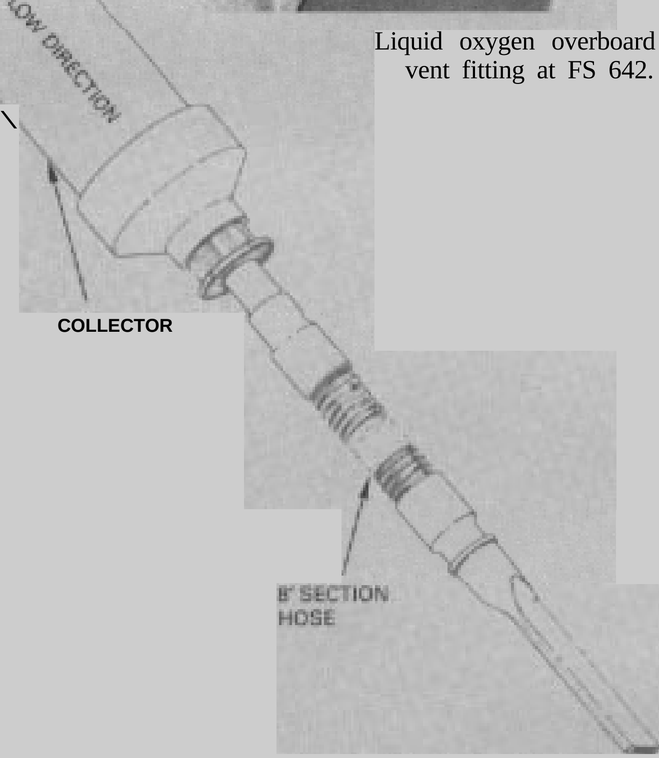
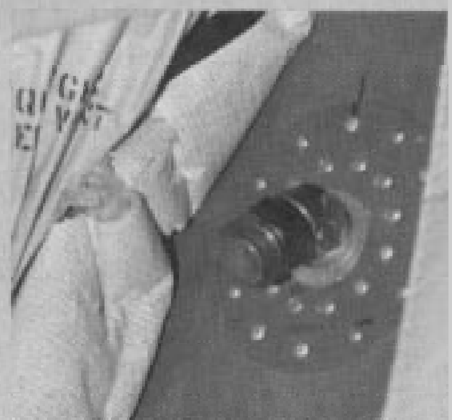


Figure 3.

INFLIGHT VACUUM CLEANER SYSTEM



Liquid oxygen overboard vent fitting at FS 642.

A vacuum cleaner is now available that will provide you with the capability to tidy up the cargo compartment **while your** Hercules aircraft is in flight. When the aircraft is pressurized, this clever system utilizes the pressure differential between the cabin and outside air as a vacuum source. Here's how it works:

The aircraft is equipped with a fuel and oxygen overboard vent fitting located behind the insulation blanket at PS 642, BL 8ZL, WL 181. The vent fitting is capped with an AN929-16 cap assembly. The vacuum cleaner kit comes with a threaded adapter to attach to this fitting. The vacuum cleaner hose then attaches to the adapter. When the easy-to-assemble vacuum hoses and canister have been put together and the aircraft is pressurized, you're ready for action.

The P/N 3403161-I vacuum cleaner kit includes:

- 1 ea. Threaded adapter
- 6 ea. 4-inch pipe segments
- 1 ea. flexible vacuum hose adapter (for 1 inch I.D. hose)
- 5 ea. 8 foot long x 1 inch I.D. vacuum hose (crushproof and waterproof)
- 2 ea. 2 inch x 1 inch bushing reducer
- 2 ea. 4 inch x 2 inch reducer connector
- 1 ea. 4 inch diameter metal screen (l /8 inch mesh maximum)
- 1 ea. 12 inch long canister
- 1 ea. accessory kit (nozzles of various shapes and purposes)

