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service news

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

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Vol. 7, No. 2, April -June 1980

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Cover: This *Malaysian* Hercules aircraft represents only one of over 1500 Hercules delivered to more than 45 countries world-wide. The versatile, economical **Hercules has** helped **make Lockheed-Georgia the Airlift Center of the World.**

After many years of intense studier, planning, evaluations, and hard work, the L-400 twin-engine Hercules aircraft will become a reality. On January 7, 1980, we authorized full design development and production of this latest addition to the Hercules family. We at Lockheed are extremely excited over the new program. We think this is an excellent aircraft to serve the needs of a large number of Hercules customers for a more economical airlifrer for shorter range, lower payload missions. We expect to have the first one flying by the spring of 1982, and the first deliveries are expected in January 1983.

The L-400 program actually began several years ago. A research project was established to determine just what type aircraft would best fit the special needs of some of our Hercules customers who were using smaller, obsolete transports for short in-country airlift. The C-130 and L-100 have more capability than is sometimes needed for efficient performance on short-range flights with small payloads. Lockheed considered several options, which even included designing a new aircraft. However, the most logical solution war a twin-engine derivative of the Hercules.

There are several important reasons why this design was chosen. One is because of the commonality with the four-engine Hercules aircraft. Over 90 percent of the spares, facilities, mission equipment and support services of the L-400 aircraft are identical with there of the C-130/L-100. Another reason is that on its design mission of 500 nautical miles with a payload of 22,000 pounds, the L-400 will be 25% more efficient than its four-engine big brother. Equally important, the purchase price will be almost 25% lower.

There is yet another advantage that the L-400 can offer. The four-engine Hercules is a time-tested, proven aircraft. Since the twin-engine L-400 is a close derivative of the present Hercules aircraft, there won't be the introductory problems which often accompany a completely new design. The L.400 will even be built on the same production line as the C-l 30/L-100, by the same experienced team that has perfected Hercules production.

I hope you will share the enthusiasm which we have for the L-400.. Lockheed's latest contribution to serving the airlifter needs of the world.

Sincerely,

Bill Bullock

Bill Bullock
L-400 Project Director

PRODUCT SUPPORT LOCKHEED-GEORGIA COMPANY MARIETTA, GEORGIA 30063

T. J. Cleland Director

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Overboard Fuel Venting

When fuel vents overboard from a parked aircraft, the result is at best the loss of a scarce and precious commodity. At worst, the vented liquid may accidently ignite and turn what was just a costly spill into a disaster.

That is why fuel venting always deserves to be taken seriously. When it happens, the interests of both safety and economy dictate that the causes of the problem be found and corrected as quickly as possible.

Before we look into the reasons why fuel venting occurs, let us first review the fuel tank arrangement on Hercules aircraft and note how the ventilation systems that serve these tanks are designed and function.

C-130 and L-100 airplanes are normally equipped with four main integral tanks, two in each outer wing. In addition, two bladder-type auxiliary tanks consisting of three interconnecting cells each are usually provided. These are installed in the right and left center wing section. Many Hercules models are also equipped with external pylon tanks mounted beneath the wings.

Full **tanks plus hot sun can add up to overboard fuel venting.**

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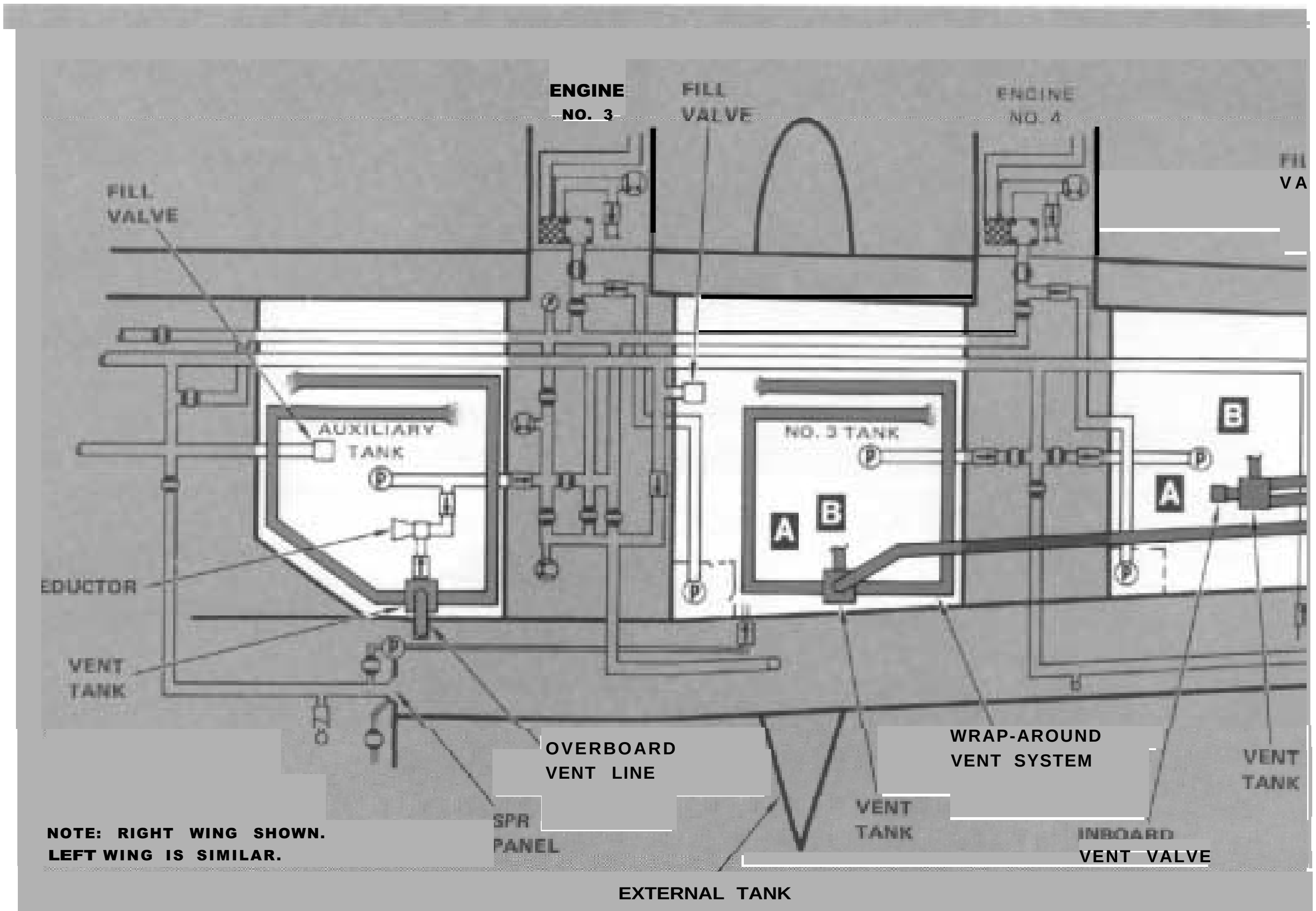

FUEL AND VENTIL

FUEL TANK VENTILATION SYSTEM

Each fuel tank has a ventilation system which is designed to meet the particular requirements of that tank's construction and location. The basic purpose of a typical fuel tank ventilation system is to provide a controlled means of maintaining the desired pressure equilibrium inside and outside of the tank. The system must be able to accommodate changes in altitude and temperature; it also must be able to allow for changes in the volume of interior airspace when fuel is added or withdrawn. A fuel tank vent system has the additional function of providing a route by which excess fuel can escape in case the tank's capacity is exceeded because of overfilling or thermal expansion of the contents.

Inboard Tanks

Three different types of ventilation systems are used on Hercules aircraft. The inboard main tanks and the auxiliary tanks are equipped with wrap-around vent systems. In this type of system, open-ended vent lines are installed in the upper portion of each tank's interior space. The vent lines are connected to a vent tank which traps and stores any liquid fuel that enters the system. Air and fuel vapors can pass back and forth through the vent tank unimpeded. The vent system opens to the atmosphere through an overboard vent line that connects the vent tank to an outlet under the trailing edge of the wing. Any fuel trapped in the vent tank is automatically returned to the tank of origin whenever the associated fuel boost pump is in operation.

Outboard Tanks

The outboard main tanks feature what is called an end-to-end system. This design uses what is essentially a long, straight vent line extending almost the length of the tank. Float-controlled valves are located at each end. A vent tank similar in construction and operation to the one used in the wrap-around system is installed in the main vent line near

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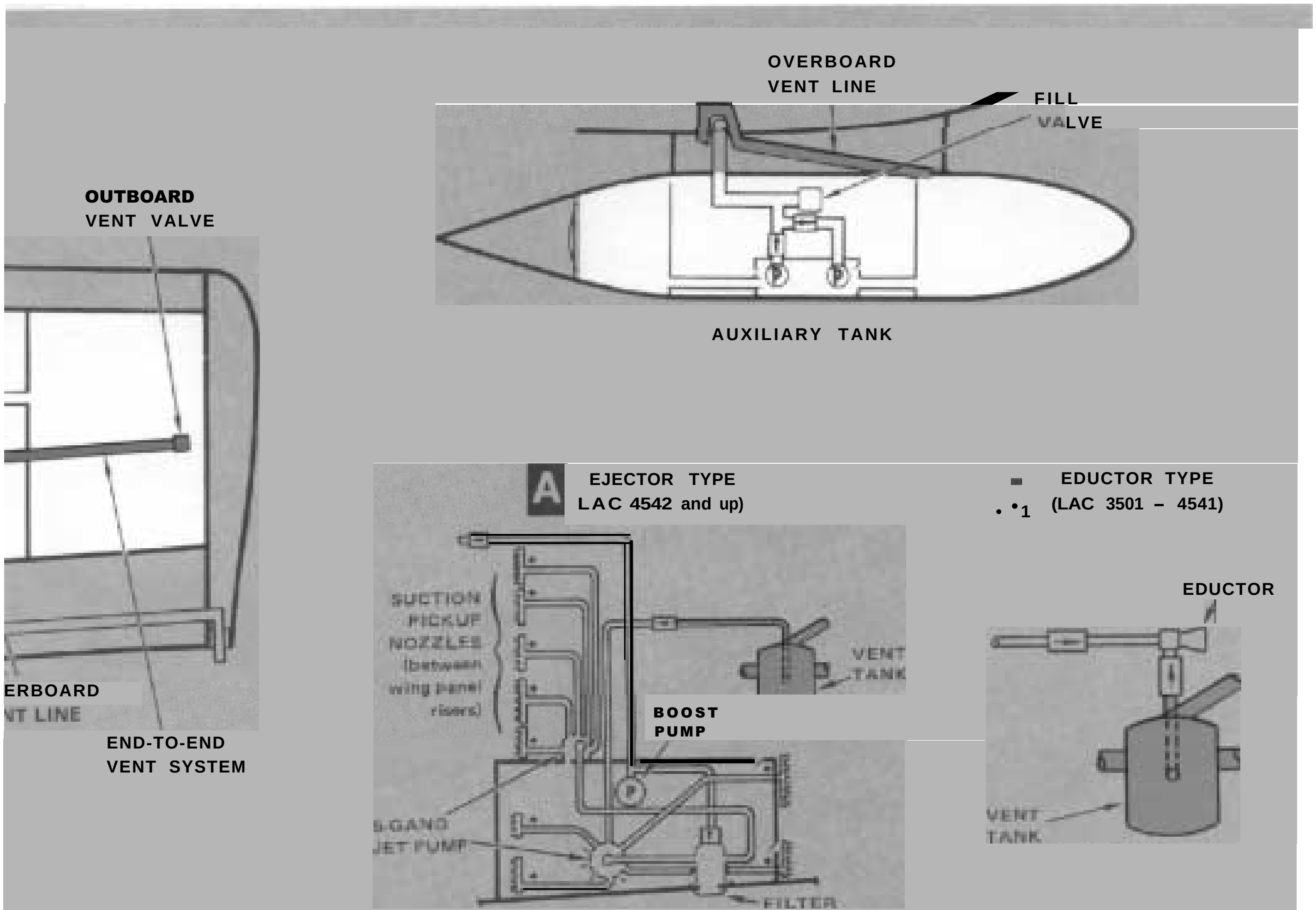

