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COVER: **The C** Mark I (Hercules) of the RAF.

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The name of the game is SERVICE

Service is the prime objective of our total product support program, and in keeping with this, we are reinstating the Service News magazine. Articles will contain maintenance tips, safety information, and servicing procedures pertaining to the Hercules and JetStar aircraft. Official technical information is regularly provided to our customers through other mediums. However, customer response to our previous service publications showed a definite need for informal articles that deal with specific problem areas. If this publication can help you save time, save money, or prevent injury to personnel or equipment, then it will have met its objective.

This is your magazine, so we welcome your suggestions, tips, or criticism. Please pass your comments to your service representative or send them to the attention of the editor.

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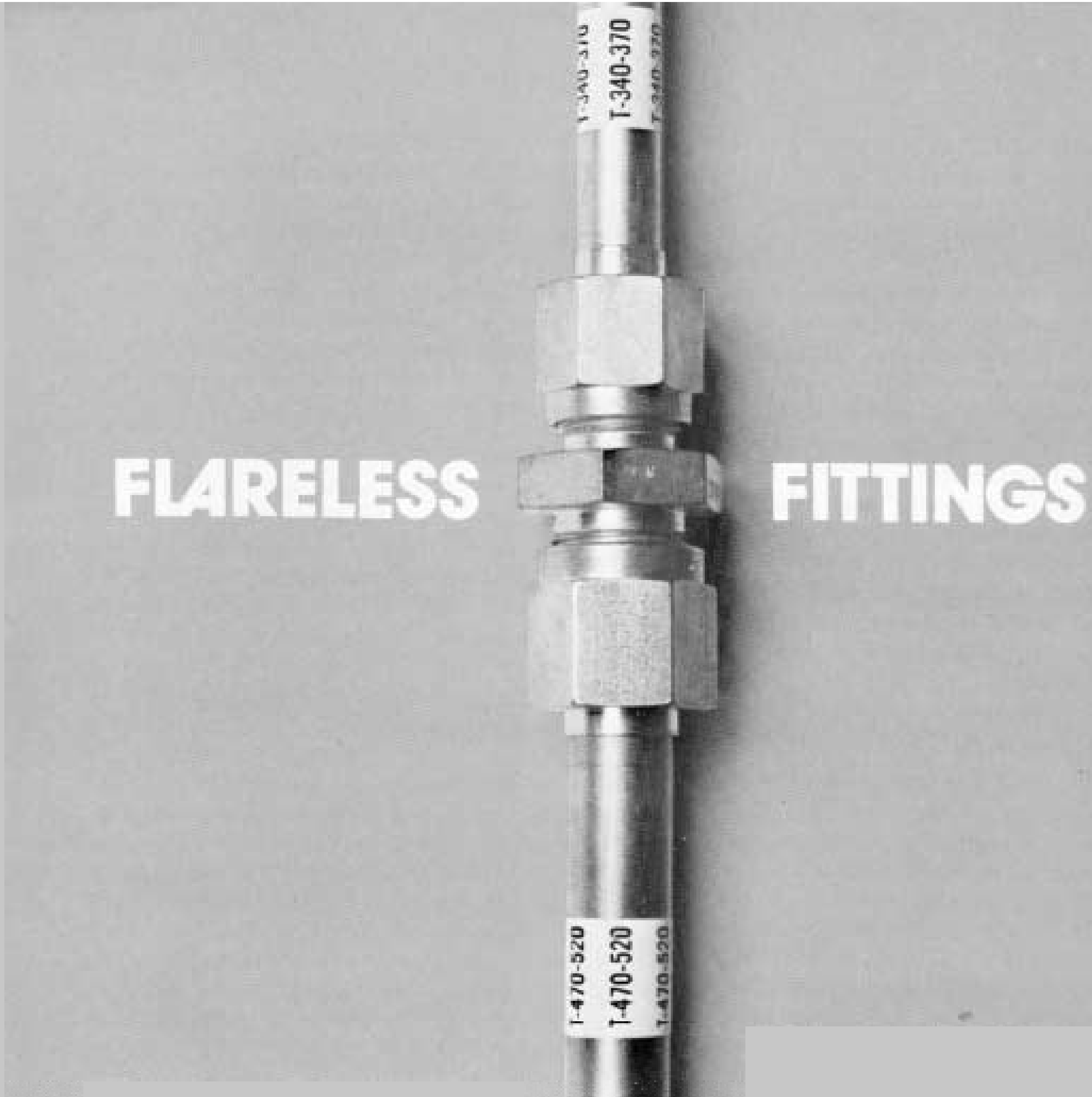
FLARELESS FITTINGS



Many of you have worked with flareless fittings for years and have developed flawless techniques for presetting, tight-, ening, and stopping leaks. To you there may be little in the way of new information on the subject in this article. We have, however, had a number of requests for information on individual problems. On the basis of these requests we have attempted to include enough material to interest those who are new to the techniques and those who want a refresher on some aspects of handling flareless fittings. There are several official sources of detailed instructions which should, of course, be consulted before performing any work, such as the applicable aircraft maintenance manual. The primary thing we have to say is, do not overtighten flareless fittings. To say it we have to go into some reasons and some ways of getting a satisfactory maintenance or rework job. Flareless fittings, sometimes called Ermeto or MS flareless, are not new to the aircraft industry, nor are thev new to the Hercules. or JetStar.

