Cockpit Chatterboxes

Built in or portable, intercoms offer the best solution for cabin communications

by Gary Picou

Good, clear and efficient cock pit communications are vital to safe flying. In addition to the safety factor, a comfortable environment for the ear enhances the flight experience and protects your hearing. Headsets and a good intercom are important accessories in any airplane. Still, not every intercom works as well as it should and for a variety of reasons. Sometimes the unit isn't up to the task but often enough, it's shoddy installation that deprives you of all the benefits of your newly purchased intercom. In this article, we'll address the different types of portable and panel mounted intercoms and we'll cover some of the installation practices while offering things to look for when the system doesn't perform up to par.

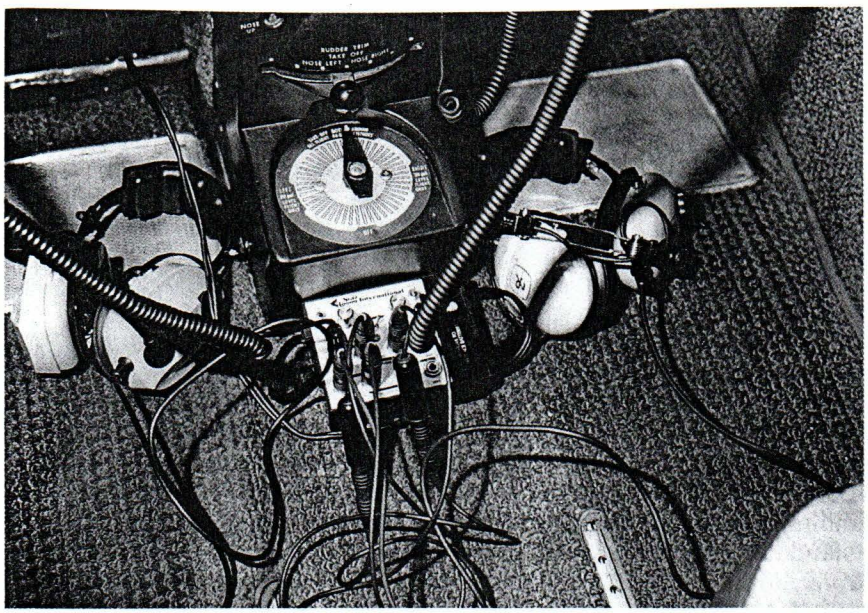
The intercom system consists of a unit that connects two or more headset/microphone stations together. It will be equipped with an amplifier capable of boosting mic signals to headphone levels. Most systems on the market today are VOX, or voice activated systems. They will have a squelch circuit that chops out the background noise between conversations. The squelch control is designed to adjust the threshold for different ambient noise levels, voice levels, and microphone types. Because we only have one set of ears, the intercom must accommodate radio traffic, too. It must, at the proper time, direct incoming radio audio to the headset. It must also connect the microphone of the designated talker to the radio for transmissions. As important as intercom conversations are, they can't compare to the air traffic control transmissions. So, your intercom always needs to pass these signals on as a priority. Whether portable or built-in, intercoms must have a failsafe feature which will pass comm audio if they are malfunctioning or if the power is removed. Most intercoms have an auxiliary or entertainment input. This can be a portable tape player or perhaps some other installed music source. When the intercom is in use or if there is radio traffic, the entertainment source will be overidden. Some systems mute it completely while others reduce the volume to half or less, automatically. When selecting or installing the system, you need to understand the functions and options available. Some systems, like the David Clark DC 200 allow the user to control how quiet the music becomes. Others, like the Flightcom 403mc, can be strapped during installation to mute the radio or intercom signals, as desired.

Carry-On or Fixed

Intercom systems fall into three catagories: Those basic systems found in comm or audio panels, a portable type that can be carried from airplane to airplane and a full-featured panel mounted intercom system installed as a separate unit. Many avionics components have a built in rudimentary intercom system and are a natural feature for a comm radio or audio panel. With few exceptions this intercom is too simple to be much good. They are not voice activated systems and as such, require additional switches to be used on each station. Audio panels often require the user to switch out of comm mode manually. This means you must remember to switch the mic back to Comm 1 or Comm 2 in order to talk with ATC. The resulting confusion almost invariably means you transmit to the wrong ears occassionally. "ATC idiots!, Make ME do a 360 for an ultralight will ya!" Yet, as with all technological aberrations, this is slowly changing. Bendix/King has had a VOX audio panel for years, the KMA 24H. Unfortunately the space required for the intercom meant that the marker beacon receiver got tossed overboard. Today, Terra makes a VOX intercom with a marker receiver, and PS Engineering's new PMA 6000M audio panel incorporates a full-featured intercom, complete with stereo entertainment inputs. Look for this intercom integration to proceed into the next generation of avionics, like the AlliedSignal stuff in the new Cessna 172's.