EM SCHEMATIC

its inboard end. An overboard vent line connects the vent tank to an outlet below the trailing edge of the wing adjacent to that of the inboard main tank.

External Tanks

Each of the two external tanks is vented to the atmosphere through a simple system that consists of a single vent line leading from the forward part of the tank, up through the pylon, and then to the trailing edge of the wing. This uncomplicated system is highly reliable. As a result, the external tanks are seldom involved in fuel-venting complaints. For this reason, they will not be considered further in the following discussion.

CAUSES OF FUEL VENTING

Fuel venting from an overboard vent line can have a number of possible causes. The most common are thermal expansion of the fuel supply, inadvertent overfilling, leaking vent tank check valves, and leaking vent line couplings.

Thermal Expansion

Thermal expansion of the fuel within an aircraft's tanks is probably the most common cause of fuel venting. Refueling activities are often carried out in the evening or early morning when ambient temperatures are likely to be relatively low. More often than not, the fuel is supplied from cold underground storage tanks. If an airplane whose tanks have been fully serviced during the cool hours is allowed to remain parked on the ramp long enough for the morning sun to warm it significantly, fuel venting may result. The cold fuel in the tanks will gradually absorb heat from the outside and expand. If the ambient temperature rises high enough, and the airplane is not flown or moved to a cooler area soon enough, the fuel may expand to a point where the tanks can no longer contain it.

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Daily temperature changes are of course to be expected, and some allowance for thermal expansion must be included in tank design if fuel venting is not be become an everyday occurrence. The tanks in Hercules aircraft provide about 3 percent airspace above the top of the fuel when they are at normal full capacity. This is sufficient to accommodate any thermal expansion that will usually be encountered in most climates.

But note that in some alpine and desert regions, diurnal temperature variations of more than 60 degrees F are occasionally experienced. Since JP-5, Jet A, and Jet A-l increase in volume about 1 percent for each 19degree F rise in temperature; and JP-4 and Jet B expand about 1 percent for every 18.5-degree F increase in temperature, a little quick calculation will show that it is entirely possible for thermal expansion to cause persistant fuel venting problems under such conditions. Even in more moderate climates, sudden extreme changes in temperature can and do occur. The possibility that such changes may affect tank capacity should always be considered when fuel loads arc being planned.

It is also important to remember that the temperature of' the ambient air is not the only source of heat energy which can have an effect on the temperature of fuel stored in aircraft tanks. Direct sunshine contains large amounts of radiant heat that is quickly absorbed by metal surfaces. A long expanse of aluminum wing can be a quite efficient collector of this form of heat. In most aircraft, including the Hercules, these same metal wing panels are in direct contact with the fuel supply. It is thus quite possible to experience fuel expansion problems on what would appear to be only a pleasantly warm day. The temperature of the fuel, not the air, is the important factor, and direct solar radiation can play a key role in determining which of the two will be higher.

What can be done to control fuel venting due to thermal expansion? Once venting has started, the quickest way to put a stop to it is to run the fuel boost pump in the affected tank for a short period of time (a minimum of five minutes). This will clear the vent tank of accumulated fuel and keep it clear as long as the pump is running. Using the boost pumps to halt or prevent fuel venting is especially convenient when the aircraft has a scheduled flight within an hour or two.

Of course, the best way to deal with thermally induced fuel venting is to avoid having it happen at all. The only sure way to do this is the obvious one: Make certain that the tanks always have enough airspace to accommodate any possible increases in fuel volume that might occur before takeoff. Some operators of Hercules aircraft have found that a 200-pound (30-gallon) reduction in the fuel load of each tank is sufficient to prevent fuel venting even under extreme climatic conditions.

A small reduction in fuel load can also be helpful in cases where the No. 3 main fuel tank has proven especially prone to fuel venting. The No. 3 tank receives all of the fuel that is drained from the single-point refueling (SPR) manifold after refueling is completed. The 26 or so gallons of fuel pumped from the SPR lines enter the No. 3 tank through an inlet which is not controlled by the tank's dual level-control and shutoff valve (usually called simply the fill valve). This means that if the tank is already full, the additional fuel from the SPR system represents a small excess over and above its normal capacity. As a result, part of the usual 3 percent minimum airspace in the tank will now be occupied by fuel. The No. 3 tank will therefore be a little less able to accommodate thermal expansion of its contents than the other tanks in the airplane. Not surprisingly, when conditions arise which favor thermally induced venting, No. 3 tank is often the place where the problem shows up first.

An additional point that deserves to be mentioned is that the tank ventilation systems are best able to cope with thermal expansion of the fuel supply when the airplane is parked with the wings and fuselage level. Any other attitude, particularly one in which the nose is angled down, can predispose the aircraft to fuel venting problems when temperatures increase rapidly and the tanks are full. Level, and if possible, sheltered parking areas will go a long way toward reducing the incidence of this kind of trouble.

Fill Valve Failure

Although many fuel venting problems can be traced either directly or indirectly to heat and thermal expansion, some are clearly due to other causes. Mechanical failure is responsible for fuel venting in certain cases, and one possibility in this category is the inadvertent overfilling of a tank because of fill valve failure. Any tank can be overfilled through the SPR system if the fill valve in that tank malfunctions.

A fill valve is located near the top of each tank. The purpose of the fill valve is to shut off the flow of fuel automatically when the tank's full capacity is reached. In Hercules aircraft, this means a level at which about 3 percent airspace still remains in the top of the tank to provide room for thermal expansion of the contents.

If a tank's fill valve fails in the open position, it will be possible to continue filling the tank until the 3 percent airspace is completely occupied. Fuel will then enter the vent tines, flood the vent tank, and pour overboard from the vent outlet in a steady stream. Should the vent system for some reason be obstructed when this occurs, the fuel rank could be overstressed or even rupture.

The fill valves are designed in such a way that sudden, complete failure of the unit is uncommon. Each valve

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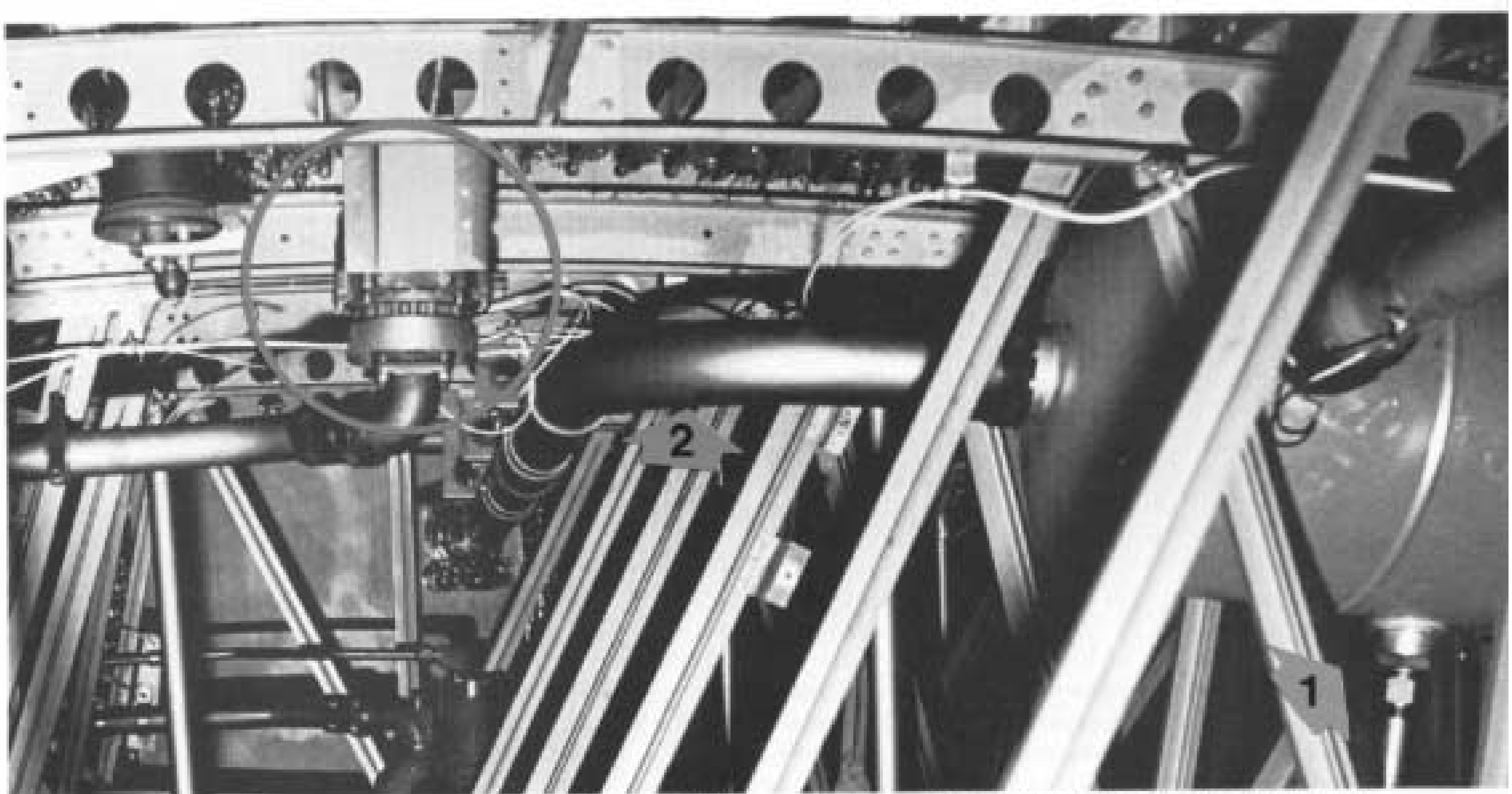
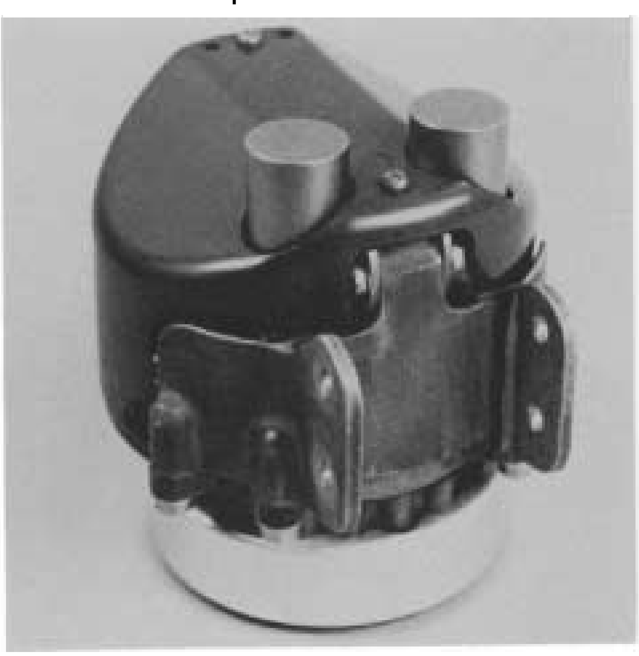