A STRONGER FITTING

The obvious difference, elimination of the flare on the tubing, is not at all obvious when the lines are installed. Flareless fittings provide a reliable means of gripping and sealing fluid lines. There are, however, considerable differences in assembly and maintenance between flareless and flared fittings. The initial coupling of flared fittings has always been a problem. It wasn't uncommon for a production line aircraft to have over one hundred leaks in its first pressure check of a plumbing system. Service experience has shown, especially for jet aircraft with their particular ranges of vibration, that a flared fitting frequently loosens and leaks. The flareless fitting is stronger, less prone to structural failure. It can be disconnected and reconnected many times without losing its sealing qualities, provided that proper procedures are followed; in addition, assembly to the tube is fairly simple.

DISCONNECT TIPS

A flareless fitting, however, may be more difficult to disconnect as it takes twice the distance to withdraw a tube from a flareless connector in comparison to removal distance for a flared fitting. This problem can be solved by putting at least one bend in the tubing to provide spring action. Where the tubing runs between thin wall areas and bends are not possible, connectors may be used to make removal easier. Sometimes, with the larger size tubes, both ends must be loosened in order to withdraw one end from the connector.

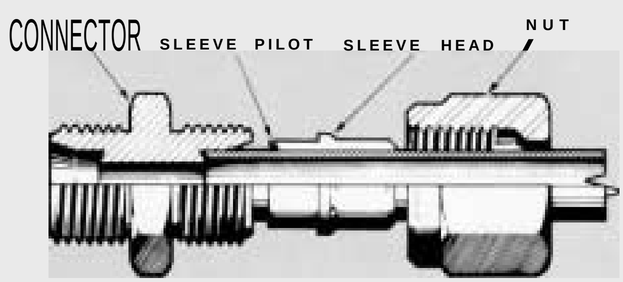
DO NOT OVERTIGHTEN

There is also a habit problem involved in installing and maintaining flareless fittings. After years of stopping leaks by tightening the nut, it's hard to adjust to the flareless fitting way, This must be learned, however, because *overtigh tening flareless fittings to correct leaks causes more leaks and results in permanent damage to the sleeve or tube.* With flareless fittings, the maximum torque group has to go.

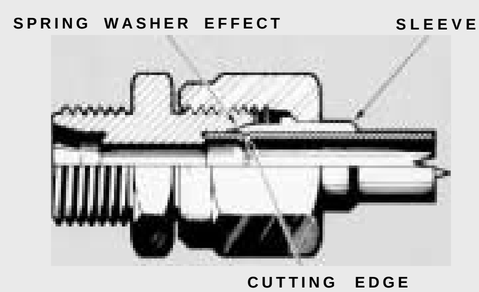
THE INSIDE STORY

We believe that an understanding of what goes on inside the fitting during presetting and tightening will eliminate most of the problems. First, the fitting sleeve serves as a seal, and the tube end serves only to seat the tube at the proper position for presetting. In the flareless installation the sleeve is preset to the tube by the application of sufficient force to cause the sleeve's cutting edge to bite into the tube wall. The depth of the bite and thus the force applied, is quite critical. Too little will result in leakage and too much will distort the tube or break the sleeve cutting edge.

Second, when the fitting is connected, the torque action in tightening the nut on the connector further tightens the sleeve to tube grip. Ideally, this additional torque and the spring action of the sleeve ensures a good seal and helps keep the nut from loosening when subjected to vibration. But if the torquing is overdone, the sleeve or tube will be damaged.