A portable intercom system has many advantages. It can be moved from aircraft to aircraft which can be ideal for renters. They are less expensive, don't incur installation labor costs and many are expandable. As you move from a Musketeer to a Bonanza, you can add expansion modules to accommodate the additional seats. Since there're not permanent, failure of the unit simply means unplugging the thing and continuing the flight. There are disadvantages too. Wires strung all over the cabin like miles of ticker tape with headset jacks plugged into various floor and panel mounted recepticles. It's easy to confuse the mess and a very real possibility exists of finding yourself cross-connected and unable to talk to anyone but yourself. While some systems might have a power connection to the cigar lighter plug, others will be powered by batteries. It should noted that batteries are engineered by the manufacturer to quit at the least op-

The Filghtcom 403mc will mute radio and intercom signals during priority transmissions.



Portable intercoms are convenient, but they are plumbed with a tangle of wire.

portune moment. (We can't prove it scientifically, but experience shows that it must be that way.)

Since the portable units have wires strewn thither and yon, there is an excellent chance that airframe noise will get into the system causing whines and buzzes. Just the sort of fatiguing noise you sought to eliminate with the intercom. Any portable system is just a good compromise in performance versus versatility. For reliable intercommunications, nothing beats a panel mount. The panel mounted system has the big advantage of a more consistent power supply (as long as the ship's electrical system is working). The system is permanently interfaced to the radios, hopefully correctly, using quality aircraft components and techniques. There are no wires to pull out or break, nothing to connect before each flight and the intercom is always there, waiting to be used. Back seat passengers aren't climbing in over wires and their headset stations are available and easy to understand. Even for the novice aviator. With a good quality unit, the controls are set for your preferences and can be ignored in a routine flight. Naturally, panel mounted intercoms cost more than their portable counterparts. The price differential isn't much on the units themselves but the installation labor can more than push the total system cost. Consider the steps involved in the installation of a sirnple four place system. First, you should nearly gut the airplane by removing seats, interior panels, instrument panel overlays, etc. You can work around them if you wish but it often takes more time that way. Since the intercom will be interfaced to the audio system, the panel jacks and avionics stack need to be exposed so they can be worked on. The panel unit needs to be installed which involves cutting holes in the panel. The copilot jacks may need to be installed and the rear jacks have to be mounted in the back. Like anything, you get what you pay for. A typical four place intercom can be installed in four hours and it'll look like it. Jacks screwed into plastic trim pieces and wires strung loosely throughout the cabin. Poor grounding and slap-dash power connections will make the system noisy and unreliable. Even at a mere four hours (at $50 per hour), the installation cost can easily exceed the unit price. A more reasonable installation time might be eight hours. Naturally, if the intercom installation is concurrent with other installations or routine maintenance, the cost drops. Annual time is a good intercom time.

Selection and Output power

How many people will use the intercom and what positions shall have access to the radios? It is not as easy a question as it may seem. Sometimes, you can be content with a"listen only" station or two. The determining factor in intercom selection is not headphones, but the number of microphones. Microphones depend on voltage, called bias, to operate correctly. This mic bias doesn't like to be subdivided. Therefore, each mic input to the intercom is usually on a separate pin, while many headphones are paralleled together. At installation you will have to decide if the copilot can talk on the radios and who will have priority. Usually the pilot side will override the copilot but depending on wiring and the unit itself, it may have a first-come first serve priority. This is useful in primary instruction aircraft.