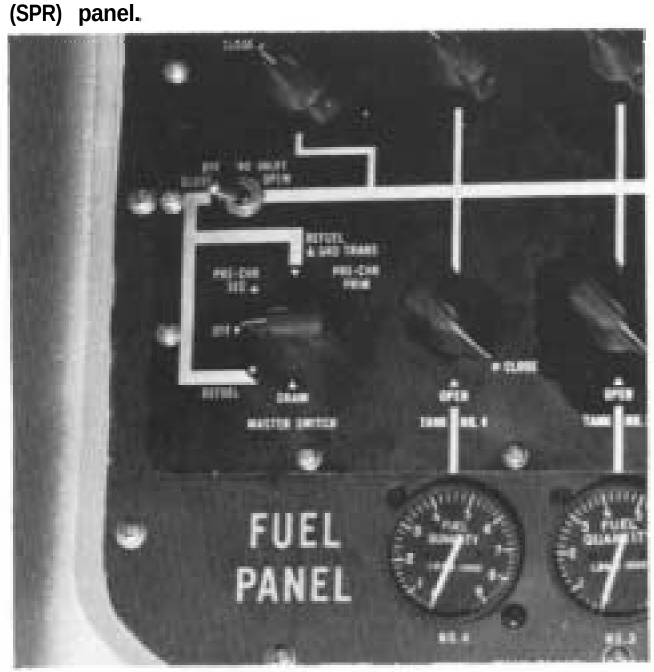
Interior view No. 3 fuel tank. Note location of fill valve (circle), the vent tank and the vent tank drain line (arrow 1), and **the overboard vent line (arrow 2).**

consists of a single housing which contains dual floats, dual diaphrams, dual pilot valves, and dual solenoids. The dual sets of components provide operational redundancy. In effect, primary and secondary systems within the valve act to back up each other. This helps to ensure that the fill valve will always close and shut off the fuel flow when the tank in which it is installed has reached its normal capacity. The proper operation of either the valve's primary system or secondary system will stop fuel from entering the tank once its maximum safe level has been reached.

A dual level-control and shutoff valve (fill valve) is installed close to the top of each fuel tank.



The master switch located on the single point refueling (SPR) panel.



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Operational Check · A reliable method of checking fill valve operation during refueling is provided on Hercules aircraft. The condition of the valves is normally checked each time the aircraft is refueled. To make this check, first rotate the master switch on the SPR panel to the PRE-CHK PRIM position. When the switch is in this position, electrical power is removed from the solenoid on the primary side of fill valves in all tanks. This closes off the bleeding action across the primary diaphrams, which in turn should cause the fuel flow through the fill valves to almost stop. (In PRE-CHK positions, fuel flow will not stop completely because a small amount of fuel continues to flow through other internal bleed passages.) Make note of any tank in which the fuel flow is not cut off. Then rotate the master switch to the PRE-CHK SEC position. Now the secondary solenoids in all of the tank fill valves will be de-energized. This causes the bleeding action across the secondary diaphrams to stop, bringing fuel flow almost to a stop once again. Take note of any tanks in which the fuel flow does not cease.

Ideally, the primary and secondary sides of each valve in all tanks that are being refueled should test good in the pre-check. If at least one side of every valve is shown to be functioning properly, refueling may continue, but the defective fill valve should be replaced at the earliest opportunity.

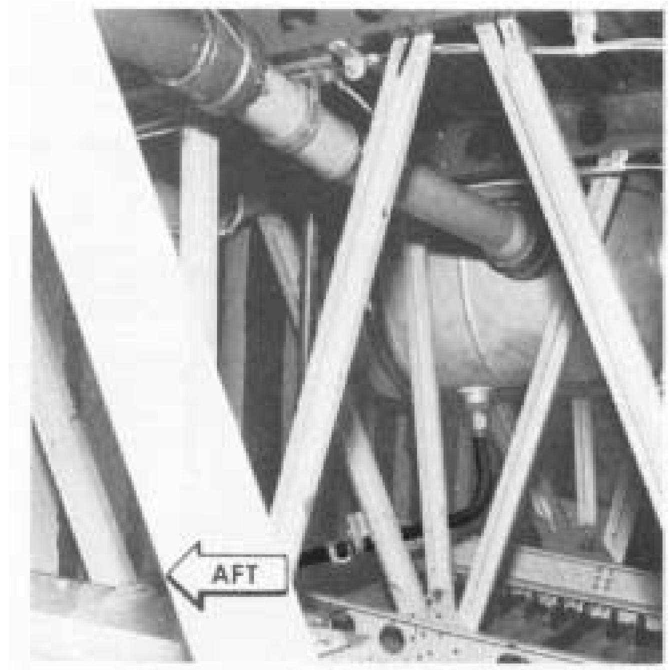
In cases where both the primary and secondary sides of a valve prove to be inoperative, the defective fill valve should be replaced immediately, if possible. If this cannot be done, it will be up to the refueling crew to make certain that the tank in question is not overfilled. Refueling should either be stopped well short of the tank's normal capacity, of if a main tank is involved, the over-the-wing refueling method can be used. The location of the wing filler ports with respect to the tops of the tanks ensures that adequate airspace will remain when the tank is "full".

Fuel venting that occurs sometime other than during or immediately after refueling is not usually caused by a defective fill valve. If thermal expansion can also be ruled out, the trouble is probably due to a leak somewhere in the vent system.

Ventilation System Leakage

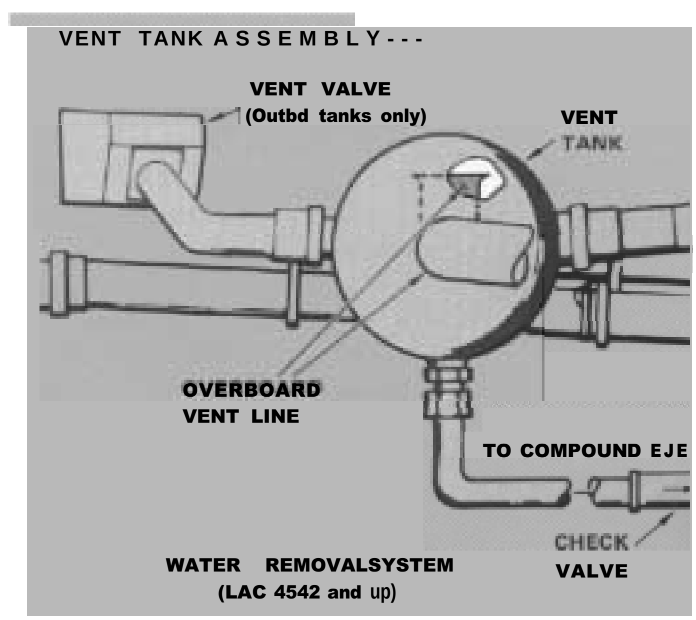
Vent Valve – In cases where an outboard main tank is affected, one of the float-controlled valves on the main vent line may be leaking. Fuel venting through a failed vent valve is most often first noted when the aircraft has for some reason been parked on uneven ground where one wing is higher than the other.

If the evidence points in this direction, there is little to do other than to remove both valves from the leaking tank and check them. Procedures for doing this are well covered in the maintenance handbooks.



A check valve is located in the line from the vent tank to the ejector or eductor system.

Check Valve – Another place where leakage has sometimes been discovered is at the check valve located in the vent tank drain lines of the main fuel tanks. The inboard tanks seem particularly susceptible. It appears that the flapper seal in the check valve in some cases swells enough in use to allow a slow bypass of fuel into the associated vent tank. Since the end of the overboard vent line inside the tank is slightly below the level of the fill valve, a leak through the check valve will cause the vent tank to slowly fill with fuel. The fuel will then move up the vent line to the outlet and drip overboard.



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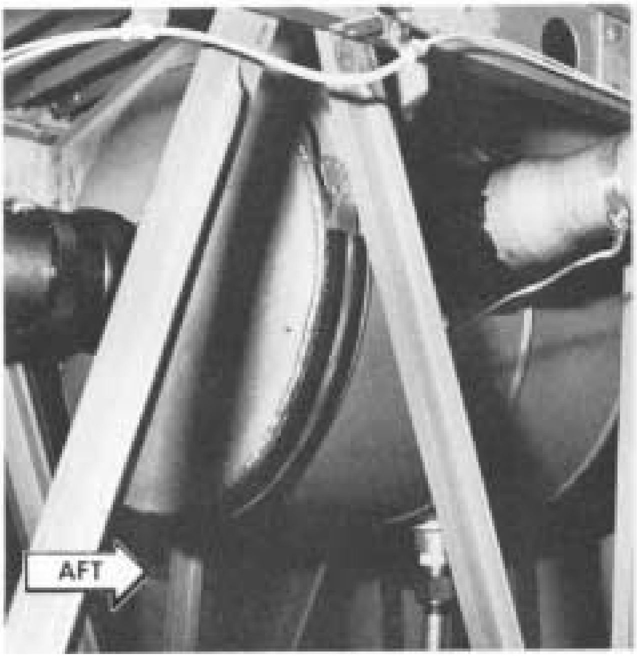


A crack in the welded seam of a vent tank can cause fuel to be vented overboard.

