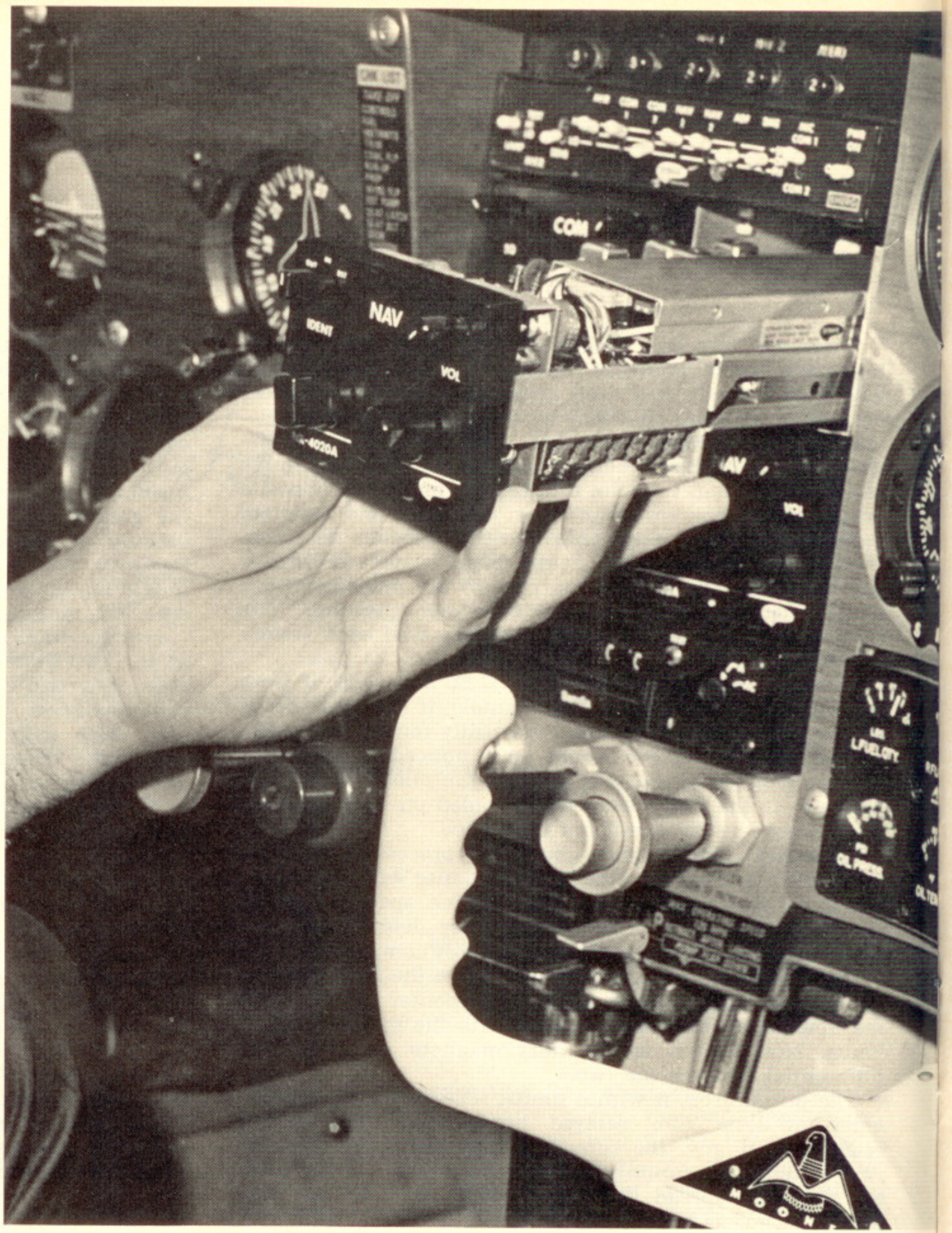
Minimize Your Avionics Maintenance Bills



How you can help your expensive electronic equipment last longer

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■■ A question pilots often ask is, "How can I reduce my avionics repair bills?" It's a fair question since avionics maintenance costs can easily exceed the original equipment purchase price after a few years.

Some pilots suffer more breakdown of their electronics equipment than others. Simply stated, there must be operational differences between people which encourage the equipment to fail. By examining and understanding some of the types of failures you can reduce your maintenance bills and extend the useful life of your avionics.

There are four areas over which the pilot has some control. These are: 1) mechanical stress, 2) temperature extremes, 3) voltage extremes, and 4) contamination by foreign material.

The electronics manufacturer built his equipment to be as trouble-free and long-lasting as possible. Radios have been isolated in cool, air-conditioned chambers, connected to bench power supplies and, when untouched by human hands, have demonstrated operational times of months without failure.

Somewhere between this haven and the overheated, high-vibration environment of an airplane, something happens which causes the device to fail and to appear in the radio shop for maintenance.