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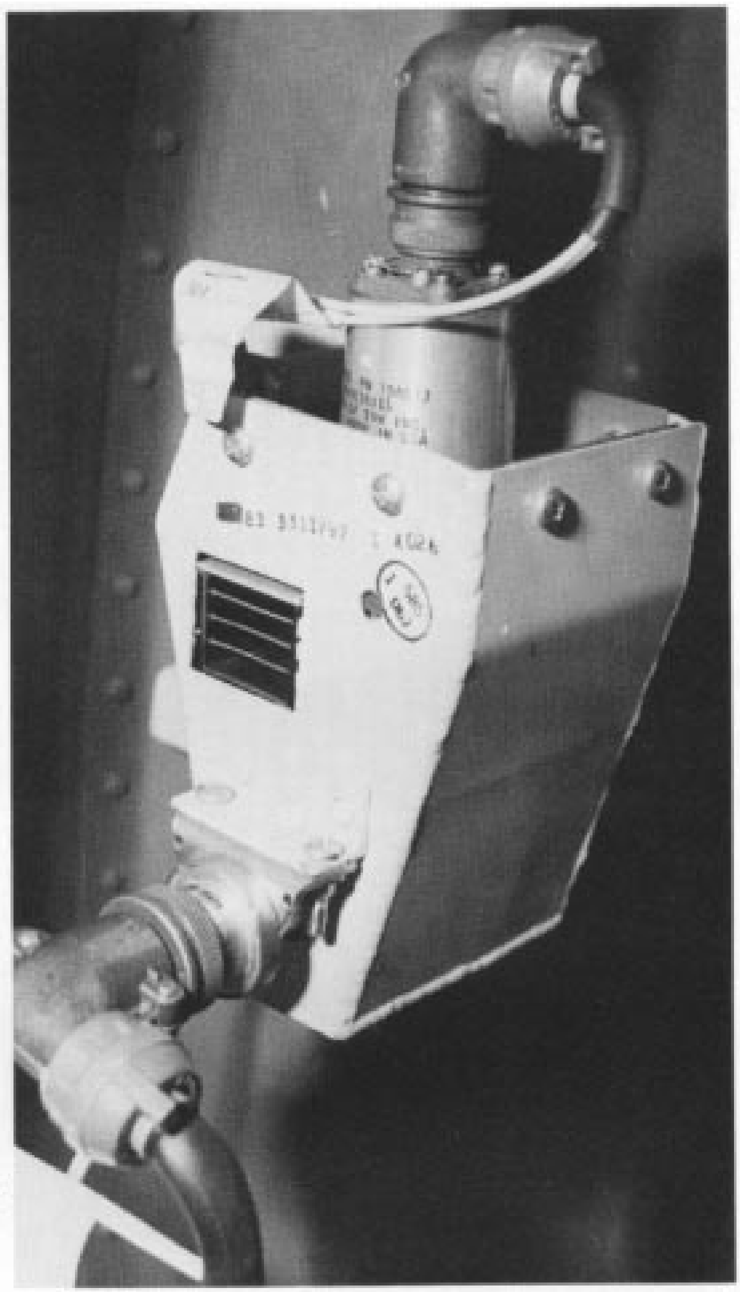