The leakage through a defective vent tank drain line check valve is usually fairly slow; in one case it took 32 hours for enough fuel to seep through the valve for venting to begin. But if the check valve is installed backwards or incorrectly, overboard venting of fuel in quantity may occur much more quickly. Make sure that this valve is installed with the direction of the arrow away from the tank to allow fuel to flow from the vent tank to the eductor or ejector assembly.

A quick temporary solution to leakage through the vent tank drain line check valve is to lower the fuel level to a point where the open end of the overboard vent line is above the fuel level. Keeping the fuel load down to 6200 pounds in the inboard tanks and 6700 pounds in the outboard tanks should accomplish this.

Of course, the only real fix for a leaking check valve is to replace it. Once it is removed, the valve can be checked for leakage with a simple test: Obtain a 3/4-inch by 24-inch section of straight pipe and provide it with a fitting on one end to adapt it to the check valve. Stand the assembly upright in a safe area and fill the pipe with fuel. The maximum amount of leakage allowed is ten drops per minute. If the valve fails this test, it must be replaced.

Vent Tank – A problem that can produce symptoms similar to a leaking check valve is a crack in the welded seam of a vent tank. Metal vent tanks are used in the inboard and outboard main tanks. If one of them develops a small crack, the fuel may enter the vent tank at a rate quite comparable to the flow through a failed check valve.

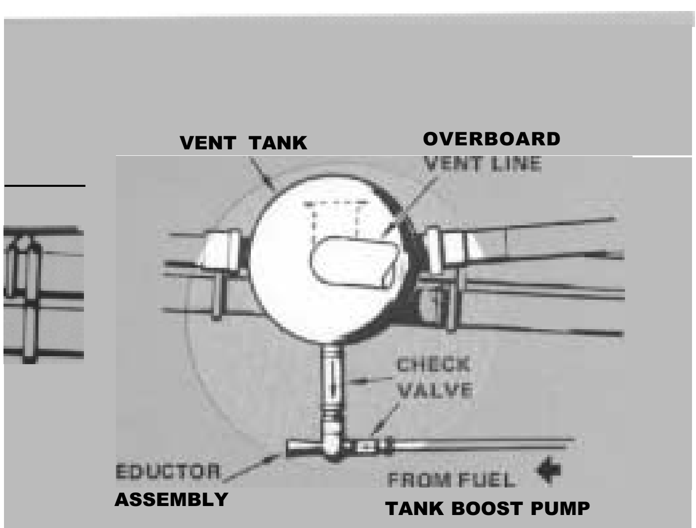
Vent tanks are not easy to test with certainty because a defective tank that is not under stress may appear to be sound. A crack may open up, however, just as soon as stress is applied-as it is when the vent tank is partially submerged in a full tank of fuel.

LOCATING LEAKS

An excellent way to check an entire fuel tank ventilation system – vent tank, vent lines, and couplings – for leakage is to pressurize the system with air. This may be done for any of the main fuel tanks, but the affected tank must of course be drained and purged first.

CAUTION

Do **not pressurize auxiliary tank vent systems.**



EDUCTOR SYSTEM
(Unmodified, LAC 3501-4541)

Ventilation System Layout

Note that before attempting to pressurize a tank ventilation system to locate leaks, it is a good practice to review the applicable vent line routing schematics. Vent system leaks can be deceptive, and having a good mental picture of the layout of the vent line plumbing could help save a lot of time and trouble.

One point in particular to remember is that the overboard vent line for an inboard tank is routed through the outboard tank on the way to its vent outlet. This means that when fuel shows up at the vent outlet of an inboard tank, it may in fact have originated in the outboard tank. The leak could be in the inboard tank's vent line somewhere along its route through the outboard tank.

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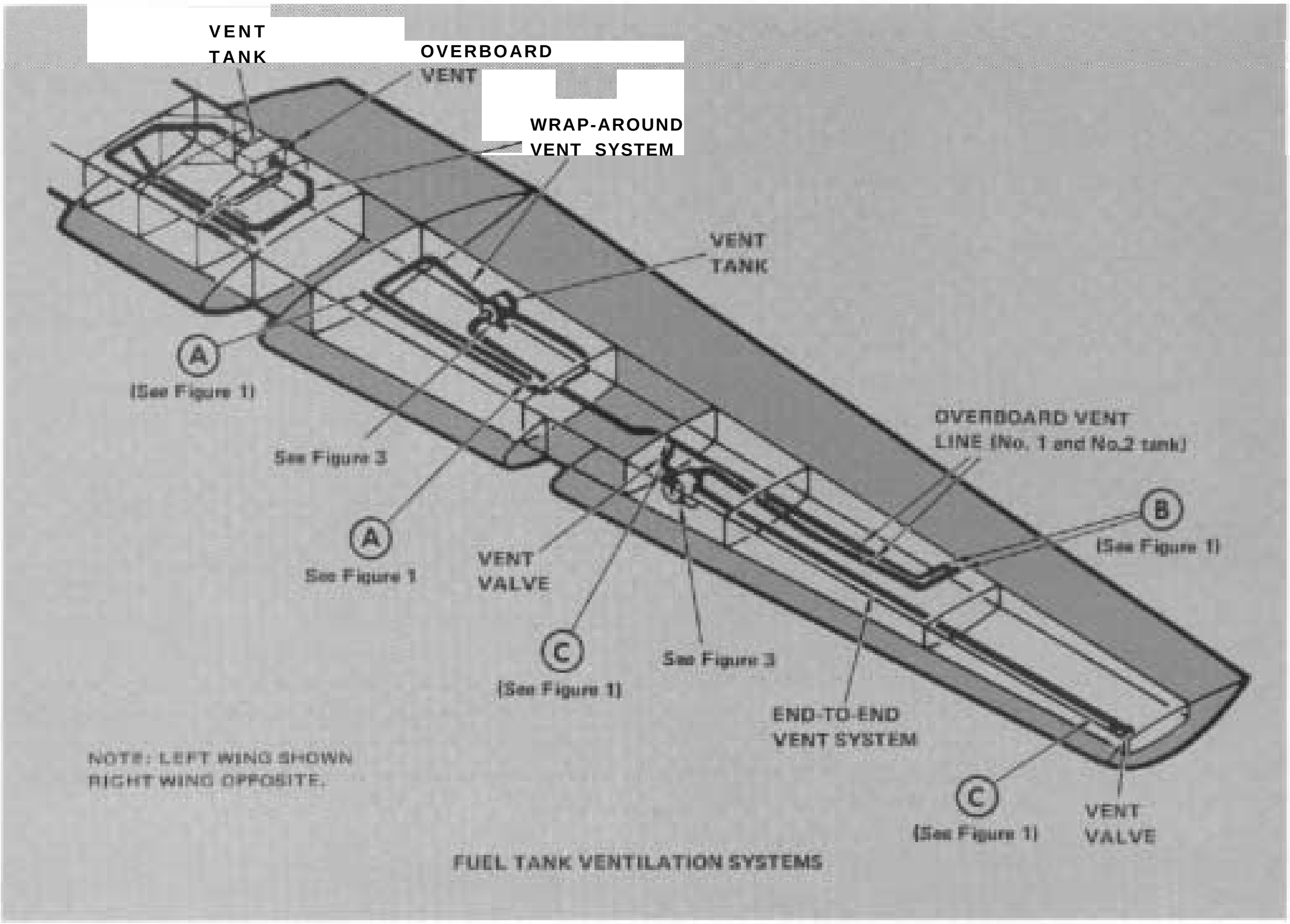


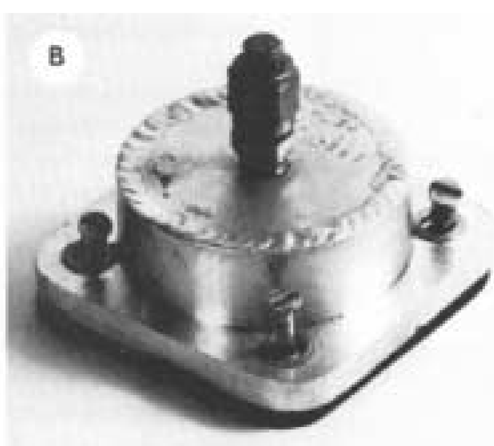
A quick way to determine which tank is the source of the leak is to drain the fuel from the inboard tank; any leakage originating in that tank will then cease. If the fuel venting continues, leakage into the portion of the vent line that passes through the outboard tank is indicated. In this case, it will be necessary to drain and purge both the affected inboard and outboard tanks in order to locate the leak by pressurizing the vent system.

Figure 1. **Locally** manufactured items used in pressurization of the vent system.

The nipple is not used in this test procedure.

Inboard Tank Vent Line Plug

Shown with acap over the adapter nipple.



Main Tank Overboard Vent Line Adapter

The tee and caps on the pluq are not needed for this test procedure.