The mechanical gremlins range from operator abuse, such as rapid channeling which accentuates wear of the switch contacts, to vibration due to poor location or worn-out shock mounts. Another significant abuse is the improper removal and re-installation of the radio in the aircraft panel by poorly trained technicians. Pilots frequently cause problems by attempting the removal themselves.

The new types of "button front" radios have made removal and re-installation easier, but, as they grow smaller and smaller, they become increasingly intolerant of any mishandling. For this reason, routine bench checks of equipment should be discouraged if no trouble is suspected. Unnecessary removal causes connector wear, loosens mounting flanges, chips paint, flexes cables, and can contribute to intermittent equipment operation.

If you wish to remove equipment from the panel, take time to have your radio technician explain the proper procedure. Some radios screw out of the panel and others simply unlatch. Using the wrong procedure can break latches and switches located behind the faceplate. This mechanical abuse is on the increase, along with the improper use of spline and allen wrenches. Never touch a set screw or other locking device without the certain knowledge that you're using the right tool. Most radios now use the spline-type set screw, and a set of the appropriate tools is good insurance against finding a loose knob in flight.

It's possible that in the future, as one avionics manufacturer has put it, the limiting point in the design of new radios will be our ability to miniaturize the on/off switch. Take heed from this warning and remember that solid-state radios have been forced to use smaller and less substantial on/off switches, volume controls, squelch controls, and toggle switches, so that any abrupt or improper manipulation can lead to damage and the need for replacement.

The radio master switch, an unusual item in most aircraft 20 years ago, has become a necessity in modern aircraft to reduce the wear and tear of on/off switches and other panel hardware. While not difficult to replace, panel switches and controls account for much unnecessary maintenance. When coupled with a shop's minimum time, these items can escalate repair bills by 10% to 20% a year and cause embarrassing failures when you least expect them.

You can prolong the life of squelch controls and volume controls by not leaving them set at exactly the same spot all the time. A minor readjustment can help spread the wear equally across the tiny carbon tracks inside.

Some locations in aircraft have been selected for electronics mounting even though they are high-vibration environments. If your avionics shop suspects vibration damage to any equipment, have it relocated without delay.

Let's look at item number two, perhaps the greatest villain of them all—temperature extremes. Ask any avionics manufacturer what he views as the greatest deterrent to successful avionics operation and, without a doubt, temperature extremes will quickly arise. There was a day in avionics history when tube-type radios predominated and it was expected that radios would operate at temperatures exceeding 130° to 140°. Not so the modern, solid-state radio.

The use of plastic components and glue joints has kept prices down, but these parts do not tolerate high temperatures. Faceplates warp, frequency wheels crack, trim strips disappear, and if heated long enough your new radio could be as wrinkled as Grandma Putt.

Remember that in a cold chamber radios have been known to operate for many months when undisturbed. But in the presence of extremely high temperatures avionics have a tendency to fail, sometimes at great cost.

There are several operator techniques available to keep these temperature extremes to a minimum. Avoid parking aircraft in the sun, which can cause extremely high cabin temperatures. If you frequently park outdoors, buy a reflective sunscreen. Before flight, give your avionics a chance to cool by opening cabin doors and windows for a sufficient time to stabilize the inside temperature. If the temperature remains high, bypass the master radio switch and use only one radio during taxi and turn on the other equipment when airborne. In the air, the cooling vents provide greatly increased airflow.

When your destination is in sight, why not turn off excess equipment and let it cool before landing if high ground temperatures are expected? Cooling airflow is going to cease after landing, and stack temperatures can rise rapidly to an excessive level.

Take heart. Every high temperature operation will not cause a failure, but the likelihood is definitely increased. Manufacturers have been quick to attack temperature failures, and one line of new equipment (Narco Centerline) boasts a temperature range of +5°F to +160°F (−15°C to +71°C).

Another villain, which is occasionally more destructive than temperature extremes, immediately comes to mind. This is the "voltage villain," which few pilots understand, but radio men have come to know and respect.

Aircraft voltages come in two basic varieties, 13.75 volts and the higher voltage of most twins and the new singles, 27.5 volts (commonly referred to as 14 and 28 volts). These are the only voltages your radio ever expected to see when the designer turned it off the drawing board. However, several things are at work to confuse, frustrate, and otherwise violate the input requirements of your avionics system. The greatest villain of all, aircraft engine start, will try to spike your radio with a sudden rush of high voltage when the starter is disengaged. For this reason radios should never be on during engine start.

Probably the only time your aircraft electrical system produced *exactly* 13.75 or 27.5 volts was when the manufacturer delivered it to the dealer. Alternators and generators age and require routine maintenance, as do battery systems. Ask your maintenance facility to adjust your system voltage at cruise rpm, using a voltmeter.

Every electronic box has a tolerance range, generally around 10%, but if any unit is operating near an upper or lower limit, there is a possibility of damaging the equipment. The pilot must be aware that additional loads on an electrical circuit, such as switching on pitot heat or landing lights, creates a sudden voltage drain. This momentary, but abrupt dip in voltage results in an increase in current. On the other hand, when those same items are turned off, there is likely to be a momentary surge of voltage resulting in a decrease in current.