TROUBLESHOOTING AIR CONDITIONING SYSTEM TEMPERATURE CONTROL SENSORS

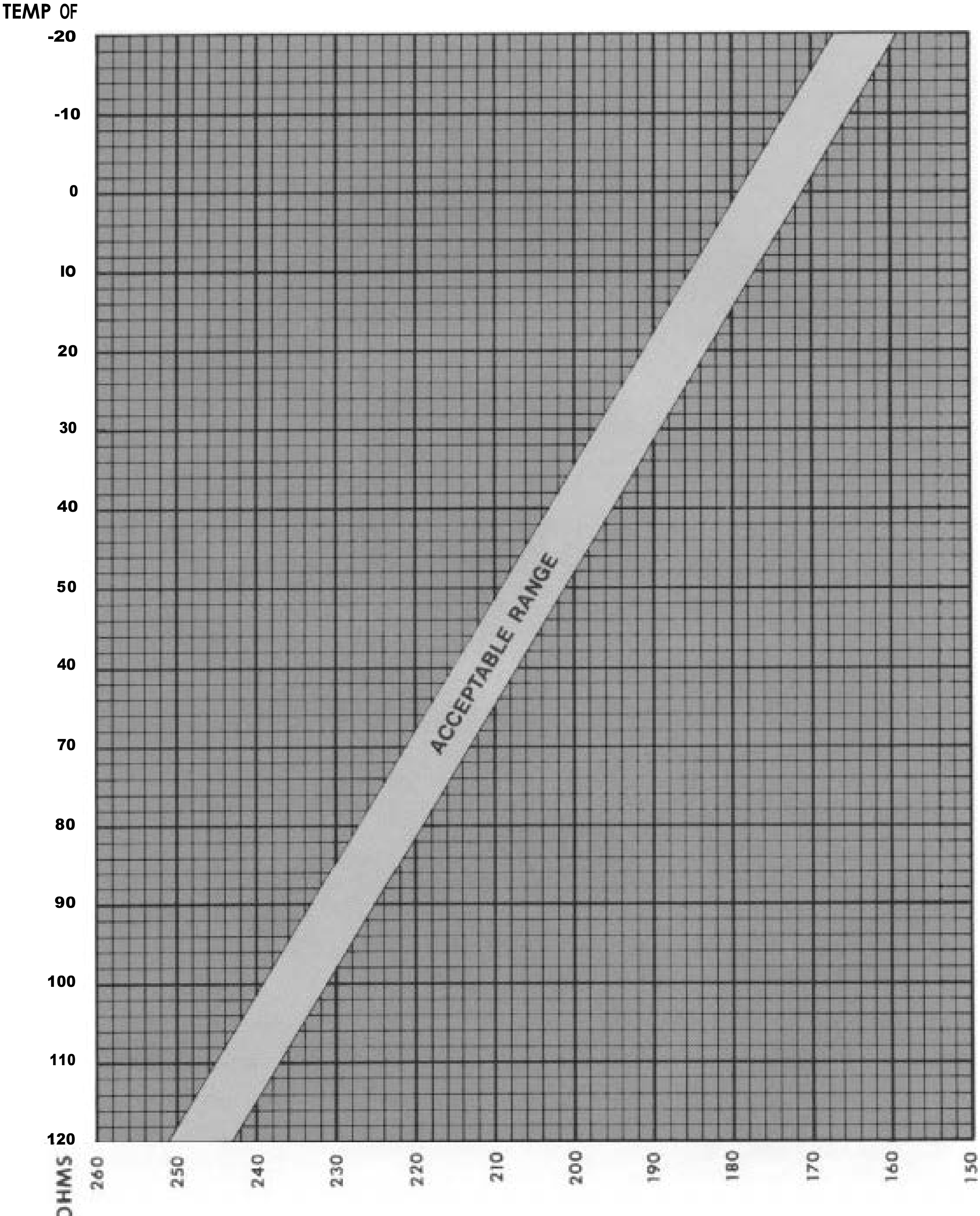
by **Frederick L. Beach, Jr.,** *Service Representative*

The forward cargo compartment and flight station temperature control systems on later model Hercules aircraft utilize all solid-state control boxes and resistive-type sensors. The electrical resistance of these sensors varies proportionally with temperature. Based on this, S/Sgt. Reuben L. Ervin, 176th TAG Environmental Shop, has developed a procedure for a quick troubleshooting check to verify the integrity of the sensors. This check is based on comparison of the sensor's ambient temperature to resistance values measured across certain pins on the sensor. By referring to the graph shown in Figure 1, it is possible to determine whether or not the sensor is indicating properly.

You **will need the following equipment:**

- A reliable thermometer capable of indicating between 0 to 120°F.
- An ohmmeter.
- Jumper wires to fit pins of the sensor electrical connection.

Figure 1.


TEMP OF
-20
-10
0
10
20
30
40
50
40
70
80
90
100
110
120
ACCEPTABLE RANGE
OHMS
260
250
240
230
220
210
200
190
180
170
160
150

Troubleshooting Procedure:

1. Place the thermometer in the vicinity of the sensor to be checked and let it stabilize for 5 minutes.

2. Disconnect the electrical connector from the sensor and use jumper wires to attach your ohmmeter to the appropriate pins (see below).