Outboard Tank Vent Line Plug

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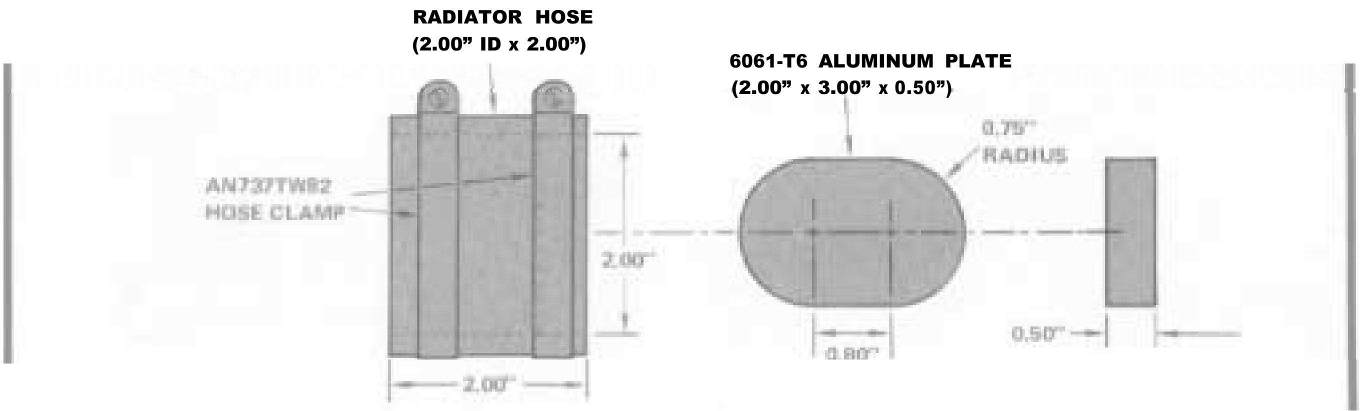
Figure 2. **INBOARD TANK VENT LINE PLUG**

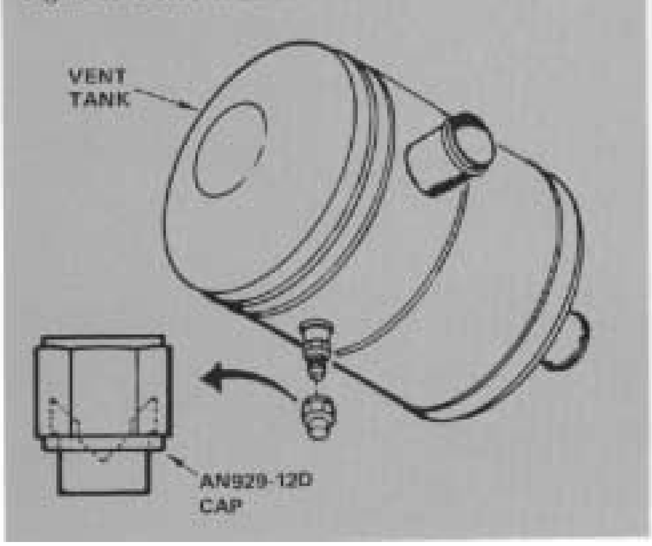


Pressurizing the System

To pressurize the vent system of an inboard or outboard main tank, an AN929-12D cap is needed, and an adapter and plugs will have to be locally manufactured.

Inboard Tanks – An inboard tank will require two identical plugs (Figure 1A), each of which can be made as follows: Fabricate an oval-shaped aluminum plate (as shown in Figure 2), and insert it into a short length of rubber hose or tubing that will withstand 10 psi pressure (such as an automobile radiator hose). Seal the mating surfaces per best shop practice to hold a minimum of five psi air and secure it with an AN737TW82 clamp.

Figure 3. VENT TANK DRAIN LINE CAP



To install the plugs on the inboard tank vent system, simply slide the hose end of one of the plug assemblies over each of the two vent line openings inside the tank and tighten with another AN737TW82 clamp. Be careful not to crush the vent line while tightening the clamp.

An obstruction in the vent system can cause serious damage to the tanks --see Figure 6.