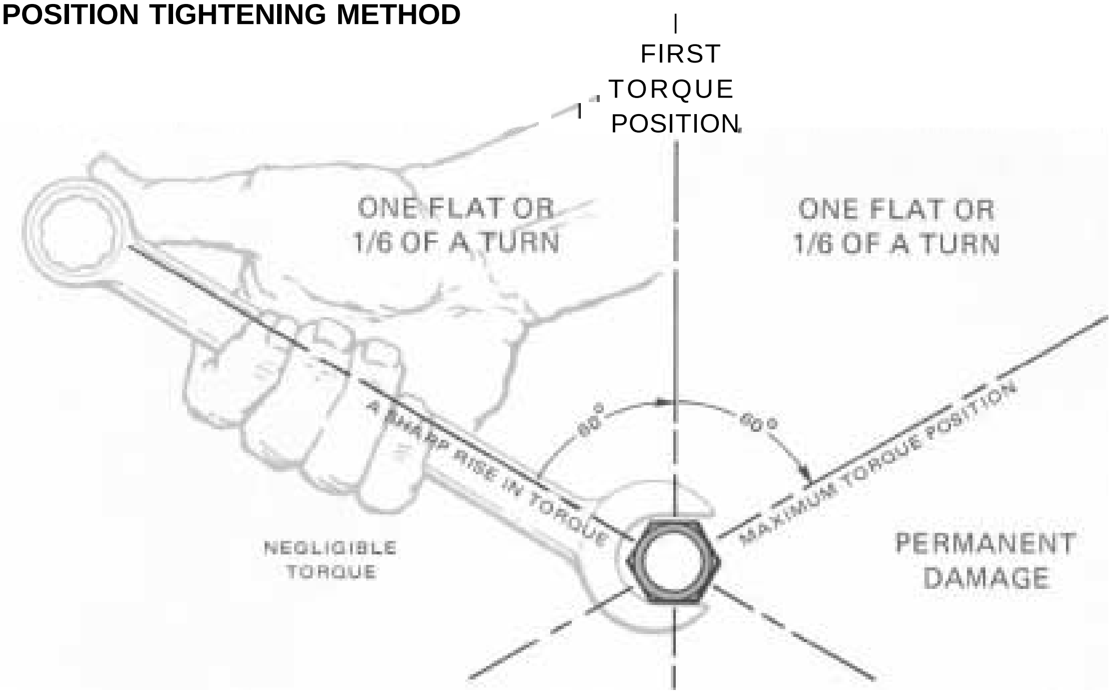
COMPONENTS



FINAL CONNECTION

COMPONENTS AND ASSEMBLY OF FLARELESS FITTING

POSITION TIGHTENING METHOD



SEVERAL PRESET METHODS

There are several variations in the method for presetting a sleeve. They involve everything from automatic presetting tools, through hand presetting adapter and torque wrench, down to the most simple field method involving use of a connector and a couple of wrenches. We'll describe only one.

HERE'S ONE METHOD

Cut the tubing end square, deburr, and clean. Do not chamfer any more than necessary to remove burrs. Insert the tube into a nut and then a sleeve, with the sleeve pilot and cutting edge toward the end of the tube. (A mandrel or smooth drill rod, slightly smaller than the ID of the tube, is desirable to support the tube wall during preset operation.) Use a presetting tool or a flareless fitting connector (preferably steel) as an aid in drawing torque required to set the sleeve. Insert the tube against the seat of the connector or presetting tool; then tighten the nut finger tight, jiggling the works around a bit as necessary to take the slack out of the connection. The reverse angle seat is designed to prevent the tube wall from collapsing during presetting, but the mandrel helps.

Next, put the connector or presetting tool in a vise or hold it with a wrench and tighten the nut slightly (until you can't turn the tube in the sleeve with light pressure of thumb and finger.) This is just enough to bring the sleeve cutting edge up to the point before it starts to bite into the tube. Then turn the nut exactly the number of turns indicated in the following table. This will make the sleeve grip and bite into the tube

PRESETTING TABLE WITH MANDRELS

TUBE SIZE (OD)	NO. OF TURNS REQUIRED TO PRESET SLEEVE
1/8	1 1/6
3/16	1 1/6
1/4	1
5/16	1
3/8	5/6
1/2	5/6
5/8 AND UP	4/6

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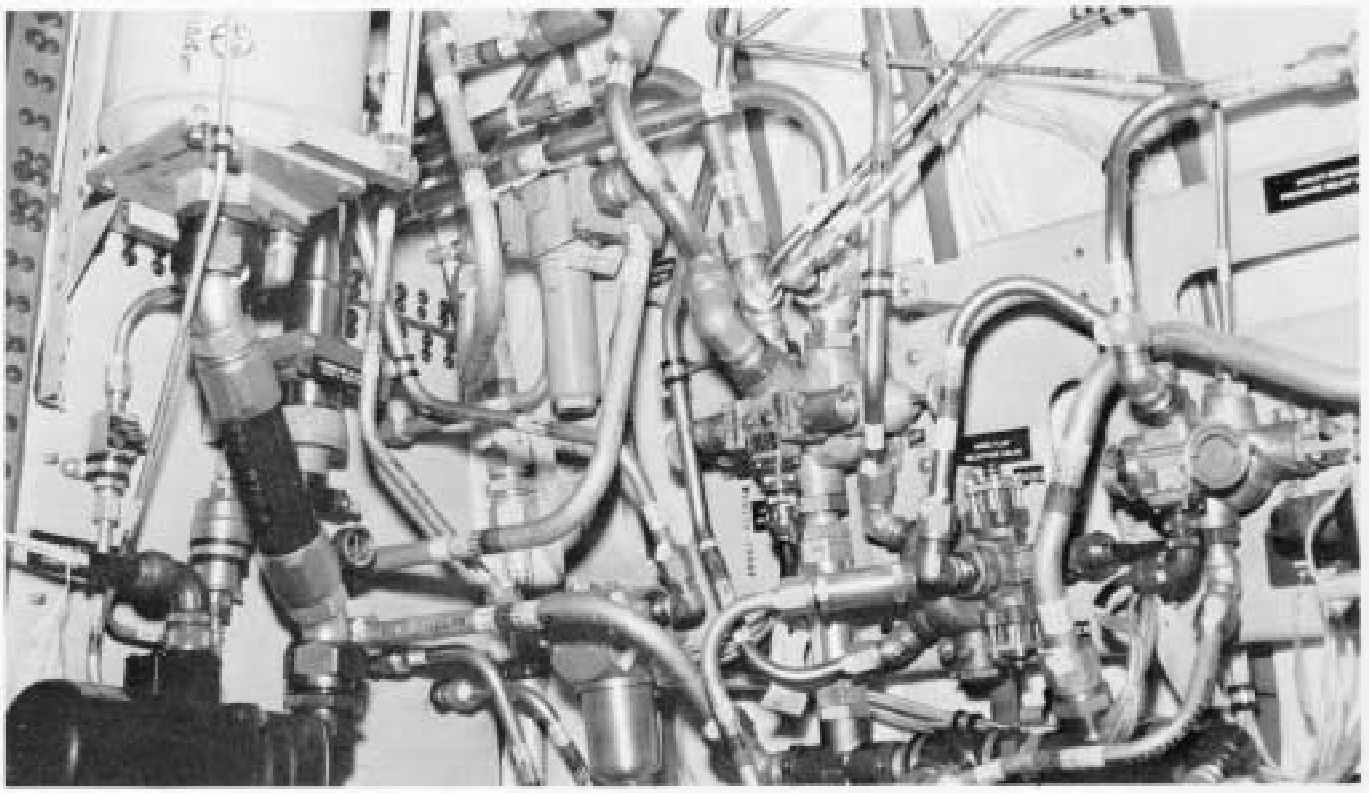