Semiconductors, including transistors, integrated circuits, and diodes are especially sensitive to these voltage and current changes. Proper adjustment of the electrical system will lessen repair bills, so accept nothing more or less than that specified in the maintenance manual.

Another consideration is in order during cold weather. Starting an aircraft engine by battery power alone when the temperature is very low extracts a tremendous amount of power from the battery. It is unlikely that the battery can maintain rated voltage immediately after a cold-weather engine start, and, here again an unwary pilot can set up a situation so that the solid-state devices in his avionics equipment can destroy themselves and blow fuses. After cold-weather starts, the engine should be allowed to run until some charge can be placed in the battery. Generator-equipped airplanes are frequently unable to charge the battery unless an rpm setting above 1,200 to 1,500 rpm is maintained.

Alternators are better because they can maintain the rated output at lower rpm settings, but frequently the electrical load in the airplane will require full alternator output and leave very little to charge the battery. If you absolutely must use your avionics equipment after a cold-weather engine start, bypass the radio master switch and use only the necessary equipment; try to turn on one radio, as required, and leave the other equipment off until some charge has been restored. Then, item by item, bring your avionics equipment back on line to minimize the tremendous electrical system drain that can occur when taxiing in cold weather, at low rpm settings. Ignorance of this technique has led to many failures.

Remember, any large electrical motor—flaps, gear, electric hydraulic pump—on board your airplane is likely to produce a low-voltage or high-voltage situation. Chances of damage are minimized if the system voltage is properly adjusted.

A good example of voltage extremes came to light in a local shop when a Sabreliner customer experienced a rash of blown fuses in his sophisticated, remote-mounted avionics. No source of trouble could be found. Voltage checks were normal and the operation of the equipment seemed to be in order; it was only after investigating the start-up/taxi procedure that the culprit was revealed.

It is routine operating technique in many jets to start one engine, turn on the avionics gear, taxi to the takeoff point, and then crank up the other engine. The fuse-blowing was eliminated when the avionics equipment was turned off before the second engine was started. It had completely slipped the pilot's mind that starting the second engine qualified as a source of electrical voltage spikes (just as starting the number one engine had) but, because the checklist was out of order, the warning was forgotten.

The last culprit is contamination by foreign materials. Here we ordinarily mean water contamination, but don't forget that hydraulic fluid and oil can also be present in the aircraft cockpit or in avionics areas.

The most common source of water contamination is a leaking windshield. Watch for and have investigated any unusual appearance of water, oil, or aircraft fluids inside the cockpit. Know where any remote avionics are located and routinely inspect them for the presence of contaminates.

Estimates are that 5% of the yearly avionics bills can be directly attributed to contamination by water. Aircraft are designed to operate in harsh environments to earn their keep. However, flying in heavy rain or clouds or being parked on a ramp during a thunderstorm with air vents open can lead to contamination of your expensive electronics devices by mother nature.

Take advantage of the safeguards available to you and see that your tied-down airplane is tightly closed against water. Close your fresh air vents, lock windows and doors securely and, if possible, seal all leaky windshields and doors with sealing compound immediately after discovering leaks. Waiting can only lead to the possibility of water or high humidity contamination.

Another source of water, of course, is the radio cooling vent which has come to be a part of modern aircraft. It's necessary to make sure that, in the process of directing cool air into your radio stack, the cool air vents have been installed properly so that they allow no moisture to enter the system.

If your radio stack or any remote avionics should become wet, or if your carpet shows signs of water, don't use the radios until they have been thoroughly dried. Open aircraft doors and windows to air out the cockpit. Any avionics shop can dry them with a heat gun and, if necessary, use a mild cleaner. Damp radios usually emerge unscathed if no power is applied before drying.

Oil and hydraulic fluid require a solvent to remove them. A mild electronics cleaner usually strips it away without damaging components. Be sure your shop cleans the aircraft connecting plugs also, using a solvent and short-bristle brush.

Don't ignore your microphones. If you have followed the microphone development of the past two years, it's hard to know where to begin shopping. When buying a mike, consult your avionics specialist and attempt to establish a performance rating based on his experience. Some microphones work better than others with your brand of radios, and the technician can discuss your particular needs.

Always ask that your mike and radio be bench-adjusted for correct modulation. If you buy two mikes, one can always be stowed in your flight case for comparison purposes or use in an emergency. Besides, mikes get old and need replacement periodically. A spare will allow you the luxury of waiting for a good buy when it's time to replace one.

Since you ordinarily can't carry an extra speaker, a good, lightweight set of headphones can be a lifesaver in the event of speaker failure.

Routine replacement of speakers every three to five years is a good precaution against the insidious onset of degraded reception. Get a properly matched speaker with a heavy magnet, since most cockpit speakers have to work hard for a living.

If you take care of your avionics, they'll take care of you—and your wallet. □