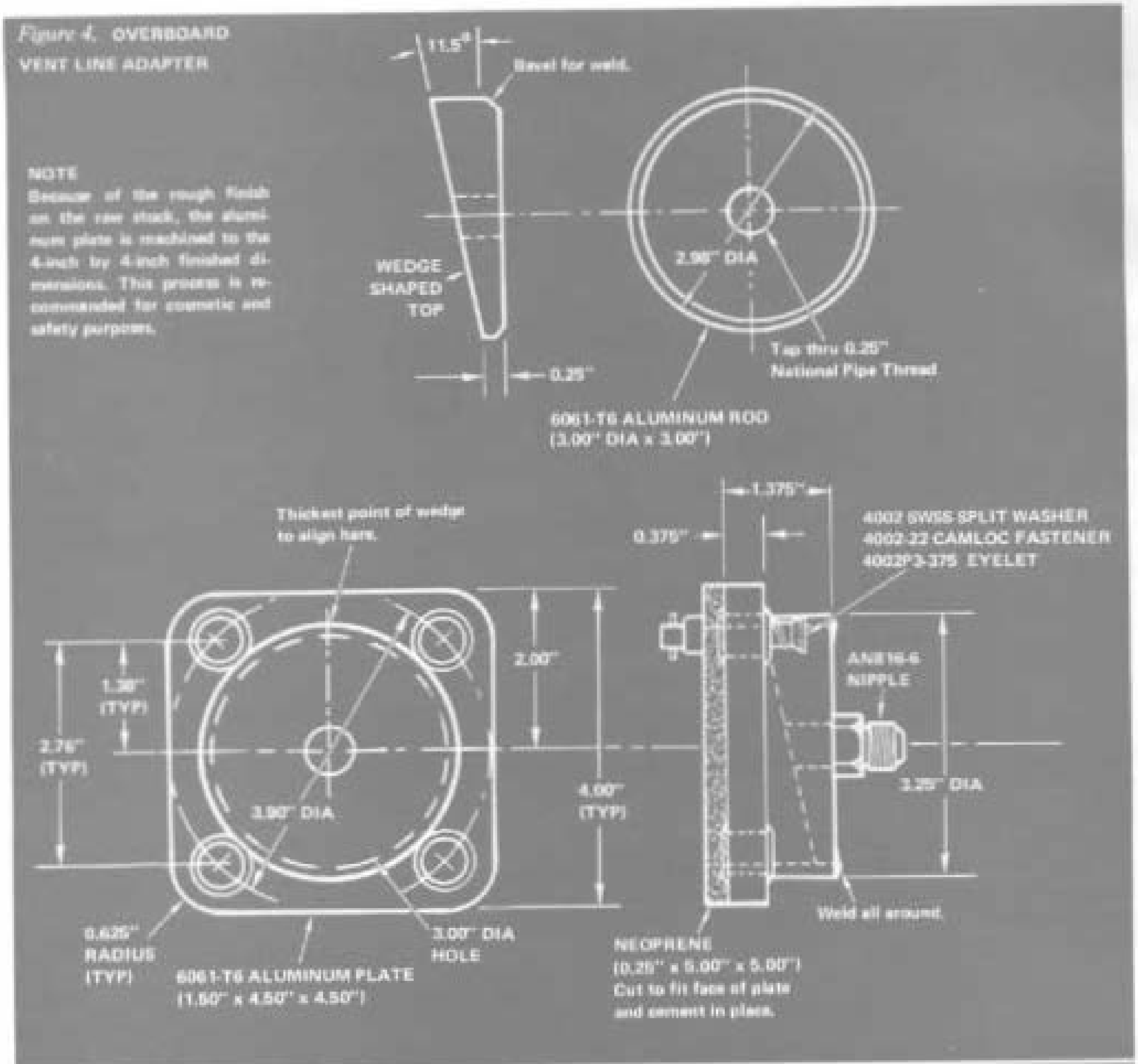


Figure 4. OVERBOARD VENT LINE ADAPTER

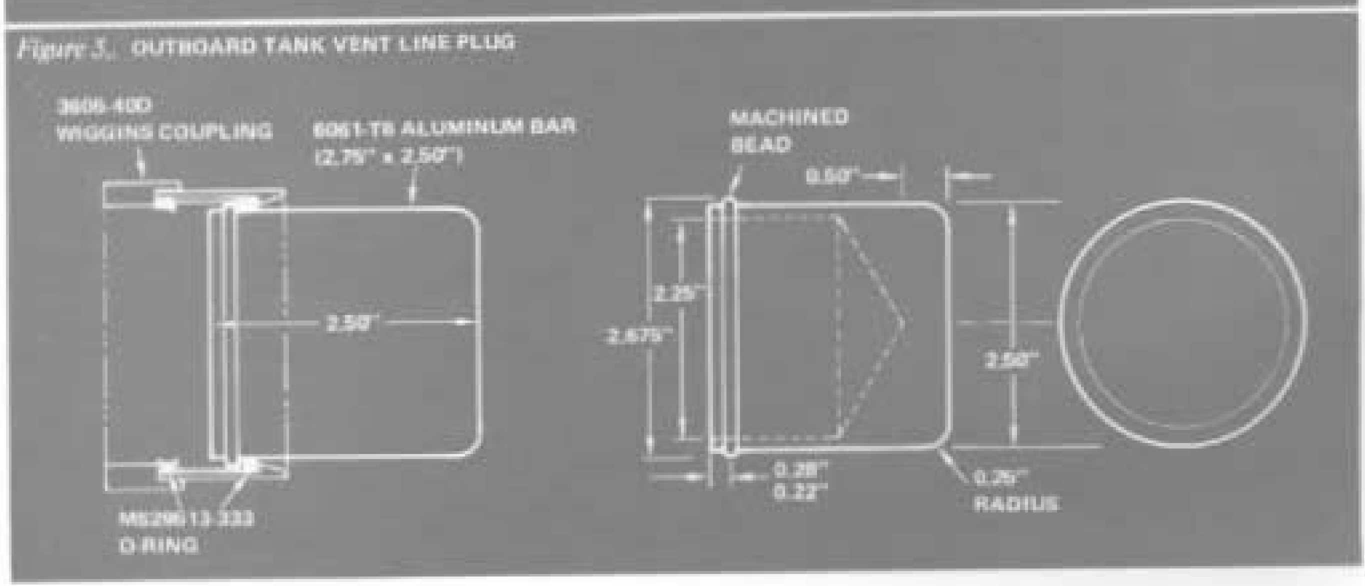


Figure 5. OUTBOARD TANK VENT LINE PLUG

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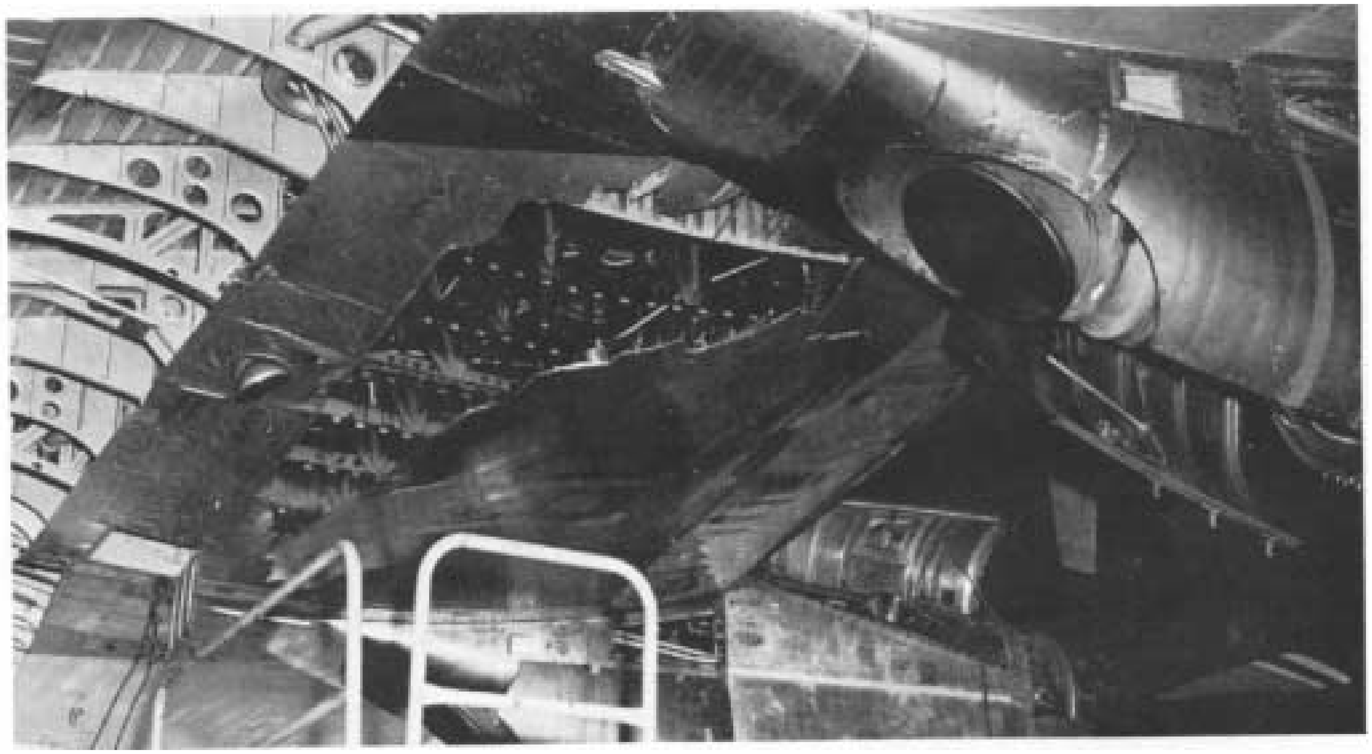


Figure 6. **A plastic bag left in the vent system caused this tank to rupture during refueling.**

When the plugs are in place, disconnect the line between the vent tank and the ejector or eductor system and cap the opening at the bottom of the tank with the AN929-12D cap (Figure 3).

An adapter (Figure 1B) equipped with a nipple that will accept an air line fitting must be installed over the outlet of the overboard vent line. To manufacture this, machine an aluminum plate to the specified dimensions (see Figure 4) and insert a camlock in each corner. Install the wedge-shaped top, with the thickest point centered between any pair of camlocks.

Weld the contact area between the plate and the top, keeping in mind that the mating surfaces must be airtight. Install the AN816-6 nipple, then glue the l/4-inch neoprene gasket to the bottom of the plate.

Pressurize the vent system to approximately 3 psi and allow five minutes for temperature stabilization. During the next 20 minutes, no leakage should occur. If the pressure decreases, indicating that leakage is present, brush the vent tank and all couplings with a leak detector solution to locate the leaking coupling or cracks.

Outboard Tanks – An outboard main tank will also require the AN929-12D cap, the adapter, (Figure 1B) and two plugs (Figure 1C); the plugs must be fabricated as follows. Machine an aluminum bar to the dimensions given in Figure 5, carefully forming a bead. To install on the tank ventilation system, remove the clamp securing vent system tubing at outer wing station 526.8. Disconnect the Wiggins coupling just inboard of the vent valve and lower the vent line. This should allow room to install the first plug. Now disconnect the coupling outboard of the inboard vent valve, and then install the second plug. Pressurize the system and check for leaks as above.

After any problem areas have been located, reduce pressure to atmospheric; remove the cap, plugs, and adapter, and restore the vent system to the normal. When repairs have been completed, visually inspect the vent system before tank closure and before refueling. Figure 6 shows what may happen if anything is left in the line that can plug the system.

The efficient use of fuel is on top of everyone's list. The solutions offered here for overboard venting should help save precious fuel and help avoid the safety hazards that fuel spills invariably entail.

Lockheed-Georgia Company's

New Airframe Training Laboratory

It's hard to match the benefits of real hands-on experience when it comes to mastering a specialty in the aircraft maintenance field, and students who acquire or refine their skills in Lockheed-Georgia's newly expanded and modernized Airframe Training Laboratory get plenty of it.

The new facility, which is operated by the Customer Training Department, is specially designed for classes in airframe maintenance and fuel tank sealing techniques, but it is also well equipped to offer superior training in a variety of related areas, such as basic sheet metal repair, corrosion control, and non-destructive inspection.

THE CLASSROOM

The Airframe Training Laboratory offers a unique combination of the features of both a shop and a classroom. The shop area contains a complete flap assembly, a section of fuselage, and an entire outer wing. All power tools, hand tools, and supplies needed for each particular course of instruction are readily at hand. The classroom area provides comfortable seating and the proper environment for lectures and audio-visual presentations.

SAFETY

Working with fuels and sealants can be tricky business, and when the new laboratory was being constructed, the safety and well-being of the students who would use it were given top priority. The facility is fully air conditioned and incorporates the latest atmospheric controls and tire safety features. Students are provided with protective clothing and modern breathing apparatus as required, and their work is constantly monitored by training specialists who keep the welfare of the students uppermost in mind.

We at Lockheed-Georgia have been very pleased with the results achieved by the more than 15 classes that have used the new laboratory since it opened last October. We believe that our students have shared our enthusiasm. The addition of this new facility strengthens the Department's already comprehensive training capability and is one more reason why customer training at Lockheed-Georgia has always had a special significance.

Left: The classroom is a large, well-ventilated area with modern equipment.
Right: Students are taught proper maintenance techniques through actual "hands-on" experience.

Scovill PANELOC Fasteners

by Bob Nazarowski, Senior Structures Design Engineer
Chuck Austin, *Service Analyst*

Paneloc fasteners, made by Scovill, are used to mount the antenna windows or radomes on many models of Hercules aircraft. Some operators have complained that they have unintentionally destroyed a number of these fasteners in the process of using them. This is not only frustrating and time consuming, but costly.

Actually, Paneloc fasteners are easy to use and have the following special advantages:

- They are capable of carrying major structural loads across removable panel joints.
- They are self-adjusting to compensate for varying panel thicknesses.
- They release with onequarter turn of the stud.
- They can be tightened to a uniform preload similar to a structural bolt.

By understanding exactly how the Paneloc fasteners work, you can reduce the failure rate considerably. First, we will give you an explanation of just how this fastener functions, and later in the article we are going to offer a few ideas which should make working with the Paneloc a little easier.

Figure 1 shows an exploded view of the Paneloc fastener. The key features of this device are the stud and the inner sleeve. Once we see how these pieces work together, understanding the rest of the device is easy.

As you can see in Figure 2, inside the inner sleeve is a spring; a spring cover, which protects the spring from the actions of the stud; and a retaining disk, which acts as a "roof' to keep the spring from being pushed out the top of the inner **sleeve.** When the stud is pushed into the inner sleeve (Figure 3), it depresses the cover and spring. By turning the stud 90 degrees to the right (Figure 4), the stud cams come against the cam stops. That is as far to the right as the stud can go inside the inner sleeve. If the stud is turned to the right any more, the stud cams push against the cam stops of the sleeve walls and the stud and inner sleeve act as a single screw and rotate together, moving farther inside the outer sleeve. If the inner sleeve travels too far into the outer sleeve, it can damage the fastener.

When the stud has been pushed in, turned a quarter turn, and has mated against the wall cam, it is held in position by the pressure of the spring pushing the stud cams against the cam stops. There is also a depression in the spring cover that the stud cams fall into, further resisting movement of the stud back to the left. This pressure is sufficient to hold the stud in place. But when you make additional turns on the stud to the right and drive the stud and sleeve farther into the outer sleeve, you increase the pressure on the stud and on the antenna cover or radome it is holding down. This allows you to adjust the amount of torque on the fastener. Besides that, the device is constructed in such a way that regardless how much torque you have put on the stud once seated, it comes free when you turn it one-quarter turn to the left. That's why it is called a quick-release fastener.

Loosening the Fasteners

The standard procedure for loosening Paneloc Fasteners in the past has been as follows:

1. Using a No. 3 Phillips-tip screwdriver, turn the stud one-quarter turn (90 degrees) to the left. This frees the stud and it could come out of the receptacle at this time, but DO NOT take it out. (The stud is actually retained on the radome by a collar and snap ring to prevent loss of the stud.)
2. Turn the stud and inner sleeve two more revolutions to the left-no more, no less.

Figure 1

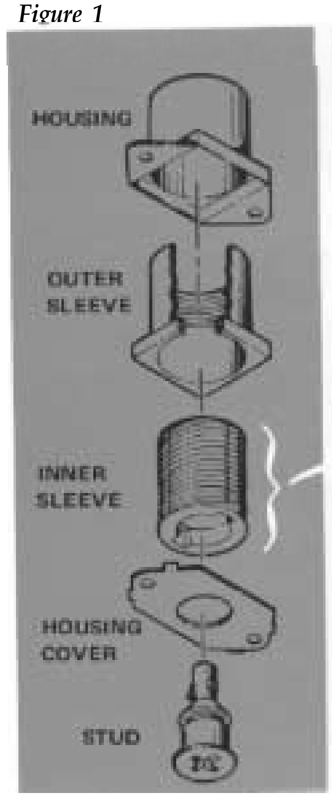


Figure 2

Figure 3

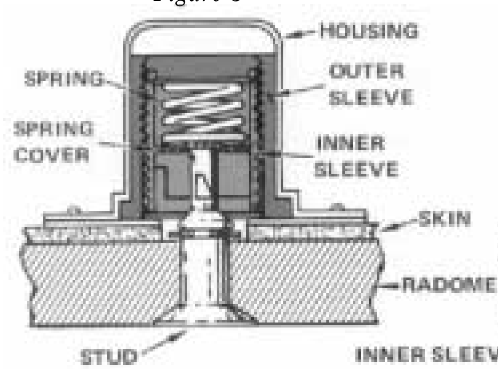
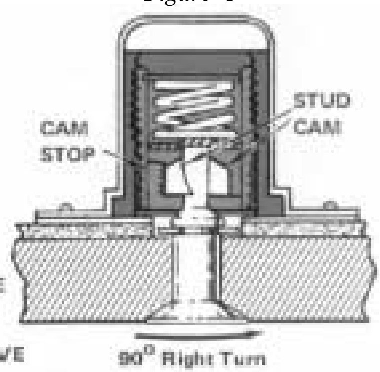
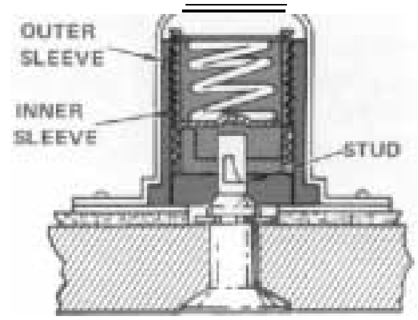


Figure 4



INNER SLEEVE
PROPERLY POSITIONED

Figure 5



INNER SLEEVE IMPROPERLY POSITIONED

This procedure has been fine except for a few practical problems. The first problem is that sometimes the radome must come off in a hurry. That, after all, is why we use a quick-release fastener. The second problem is that the downward pressure of the weight of the radome, and the spring-like reaction of its pressure seal, make it almost impossible to push the last several studs back into the inner sleeves far enough to back them out. This means that although the studs can usually be released, the sleeves are often not backed out.