Some flareless fittings on a C-130 installation are pictured above. Although their general appearance is similar to AN nuts on flared tubing, installation and tightening are entirely different. The torque putty, when unbroken, indicates that the nut has not turned since installation. The flexible hose fittings require their own tightening treatment, as pointed out in the text.

the required amount. Now, back off the nut and, after cleaning, this end is ready for installation in a system. (All tube assemblies should be proof pressure tested before installing in a system.)

One more thing. The connection you used for presetting, providing you had no presetting tool, should not be installed on an airplane. It has undergone considerably more stress than it would ever undergo on the airplane, and it may be damaged. If you used a steel connector, you can use it three or four more times as a presetting tool – but no more than that. If you used an aluminum connector, throw it away. (Use aluminum connector in emergency only.)

THE HOOKUP

To reconnect a tube assembly with a previously set sleeve, go through the following steps:

Insert the tube ends into the connectors. This should require no force, and the center lines of the tube and connector should line up. The tube should be free in its fittings.

Run the nut down on the connector until it bottoms. This has been variously described as finger tight or until an initial rise in torque is felt, both of which can be confusing. Try running it down finger tight if in doing so you can make the nut bottom. If you cannot make it bottom with your fingers, check for trash or misalignment. As a last resort, use a wrench cautiously. Then feel for the *initial rise in torque.* What you are looking for is the first indication that the nut has started to tighten, not the resistance to bottoming that may exist.

After this *initial rise in torque,* tighten the nut an additional 1/6 turn (one flat of the hex nut).

That's it. The coupling should be tight and leakfree. If it should leak, an additional 1/6 turn *and no more* is permitted on the nut.

During presetting, the force applied by the nut to the sleeve is applied through mating conical surfaces which cause the sleeve to grip the tube, thus reducing operational stresses transmitted to

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the sealing surfaces of the sleeve. Also, the sleeve bows outward when the nut is tightened and it acts as a spring washer to keep the connection tight. If the nut is tightened excessively the tube and sleeve are permanently deformed, sealing is lost, and the spring action of the sleeve is destroyed.

STOPPING LEAKS

Now suppose we have a situation on a previously satisfactory installation that is now leaking. The minimum and maximum torque are printed on a decal wrapped around the tube. Never, however, retighten a flareless fitting without loosening it first. This is to assure that the sleeve's spring action is retained. If torque wrenches are available, a slight loosening and subsequent retorquing within the range shown on the decal may do the trick. If no torque wrench is available, loosen and use the torque-rise-plus-one-flat method previously discussed. Still leaks? Then disconnect and examine the fittings for a damaged sleeve or tube. One point often overlooked is the connector. Many times the leak will be caused by a rough or worn elbow, union or the like. Or, trash in the mating surfaces can cause leaks.

System oil is usually used for lubricating as necessary during presetting operations. For example, use red petroleum base (MIL -H- 5606) hydraulic fluid to lubricate hydraulic system

TURNS TO PRESET WITHOUT MANDRELS

1/8 HARD STAINLESS STEEL TUBING

TUBE WALL THICKNESS AND NUMBER OF TURNS

TUBE O.D.	.018	,020	.022	.025	.028	.035	.042	.049	.058	.065	.072	.083	.095	.109	.120	.134
1/8	1 1/6	1 1/6	1 1/6	1	1	1	1	1	1							
3/16	1 1/6	1 1/6	1 1/6	1	1	1	1	1	1	1	1	1				
1/4		1 1/6	1 1/6	1 1/6	1	1	1	1	1	1	1	1	1	1		
5/16			1 1/6	1 1/6	1 1/6	1	1	1	1	1	1	1	1	1	1	1
3/8				1 1/6	1 1/6	1	1	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6
1/2					1 1/6	1 1/6	1	1	5/6	5/6	5/6	5/6	5/6	5/6	5/6	5/6
5/8						1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
3/4						1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
1							1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3	2/3	2/3
1 1/4							1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3	2/3	2/3
1 1/2								1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3	2/3
2									1 1/6	1 1/6	1	2/3	2/3	2/3	2/3	2/3

6061 ALUMINUM AND ANNEALED STAINLESS STEEL TUBING

TUBE WALL THICKNESS AND NUMBER OF TURNS

TUBE O.D.	.022	.025	.028	.035	.042	.049	.058	.065	.072	.083	.095	.109	.120	.134
1/8	1 1/6	1 1/6	1	1	1	1	1							
3/16	1 1/6	1 1/6	1 1/6	1	1	1	1	1	1	1				
1/4			1 1/6	1 1/6	1	1	1	1	1	1	1	1		
5/16			1 1/6	1 1/6	1	1	1	1	1	1	1	1	1	1
3/8			1 1/6	1 1/6	1 1/6	1	1	5/6	5/6	5/6	5/6	5/6	5/6	5/6
1/2				1 1/6	1 1/6	1	1	5/6	5/6	5/6	5/6	5/6	5/6	5/6
5/8				1 1/6	1 1/6	1 1/6	1	1	5/6	5/6	5/6	5/6	2/3	2/3
3/4				1 1/6	1 1/6	1 1/6	1	1	5/6	5/6	5/6	2/3	2/3	2/3
1					1 1/6	1 1/6	1 1/6	1	1	5/6	5/6	2/3	2/3	2/3
1 1/4						1 1/6	1 1/6	1	1	5/6	5/6	2/3	2/3	2/3
1 1/2						1 1/6	1 1/6	1 1/6	1	1	5/6	5/6	2/3	2/3
2							1 1/6	1 1/6	1	1	5/6	5/6	2/3	2/3