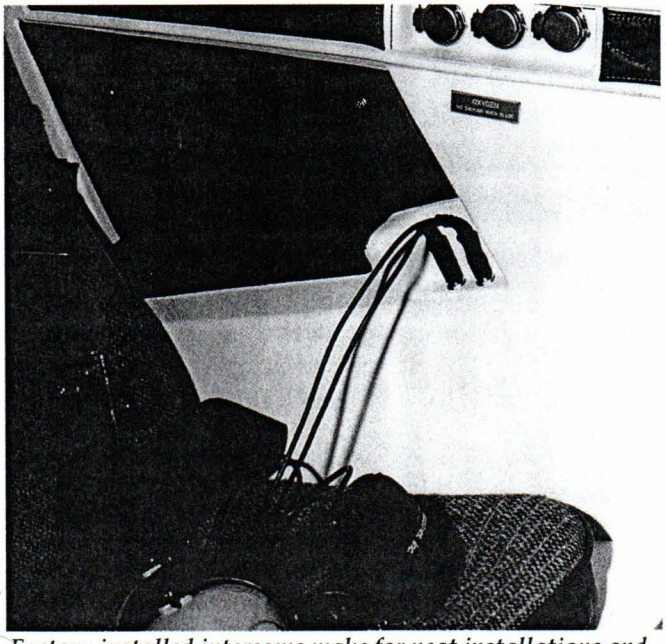
When shopping for an intercom, there are a few other specifications to look at besides nurnber of places supported. In addition, there are some that don't matter. The most important of all specs is output power. This can be expressed as total output or as output per station but the important point is that more is better. More audio power will efficiently overcome aircraft noise, reduce distortion and drive more headsets. In low power systems, the volume drops as more headsets are plugged in. Beware of a company that doesn't list an audio output specification. In tests conducted for other publications, total power ranged from a low of 50 milliwatts for the Sigtronics SPA-400, to over 400 mW for a Northern Airborne Technology AA80.Some systems make claims of low distortion. Come on, it is an airplane for heaven's sake. Even if you drag along your portable CD player and listen to Beethoven's Sixth Symphony with some of the customized headsets now available, the difference between 5% and 1% distortion won't be noticeable. A low distortion figure is meaningful as an indicator of quality only if coupled with other features like power and individual mic circuits. In the better intercom systems like David Clark, Northern Airborne Technology, PS Engineering, QuietFlite and Telex, only the microphone that is spoken into is active. In other systems, like Flightcom or Sigtronics, when one person speaks, all the microphones are "hot ". That means all of the noise in the back seat gets passed through the system. This can be intolerable in noisy airplanes and when the kids in the back seat get restless. Getting a good intercom is only a small part of the battle. A

low-end intercom will work fine in a good installation, but even the most expensive system will be a bad investment it not properly installed.

Grounds, Shielding and Noise

Should you use shielded wire? Always and without question. Noise is the biggest problem in any audio system and the intercom is extremely susceptible to the slightest leak. Electrically, there is little difference between alternator noise and the spoken word, so it can't be easily filtered out on the output. The best course of action is to keep it out completely so a filtering device isn't needed. A common place for noise to affect the intercom is the power input. An AC noise signal rides along on the DC power and essentially modulates the power supply. The aircraft electrical system shouldn't be too full of noise if the alternator and regulator are working properly. A quality intercom will filter out "normal" power noise but sometimes an alternator filter is required. To prevent airframe noise from further contaminating the power leads, avoid bundling them (or any intercom wires) with high current wiring like alternator cables, heater or blower wires and rear motor leads. Also, avoid bundling them with or near the transponder, DME or ADF antenna coaxes. Why ADF? Because many direction finder systems use a chopper signal in the loop circuit which makes a cool buzzing noise. Something you don't want in your headset.

The purpose of shielded wire is to control noise. If you want to keep noise in the circuit, ground the shield at both ends. This is commonly done to alternator field wires. To keep noise out of the wiring, ground the shield at only one end-preferably the source of the signal. This way noise roaming around will fall into the shield and travel to ground where you want it to, without being induced into a signal wire. If the signal wire shield is grounded at both ends, it sets up a ground loop. This can actually create noise by acting as a tiny antenna. One common problem is noise created by a difference in ground potential between parts of a system. The low side of the microphone jack isn't necessarily the same electrical ground as the intercom unit itself. To the intercom's amplifier circuits, it all looks like somebody talking. In an intercom installation, we like to see a "single-point ground." This refers to the fact that all grounds, whether power low or shield termination, return to the same electrical point. We can live with grounds that float electrically, so long as everybody floats together. The single most common noise inducing mistake in intercom installation is grounding the headphone and mic jacks. This often happens unintentionally when the well-meaning installer secures the jacks with metal washers. The proper jack should be isolated from the structure with fiber or plastic washers, available from any aviation supplier, and usually are included with a jack kit. Since the ground side is the outside of the jack, when it touches the metal, a ground loop is created which picks up noise all along its path.



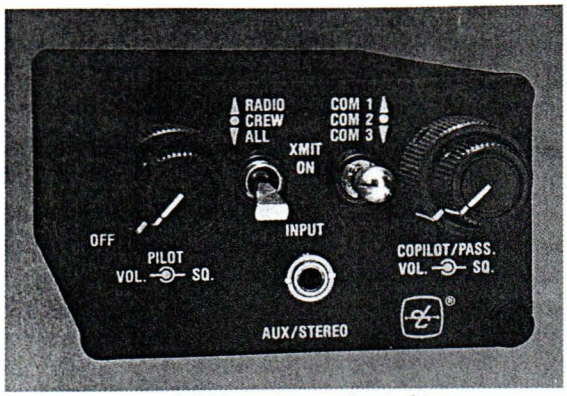
Factory installed intercoms make for neat installations and simple operation, even for the novice passenger.