We have now reached the most common problem area. If the inner sleeve has not been backed out far enough, it is almost impossible to push the stud in far enough to seat it when putting the radome back on (see Figure 5). The stud may not even go in far enough to back the inner sleeve out. However, if the stud is in far enough to back the sleeve out, but you continue to try to seat it by turning it to the *right* rather than backing it out by turning it to the left you can drive the inner sleeve farther back into the housing. This makes seating the stud even more difficult.

To avoid some of the difficulties that have just been described, we suggest the following method of loosening Panelocs.

1. Using a No. 3 Phillips-tip screwdriver, turn the stud one-quarter turn (90 degrees) to the left and let the stud fall free of the Paneloc receptacle.
2. Continue this process until you have unseated each stud on the radome; then remove the radome.
3. Turn the inner sleeve of each fastener two full revolutions to the ***left.***

CAUTION

Do **not use WD-40, Liquid Wrench, or equivalent to loosen or lubricate Paneloc receptacles.**

It has been reported that some operators have used WD-40 to help loosen tight Paneloc receptacles. This type of lubricant works well on many items, but not on Paneloc fasteners. It seems to work fine when first applied to the receptacles, but later it can cause the fastener to "lock up" and thus ruins the fastener. An explanation of what happens is as follows.

Penetrating-type oils such as WD40 or Liquid Wrench are petroleum-based products with some type of solvent as a major ingredient. It is the action of these solvents that allows the penetrating oils to reach tight places in order to loosen and dissolve rust, caked grease, and dried oil.

Some of the adjustable components in the Paneloc receptacles are coated with a special solid-film lubricant that consists of a molybdenum disulfide powder in a special resin binder. This coating provides a permanently lubricated surface between the adjustable parts of the Paneloc fastener.

When a penetrating-type oil is used to lubricate the receptacles, the solvents in the oil dissolve the resin binder that holds the solid-film lubricant. At this point, the adjustable parts in the receptacle move freely and easily. However, when the resin dissolves, two things happen: The clearance between the adjustable parts of the receptacle is increased (which makes the parts move more easily), but this increased clearance also decreases the holding power of the self-locking feature of the receptacle. While the penetrating oils are wet, the minimum torque requirements are not met for the self-locking feature of the receptacle.

When the dissolved resin dries, it again performs its initial task, which is to bind the molybdenum disulfide powder to the receptacle component. The problem is that the resin can not distinguish between the powder and the components; therefore it binds not only powder to the components, but also binds the components to the other components. After this binding occurs, it can be extremely difficult to move the adjustable parts of the fastener.

Tightening the Fasteners

1 Using a No. 3 Phillips-tip screwdriver, push the stud into the receptacle and turn it one-quarter turn to the right. Take the screwdriver off the stud. If the stud stays in the

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receptacle, you have seated it and you can go on to Step 2. If the stud comes back out, push it back in as far as it will go and turn it one full revolution to the *left.* Now push the stud back in and try turning it a quarter turn to the right. If the stud does not seat this time, continue this backing out process until it does. Be careful not to back it out too far so that the receptacle is damaged by the jackscrew effect described below. The stud should seat, however, long before that happens.

2. Once the stud is seated, turn it to the right to a torque of 50 inch-pounds.

CAUTION

Do not use power tools on Paneloc fasteners. The problem with power tools is that they turn too fast. Before you can get your finger off the trigger, the power tool has turned the stud 5 to 10 revolutions. If the stud is forced to rotate more than two turns, the inner sleeve will function as a jack screw and thereby ruin the receptacle by destroying the housing cover.

One question many operators ask is: How many Paneloc fasteners can be loose or missing before they need to be replaced? Lockheed engineers recommend the following guidelines to cover the maximum number of Panelocs that can be loose or missing from the Doppler radome:

Forward and Aft edge – A maximum of 2 non-adjacent studs may be loose or missing on each side of the centerline.

Each side – A maximum of 3 studs may be loose or missing, providing that 2 good adjacent studs are on each side of the loose or missing stud.

You should, of course, always follow the limits established by your organization and the applicable maintenance manuals for all radomes and panels secured by this type of fastener.

Many operators have complained that the Scovill Paneloc fasteners are too easily damaged and should be replaced by some other kind of fastener. Now that you understand how these fasteners work, you should be able to dramatically decrease the failure rate. They don't need to be replaced; just understood.

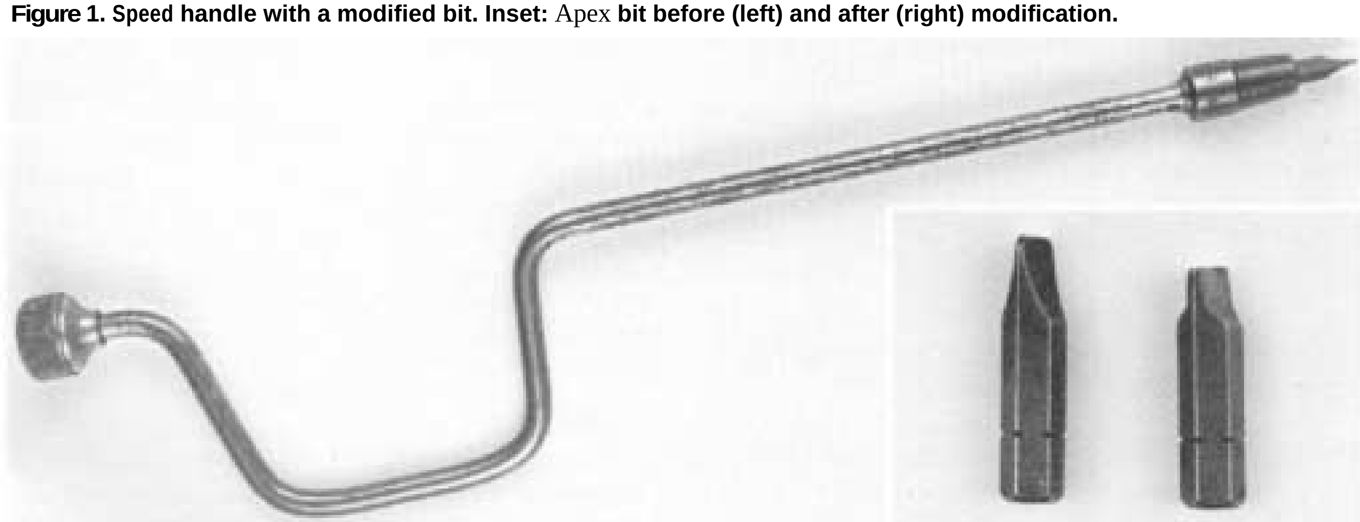
Tools for Panelocs

Locally made took helpful in adjusting inner sleeve

by Chuck Austin, *Service Analyst*
Joe Pamigoni, Service Analyst

Removing the Doppler radome or a heavy antenna window can be difficult when you are trying to hold the radome, unseat the Paneloc fastener studs, and count the number of revolutions needed to properly back out the inner sleeves all at the same time. It is no surprise to find that sometimes the fasteners are not backed out the correct distance during such operations. As we have seen in the previous article, this can cause real trouble when you get ready to put the radome back on.

Figure 1. Speed handle with a modified bit. Inset: Apex **bit before (left) and after (right) modification.**



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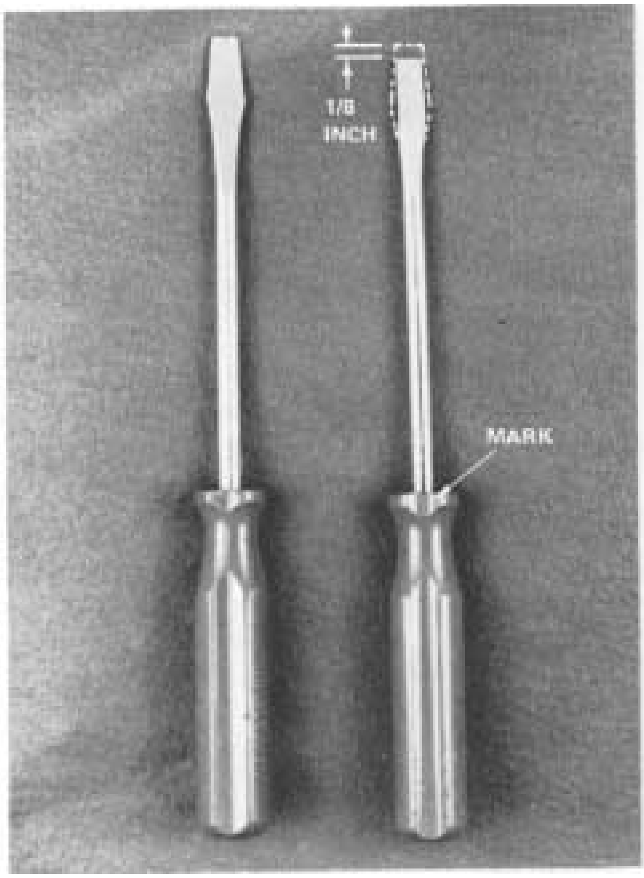
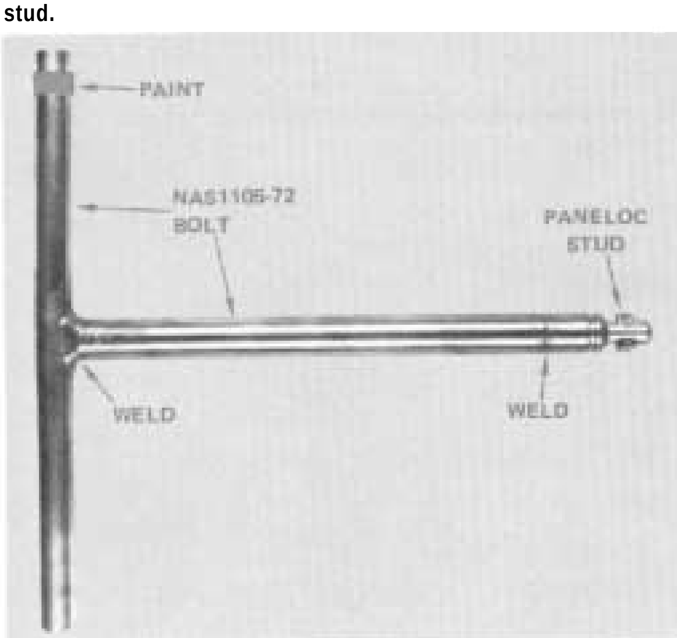


Figure 2. A No. 3 fiat-blade screwdriver (left) is modified as shown (right).