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fittings. And, of course, you should always drain pressure and fluid from the area of the tube before attempting any of the leak stopping measures.

CAUTION

Some aircraft use flareless fittings for the oxygen system. Do not use oil on these – refer to the appropriate aircraft maintenance handbooks for more detailed information.

CONNECTING FLARELESS TO AN

There comes a place in almost every system where the flareless fitting will connect, through an adapter, to an AN fitting. This usually occurs at the junction of a rigid tube and a flexible hose. It is obvious, if you stop to think about it, that the flareless fitting and the AN fitting on the other side of the adapter will be torqued differently.

We have a bit of help in this situation. The fitting manufacturers incorporate V-shaped grooves or nicks in the hex edges of fittings that adapt from AN flared tube to flareless tube. These nicks, whether on plain or bulkhead adapters, are fair warning to the mechanic that there is a flareless fitting on one end of the adapter and an AN fitting on the other. Where bulkhead adapters are involved the nicks, of course, will be visible on only one side of the bulkhead. So a close examination of all bulkhead fittings may be in order before tightening.

The AN side will require the amount of torque called out for the particular hose fitting involved. And the flareless side will require the same tightening as discussed under previous subtitles in this article, with the same caution: DO NOT OVERTORQUE THE FLARELESS FITTING.

StarTips

HERCULES Engine Tachometer

Apparent "power surging" with rpm and torque fluctuations, and an out-of-sync prop beat can be the result of a worn tachometer generator drive shaft, nylon sleeve, or the drive within the gearbox.

In explanation of how this wear can appear to be "power surging" or "intermittent rpm fluctuation," this system supplies voltage to the rpm indicators on the instrument panel and "speed derivative sense" to the propeller synchrophaser. This "speed derivative sense" is sensitive only to changes in the voltage output of the tach generator; however, it reacts to both magnitude and rate of the change. Therefore, any slippage, chatter, etc., of the tach-generator drive shaft affects its output voltage which is interpreted by the synchrophaser as an engine rpm change. This causes the synchrophaser to signal the propeller to change blade angle to "return to 100 percent rpm" resulting in rpm and torque fluctuations and an out-of-sync prop beat, which is usually interpreted as "power surging."

Either the inside or outside (or both) of the nylon sleeve on the drive shaft may be worn. Detection of wear in the engine gearbox drive

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requires an inspection mirror and light. If this drive is worn, the pad identified as Item 40, Figure 28, Chapter 72-1, in Allison s IPB 4RC4 (501-D22 & 501-D22A) or Item 37, Figure 55, in USAF T.O. 2J-T56-44 (IPB T56-A-15) may be used as an alternate. Attachment of the electrical connector to the generator prior to installation may be necessary due to the lack of clearance.

A peculiarity of this wear is that it usually manifests itself intermittently. A vibration level change from a power, attitude, altitude or other change may "trigger" the tach generator drive to chatter or skip. Also, once it starts, a change in vibration level such as selecting "mechanical governing" can return the condition to normal. This is the reason this problem usually does not "ground repeat" and changing a propeller is not necessarily corrective action.

JetStar Nose Steering

Occasionally we receive reports from JetStar operators that the aircraft pulls to one side or the other during taxi. Several things can be suspect. However, some can be checked quickly and should be examined before any parts replacement effort is made.

The nose wheel tires on the aircraft should be matched/paired per manufacturer, tread pattern, tire pressure, and amount of wear. Any mis-match of the above features can cause the "pull" condition and can be corrected easily by tire/wheel replacement or tire pressure adjustment. And then there was the case during ground operations of the aircraft pulling to the right. After extensive troubleshooting. It was found that the right hand main strut was low.

OXYGEN SAFETY

A **general article, applicable to any aircraft equipped with an oxygen system.**

If there is one inflexible rule concerning oxygen systems, it goes like this: OXYGEN SHOULD BE HANDLED BY QUALIFIED PERSONNEL ONLY.

Aircraft and spacecraft oxygen systems are installed for personnel safety and welfare (primarily to prevent hypoxia). Like some of our other protectors, however, oxygen can bite back, damaging the human and the machine. Neglect and improper use of oxygen equipment show up in the accident records as fires, explosions, and hypoxia incidents. These results can and must be prevented by proper training and continuous attention to details.

In military combat airplanes, the oxygen system is regularly in use. In both civilian and military transport airplanes, however, the passenger oxygen distribution system is rarely used, and the system either entirely or in part may be unpressurized or inactive for long periods. When it is required, though, it is needed immediately – which in some cases is a matter of seconds. Too late then to discover that the oxygen system pressure is insufficient, that the equipment will not work, or even that the crew does not know where the equipment is located (particularly true in large transport aircraft). Routine checks should be made before each flight; and particular attention paid to scheduled inspections and checks made in accordance with the applicable aircraft inspection and maintenance manuals. Flight crews and maintenance personnel should also check the aircraft manufacturer's and component manufacturer's service bulletins and reports such as the Operators Maintenance Report (OMR) A34, which was issued in September 1973 for the JetStar, covering this same subject in de tail.