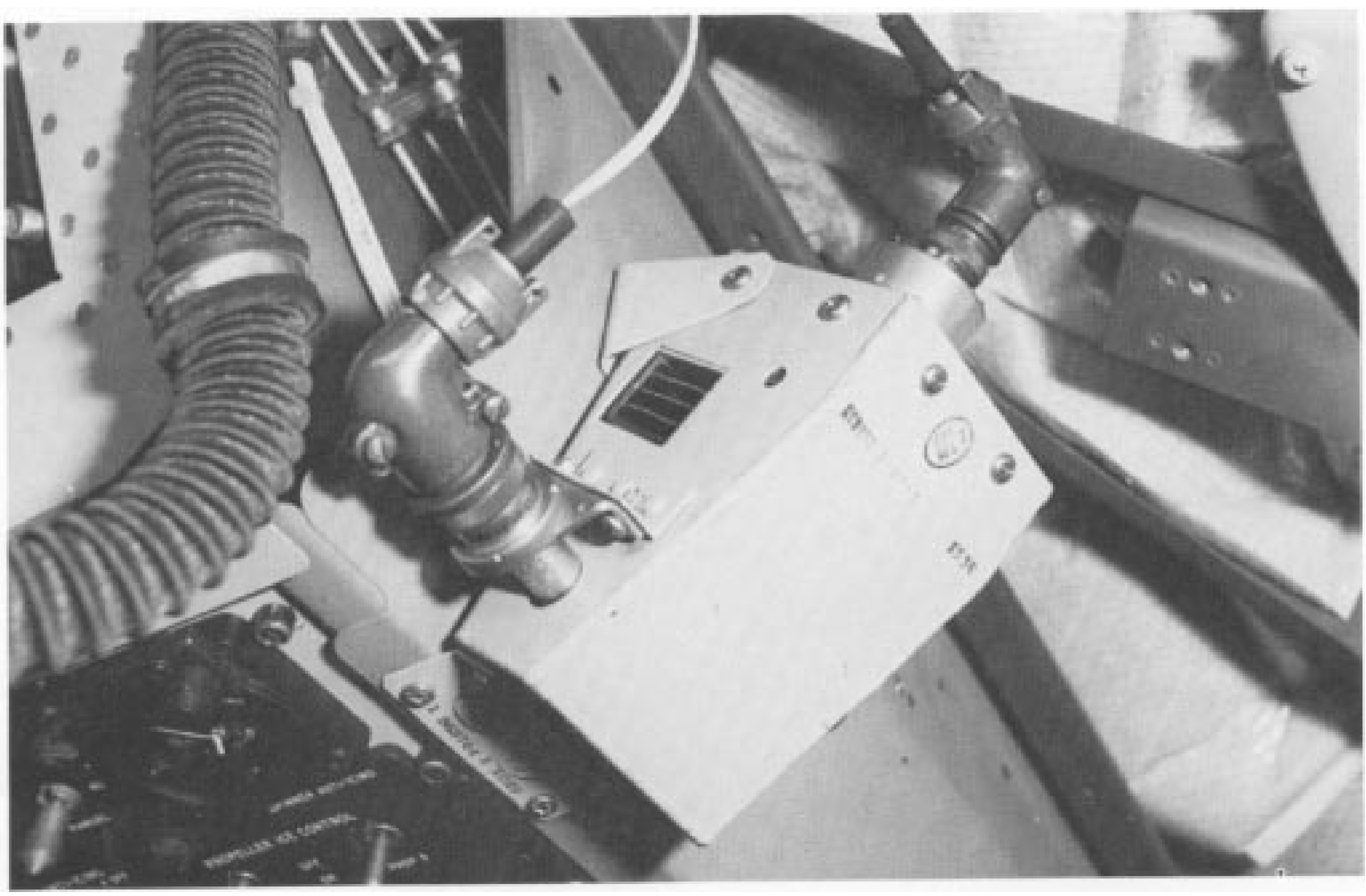
If you are checking...	Connect ohmmeter to pins...
Flighl deck low limit sensor	A and B
Flight deck overheat sensor	A and B
Flight deck duct sensor	C and D
Flight deck cabin sensor	C and B
Cargo compartment low limit sensor	A and B
Cargo compartment overheat sensor	A and C
Cargo compartment duct sensor	C and D
Cargo compartment cabin sensor	B and C

3. Using a resistance range suitable for measuring 160 to 250 ohms, record the resistance of the sensor.

4. Record the stabilized thermometer reading.

5. Refer to the Ohms/Temp Graph in Figure 1 to determine if the two readings define a point that falls within the acceptable range indicated on the graph. If the point is outside of the acceptable range shown, the sensor is defective and is providing erroneous information to the system. Replace it with a serviceable sensor of the appropriate type.

6. Verify proper system operation by following the checkout procedures in T.O. lC-130H-2-10, TM 382C-2-9 or Hercules Maintenance Manual (SMP 581) Chapter 21A, as applicable to your aircraft.



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