Besides proper grounding techniques, there are some microphone rules of thumb too. Because microphones are biased, never hang more than one on the same line at a time. That goes for communication radios, intercoms, PA systems or anytime a microphone is used. Never leave a headset unattended. For instance, if you have a four place system, unplug the rear headsets when there isn't a head in thern. It's always a good idea since any headset can pickup and transmit noise. It's absolutely mandatory when you have an intercom that activates all mics during a transmit because any unattended set will create a nasty feedback.

Mics, Jacks and Troubleshooting

Microphone and headphone jacks require occasional maintenance. They can become loose when subjected to repeated poking and pulling and poor connections caused by dirt and debris are common complaints. While a properly constructed jack won't care if it falls completely off the panel (mainly because it doesn't depend on it for a ground), loose jacks can create noise as they make and break contact with the metal panel. They can get twisted around and can short out against static lines, control cables, and any of a thousand potential grounds behind the panel. Contacts can get mashed, bent and squeezed, usually by somebody working in the area and shorting out the whole audio system can be accomplished with one careless move. It's easy to check your jacks for security (they shouldn't move) and if tightening is required, hold the jack carefully as you tighten the attaching nut with a suitable pair of pliers.

What do you do when the intercom starts to misbehave? Perhaps you can see the copilot's lips move, but you can't hear anything? That's a good clue that something isn't working (It doesn't count if it is your instructor saying his Rosary, like mine). The most likely place for audio problems remains in the headset. Generally used and abused, headset plugs are yanked out by the roots from across the cockpit and wires are twisted and wound to impossible angles. If the intercom doesn't work, first, try another headset. It's always good to carry a spare. The next step would be to turn off the



DC-Com model 500 voice-activated intercom.

intercom system. It doesn't matter what the problem is, almost any intercom you'll find has a fail-safe mode. As soon as the switch is in the off position, radio phones and speaker signals are passed straight through to the pilot position headset. If that's okay, you can decide what to do about the intercom at a later date. If you still can't hear anything, and you have switched headsets, it's time to dig out the hand-held. It's unlikely that your intercom is at fault, either, except for one important fact. Many intercoms are in series with the radio audio. Audio goes in one pin, and back out another. If the intercom is unplugged or a wire breaks, the whole system is down, including the comm radio and other headset audio signals. Can you say NORDO?

Troubleshooting noise in the intercom audio is tough. Describing it to your avionics technician is even tougher. With the crackling and popping of an insecure intercom system it becomes difficult to identify a hiss from a buzz and a snap from a sizzle. But listen you must, because it will tell you much about the source of the problem. In case you haven't already been indoctrinated into the electrical sounds of an airplane, here goes. Alernators whine. It is a high frequency whistle that changes pitch as the engine RPM changes. It may become more pronounced as the regulator kicks in or as the paralleling relay activates in the case of a twin. Chances are, unless you have the intercom wires tied to the amp meter cable, this noise is coming in through the power input. It'll have to be corrected at the source, through alternator maintenance or filtered out there. If you notice a popping noise that sounds like spark plugs firing and the noise accelerates with the engine speed, one or more ignition leads are inducing an electrical push into the audio wires. This is usually caused by a bad mag harness or one that is improperly grounded. It is a frequent complaint following new engine or harness installation. It's also a frequent complaint after an intercom is installed, particularly when an active noise canceling headset is used. Why? Before the intercom, all you listened to were the radios, which never set any great standards for fidelity. Now, you're listening to your companions without any radio interface and you KNOW what they're supposed to sound like. In addition, you now have many feet of wire acting as a noise-receiving antenna. With ANC headsets, all of the wind and mechanical noise is gone, leaving only the electrical noise to deal with. The solution is to ensure that the installation of all aircraft components is electrically correct as well as mechanically proper. If it doesn't whine or pop but hisses and crackles instead, it's probably airframe charging. Not the AOPA Gold Mastercard kind but a static build-up that isn't effectively handled by the static wicks. Fixing this problem will require a careful and extensive evaluation of the static discharge system, including wicks, bonding straps and overall airframe grounding.

On the surface, an intercom might seem to be a simple system. There are no antennas, not mystical cable lengths or arcane formulas. Still, the difference between a good and bad intercom can be defined by two factors. Product quality and installation quality. In both cases, price is a fairly good indicator of the kind of performance you can expect. Yet, while competition can lower the cost of even the best of units, you can't short-cut the installation and still expect the system to provide you with the clear, clean communication you wanted from the intercom.

Intercom Suppliers

David Clark Company Inc.
360 Franklin Street
P.O. Box 15054
Worcester, MA 01615-0054
508-753-5827

Flightcom Corporation
7340 S.W. Durham Road
Portland, OR 97224
503-684-8229

P.S. Engineering, Inc.
9800 Martel Road
Lenoir City, TN 37772
423-988-9800

Sigtronics Corporation
822 N. Dodsworth Ave.
Covina, CA 91724
818-915-1993

The David CLark 200 will isolate the driving mic while muting remaining sets.