With this as background, let's get into the subject of more immediate concern: the safe handling and maintenance of oxygen systems. Oxygen safety begins with equipment design and must continue through manufacture, installation, servicing, inspection, maintenance, and use.

We'll talk about some other systems later, but for now let's look at a most dangerous area of the oxygen picture – Procurement and Handling.

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Procurement and Handling

There are a number of military and federal specifications for aviator's breathing oxygen. We recommend procurement to Federal Specification MIL-0-27210, which is more demanding than most. Oxygen procured to this specification has a minimum oxygen content, disregarding moisture content, of 99.5 percent by volume and does not contain more than 0.02 milligrams of water vapor per liter of gas at 68 F and 760 millimeters of mercury. It is odorless and free from all poisonous substances and adulterants, including drying agents. Two basic types of oxygen are used in aerospace systems: Type I is gaseous oxygen and Type II is liquid.

You'll see a lot of do *nots* concerning oxygen, and here is a big one: DO NOT use "welding" or "hospital" oxygen in an aerospace breathing system. These grades usually contain enough water to freeze and plug the valves and lines of an aircraft system.

This and many of the other things to watch out for are included in the training and experience that make a qualified oxygen handler. Assuming the handler is qualified, he is also human and, therefore, subject to human frailties. Some of the simple safety precautions are violated again and again; to keep oxygen safe we have to repeat and repeat the simple rules.

KEEP OXYGEN AWAY FROM FIRES – Remove all power from electrical or electronic equipment when the oxygen system is open or leaking. While oxygen does not burn, it supports combustion. With any combustible material in the area, a spark may be all that's needed to cause a fire or explosion. When servicing the oxygen system of an airplane, make sure the airplane and the oxygen servicing equipment are properly grounded.

KEEP OIL AND GREASE AWAY FROM OXYGEN – This goes for dirt and dust too. Install dust caps, plugs, and covers on the equipment when you are not using it. A drop of oil in the wrong place can cause an explosion; dirt and dust can, too, or they can plug the system. This seems simple enough, but people have been known to use an oil type lubricant on oxygen fittings. This means, also, that tools used by oxygen handlers should be stored separately and used for this purpose only. They must be maintained free from hydrocarbon contaminants at all times. Even the body, clothing, and protective equipment of an oxygen handler must be absolutely free of grease and oils. (Hair preparations – oils, sprays, waxes, etc. – contain combustible products.)

HANDLE CYLINDERS AND VALVES CAREFULLY – A cylinder with a broken valve can become a rocket or torpedo. Open and close valves slowly by hand only; if the valve cannot be closed by hand, return the cylinder for repair or replacement. Be sure the cylinder is firmly supported before you open or close a valve, and always open or close a valve slowly.

SERVICE WHEN THE AIRPLANE IS OUTSIDE THE HANGAR – Preferably the airplane should be isolated from other aircraft, especially if the other aircraft are being serviced or maintained. Safety regulations during servicing of the oxygen system should be even more rigid than those applied to fueling the airplane. Smoking or open flames must be prohibited within 50 feet of the airplane. Also, fire extinguishers should be situated close at hand while the airplane is being serviced. No power should be on the airplane and no maintenance should be performed while the oxygen system is being serviced. No personnel other than those engaged in servicing should be on or near the airplane.

NEVER FILL A LOW PRESSURE SYSTEM WITHOUT USING A PRESSURE LIMITING REGULATOR – Airplanes have been destroyed by having high pressure oxygen dumped into a low pressure system.

NEVER MIX OXYGEN WITH OTHER GASES – Never use oxygen in systems intended for other gases. Never charge the oxygen system with anything but oxygen. To quote from the Technical Manual of Maintenance Instructions, Oxygen Equipment, USAF T.O. 15X-1-1 (NAVAER 03-50-l), "At Columbus, Ohio, a cylinder of hydrogen was used in recharging the oxygen system of an aircraft. This caused an explosion which killed four men and demolished the aircraft. The cylinder was plainly marked HYDROGEN. This incident demonstrates the need for adequate instruction of ground personnel in the handling of oxygen."

In addition to the general precautions to be taken in handling oxygen, there are special precautions which must be observed with liquid oxygen.

Liquid oxygen is cold. At -297 F, any concentration will cause a quick freeze (burn) on flesh. The handler should wear protective clothing, with no pockets, keeping sleeves and trouser legs rolled down. Face shield and heavy gloves are also needed. When working with a partner, each should know what the other is doing at all times.

The clothing can become contaminated with oxygen vapors; be sure these vapors are dissipated before smoking or moving near a fire or sparks. And, as mentioned earlier, clothing contaminated with oil or grease can ignite spontaneously in the presence of oxygen vapors.

AVOID OXYGEN SYSTEM CONTAMINATION – There is yet another facet of oxygen system safety which cannot be disregarded. This is contamination by maintenance personnel other than oxygen handlers.

In this connection we have heard recently of an incident in which an oxygen system became contaminated with toluene. As a result, a crew member suffered numerous physiological impairments. Investigation of the incident disclosed that the contamination had come from careless use of toluene to degrease prior to painting, and to correct paint overspray in the vicinity of an oxygen system hose.