Figure 3. **This tool is made from 2 bolts and a Paneloc stud.**



If you have also had this experience, we suggest that you try one of the three tools shown here for backing out the inner sleeve of the fastener. Any one of these tools will be effective. It will be more or less a matter of personal preference as to which tool you decide to use. These tools will also make it easier to count the exact number of revolutions you need to perfectly position the inner sleeve for reseating the stud in the fastener. The importance of counting the revolutions is discussed in the article on Paneloc fasteners.

The first tool we want to mention makes use of a 3/8-inch drive speed handle with an Apex 835 adapter and a modified Apex 4854 bit. This tool makes the job go faster, and it is relatively easy to make. Grind l/8 inch off the end of the Apex 4854 bit and take enough off the sides to give the bit a good fit into the Paneloc fastener (see Figure 1). Now put the adapter on the speed handle, the bit in the adapter, and you are ready to go. This tool makes it simple to count the exact revolutions needed, and it also provides the proper amount of torque.

The second tool is made from a standard No. 3 slotted-head (commonly called flat-blade) screwdriver (Figure 2). To modify the screwdriver, simply grind **off 1/4** inch from the tip and remove enough from the sides so that the screwdriver will go through the housing cover and tit snugly into the fastener. Place a mark on the handle so you can count the revolutions. This tool is inexpensive and very easy to make.

The third tool is a bit more complicated and will require some welding and machining. But it does have some advantages. This tool, **shown** in Figure 3, is made from two NAS1105-72 bolts and a Paneloc stud from which the head has been removed. To make this, you will need to remove the thread and head from both bolts. Place the bolts so that they make a T shape and weld them together. Then weld the piece of Paneloc stud to the end of the bolt that forms the shaft of the T-handle. Paint the tip of one end of the handle red to simplify counting the revolutions (see Figure 3). This tool offers leverage that the screwdriver can not give. Also, the end of **the** stud will obviously fit the inner sleeve more precisely than with any of the other tools.

We think you will find that using any of these three tools will considerably simplify reseating the Paneloc fasteners which hold the radome. The Hercules operators who already use these tools say that they are a real saving in time and convenience.

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Torque Strut Bolt

New preferred spare now available –

The MLG torque strut bolt P/N 388613-l (Figure 1) on C-130E and later models has been plagued by cracks at the base of the tang. This tang fits into a vertical slot in the main gear piston, and anchors the bolt while the nut is being installed or removed.

A replacement bolt, which eliminates the cracking problem, P/N 3314892-1 (Figure 2), has been incorporated in production on LAC 4827 and up. The new bolt has a full circle head and a wall at the head end, broached to accept a 3/4-inch Allen wrench. The slide hammer type removal and installation tool can be used with both the old and new bolt.

An old P/N 388613-1 bolt with cracks at the base of the tang can be modified by removing the tang and cracks (Figure 3) as an interim solution until the new bolts can be acquired. With this modification, it will be necessary to hold the bolt by the locking bolt slots in the threaded end in order to install and remove the nut.

Figure I. Old torque strut bolt.

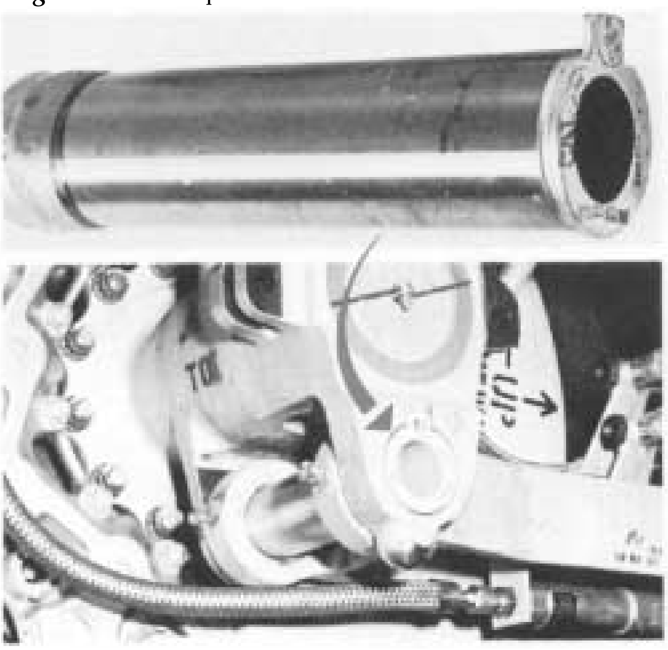


Figure 2. New torque strut bolt.

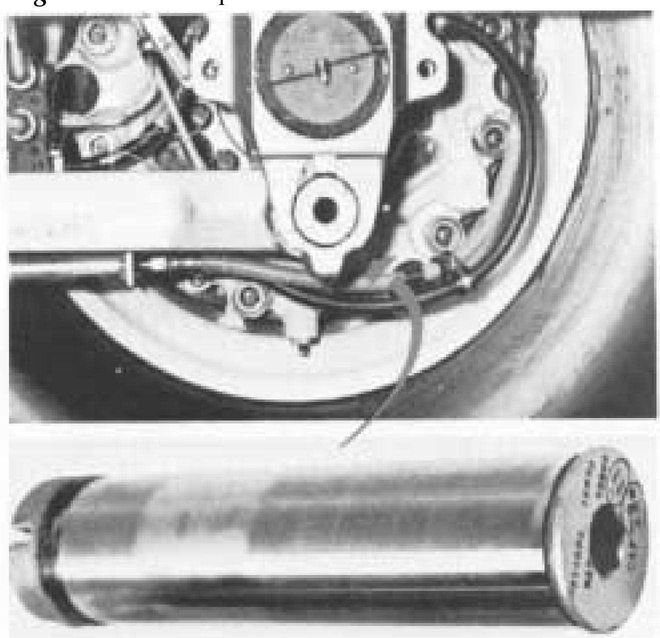
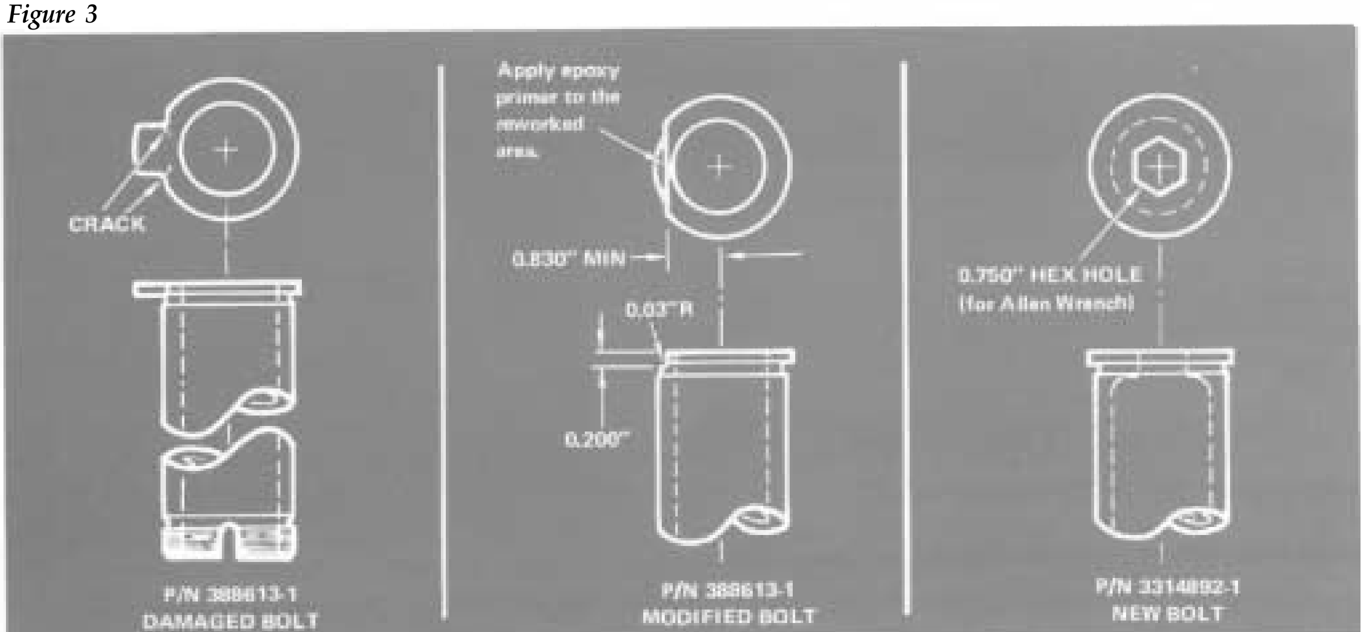


Figure 3



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A Fuel-Efficient Air’ lifter of the ’80s

Lockheed Hercules L-400

The new twin-engine Hercules aircraft, the L-400, will soon be replacing the aging and smaller cargo aircraft of many nations and airlines around the world.

This new cargo plane is ideal for short and medium routes, and handles loads which are impossible for aircraft such as the DC-3, DC-4, C-119, G-222, F-27, Noratlas or Buffalo. The cargo area will have the same perfect shape and size as the four-engine Hercules, which can carry fully assembled bulldozers and trucks.

The L-400 will carry 22,500 pounds for 500 nautical miles, or 15,000 pounds for 1,350 nautical miles. It will be certificated by the U.S. Federal Aviation Administration.

Several advantages of the L-400 that can save you money are:

- The twin-engine L-400 needs a crew of only two.
- You get the Hercules aircraft’s cargo compartment volume and ease of loading for only a fraction of the regular Hercules’ fuel cost when you use the L-400 for flights of less than 500 nautical miles.
- It has more than 90 percent parts commonality with the four-engine models of Hercules aircraft.
- A worldwide logistics system for Hercules series aircraft is already in operation.
- Plus, its thrifty turboprop engines use less fuel than the best fanjet engines, and that saves money year after year.

The L-400 twin-engine Hercules is the new cargo plane without the high cost of a new plane. And it will be rolling down the Lockheed-Georgia production line late in 1982.

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