Hazards inherent in incidents such as the above point out the need to exercise extreme caution in the use of foreign agents in the vicinity of oxygen system components, and in cases such as the above, to remove, mask, or otherwise protect such components during painting and cleaning operations. If, inadvertently, paint overspray or solvents should contaminate an oxygen hose, it is recommended that no attempt be made to clean it since all solvents are toxic to some degree. The safe thing to do is to remove and replace.

Oxygen Systems

Each aircraft or aerospace vehicle has its own peculiar oxygen system. There are, however, several general types which are identified in various ways.

Gaseous oxygen systems are usually classified as low pressure or high pressure. Low pressure systems operate in the range of 400 to 425 psi. High pressure systems operate at approximately 1800 psi. Another type system, the liquid oxygen (LOX) system, normally operates at 70 or 300 psi.

The basic components of an oxygen system are storage containers, plumbing, regulators, indicators, and masks and hoses. In addition to the installed system, most airplanes have portable and emergency equipment which can be carried by personnel.

The storage containers for a gaseous system usually comprise a variety of cylinders of shape and size to meet the space and usage requirements and of strength to withstand the design pressure.

As to plumbing; systems are generally similar, but some differences are usually referred to as types. For instance, fittings for low pressure gaseous systems are usually designed to attach to double flared tubing ends. In contrast, a high pressure gaseous system may have fittings to attach to cone nipples on all lines between the filler valve and the pressure reducing valve (high pressure lines). Other fittings such as the "flareless" are also used on oxygen systems.

Servicing

When you open an oxygen system to replace any part, you must plug or cap all openings immediately to prevent entrance of foreign matter. Use proper plugs and caps, preferably plastic. Makeshift plugs are dangerous and although this is well known, you still hear of people using masking tape and such instead of the proper plugs and caps.

A system that has had all the oxygen supply drained during flight should be charged within two hours after landing. This requirement and the one following are covered in USAF

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T.O. 15X-1-1 (NAVAER Manual 03-50-l). If the system is accidentally left open, if a major component is replaced, or if the system is depleted in flight and not recharged within two hours after landing, it must be purged. An empty system can develop condensation.

An alarming sequence of events, which miraculously did not develop into an accident, was reported by one of the military services. A check valve failed to operate when the filler hose was disconnected after filling a liquid oxygen converter. Some of the liquid oxygen went into the airframe and settled there, fortunately without creating a fire. A mechanic called the fire department then went into the airplane and opened all the hatches to dissipate the oxygen. A spark of static electricity could have initiated a fire or explosion, but by good luck it did not. Then it was decided to move the plane away from others on the line. How lucky can you get? The tractor and towbar didn't cause a fire, though by all rights they should have. Moving the other planes away from this one would have been the best procedure.

Less spectacular, but just as dangerous, is failure to keep clean and to keep equipment clean. Wear clean protective clothing. So it was clean Monday or last week. Today it may be greasy or dirty and tomorrow may be too late. Fire or explosion doesn't happen every time, but once is too many.

As to charging equipment, you can keep it clean as a pin – properly plugged and covered. If, however, the trailers or cylinders are left outside unprotected during rain and temperature changes, you must purge low cylinders and lines before using them to recharge the airplane oxygen system. If you don't, condensed moisture may get into the system and freeze at high altitude . . . furthermore, if someone should carelessly leave the equipment unplugged and uncovered; you will surely have a wet system.

Servicing finished, and all safety precautions observed, take time to be sure there are no leaks in the system. Make periodic checks, watching for general conditions, rubbing, chafing, cleanliness, and to see that the system operates properly.

It all goes back to the original statement: OXYGEN SHOULD BE HANDLED BY QUALIFIED PERSONNEL ONLY. With the added thought that even the qualified person needs to train, retrain, and continually remind himself that safety precautions are to be observed . . . that oxygen is at the time a friend and a potential enemy.

NO REASON TO HAVE A BLAST IN THE

HERCULES FUEL TANK VENT SYSTEM

by Ted Faber,

Aerospace Safety Engineer, Senior

REFUELING THE HERCULES is normally done through the airplane's single point refueling system from a truck or fuel pit. After the necessary grounding precautions have been carried out, you insert the fueling nozzle into the SPR receptacle, select the tanks to be fueled, and control the flow either manually or automatically. Manually, you turn the tank selector switch to the closed position when the desired fuel quantity is in the tank; of course the float-operated shutoff valves will automatically stop the flow of fuel when the tank is filled to capacity.

All too often this routine procedure, accomplished daily around the world, is suddenly interrupted by a low rumble, or sometimes a loud explosion. And a surprised servicing crew finds fuel leaking from one of the tanks. Further checking usually reveals an unusual bulge in the wing (Figure 1). On one occasion, evidence of fuel tank rupture and resulting structural damage was discovered after the C-130 had completed the first leg of a mission (the fuel tank, itself, is wing structure on the Hercules).

Several mishaps have occurred where the fuel tanks ruptured enough to suddenly dump hundreds of gallons of fuel on the ramp, creating a serious fire hazard. Ruptures have even happened in internally installed fuselage tanks.

FIGURE 1

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What- causes most fuel tank blowouts? Nothing more nor less than obstructions in the tank air vent lines. When the vent system is blocked for any reason, the pressure inside a tank will build up as fuel quantity is increased until tank design strength is exceeded and failure occurs. Conversely, negative pressure created in a tank with a blocked air vent system has resulted in collapse of the tank in the course of airplane defueling from the SPR.

In a recent accident a small plastic bag became trapped in a vent line and ultimately caused tank rupture which resulted in wing replacement. The bag apparently had been left in the No. 3 tank "wrap-around" vent line during fuel cell repair. When the fuel tank was serviced, air pressure moved the bag down the line until it was stopped by the overboard outlet flame arrestor screen (Figure 2). As fuel quantity increased, pressure inside the tank rose until the tank ruptured (Figure 3).

Other accidents of this type have been caused by failure of people to remove external plugs, plates or tape from overboard vent outlets. Tape, applied over the outlets before cleaning or painting the airplane, is the main offender followed closely by plugs inadvertently left installed after maintenance pressure tests. Servicing instructions are quite clear for the inspection of vents before refueling or defueling. Failure to heed these simple rules can be an expensive affair.

Lockheed recommends the following precautions whenever Hercules wing tank work has been done: After the vent system is re-installed, remove the overboard vent line flame arrestor screen and introduce air into the system through the individual tank overhead filler point. When free flow is confirmed, replace the screen. Later, before refueling the airplane, check the vent system again with the screen removed to be sure the vent line is still open. Replace the flame arrestor screen and secure it.

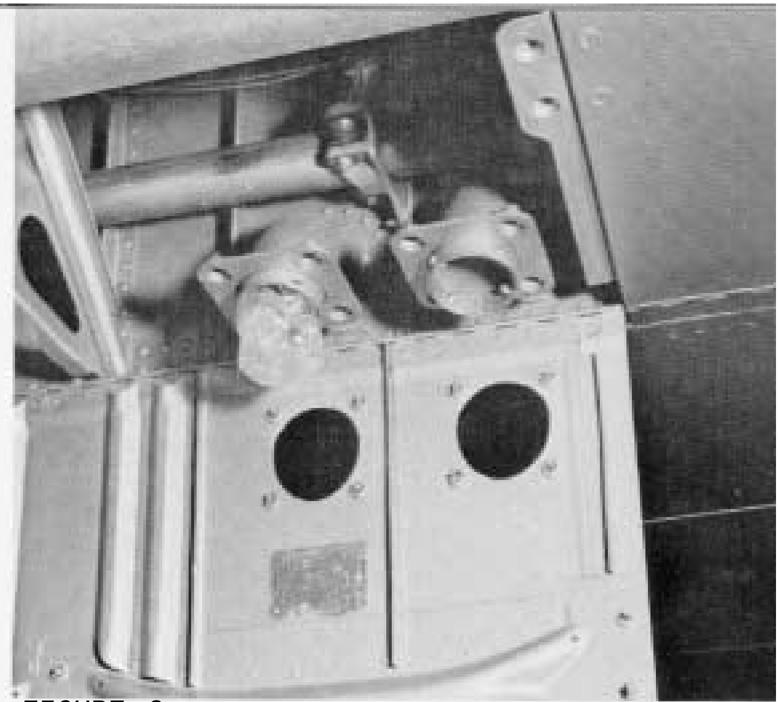
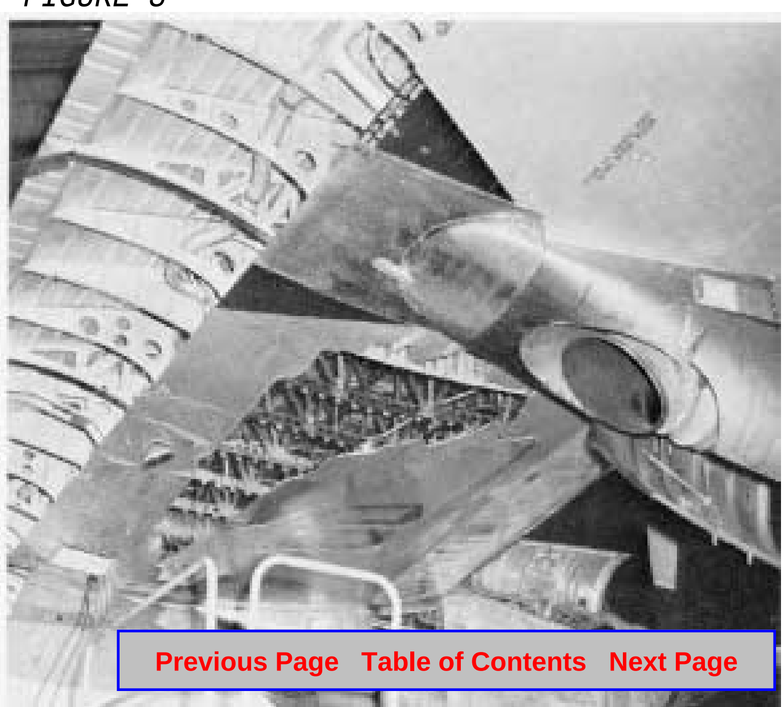


FIGURE 2

Remember to remove plugs and keep foreign objects out of fuel tanks and you've gone a long way toward preventing a blast in the tank vent system. In all cases, follow the procedures outlined in your servicing manuals. Some of these costly errors could have been prevented by using the pre-check primary and secondary on the fuel panel, and by having the ground observer watch the flow from the vents..

FIGURE 3



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