coax dehumidifier

Here's a drier
for hard-line coax
that uses no motors,
no pumps,
no electricity,
no gas, and
practically no money

William L. Smith, K4RJ, Franklin, North Carolina 28734

It looks like RG-8/U coax is on the way out, and not a day too soon. Repeater operators, meteor chasers, aurora gazers, moonbouncers, microwave nuts, and even dc-band DXers are making more use of low-loss lines which use metal-tube outer conductors in place of that old braid.

There are two kinds of hard-lines in general use. In one type the cable is filled with foamed insulating material, which excludes air and moisture, and supports the inner conductor. In the second type, usually called "air dielectric" the inner conductor is supported by a minimum of insulating material, the rest of the space being filled with dry air or gas. This is the kind which has the lowest losses at all frequencies.

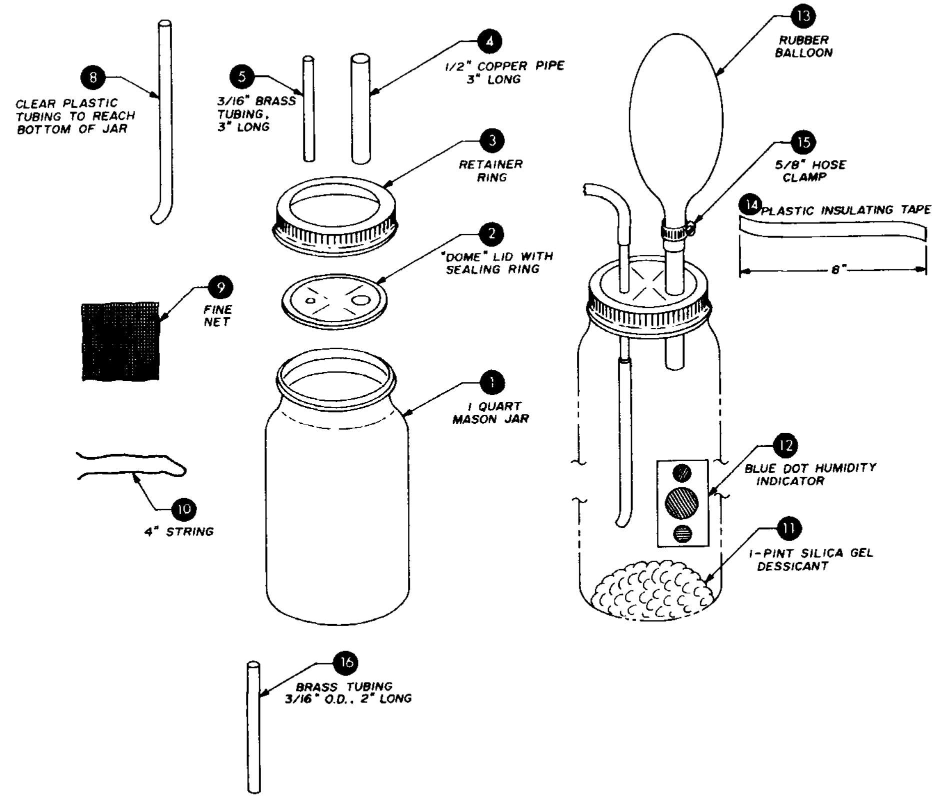
The big problem with air-dielectric cable is how to keep it dry inside. Commercial installations use tanks of dry nitrogen or other gas under pressure, air pumps equipped with dessicators, or mechanical dehumidifiers, and sometimes even include heaters for drying the dessicant. Most such installations cost between $100 and $1000; amateurs need a more simple and economical solution to the problem.

The cable I use at K4RJ (and formerly at W3GKP) is a 40-foot length of 1-5/8-inch Styroflex. The input to the cable is about 275 watts at 2304 MHz. The power is monitored with a directional coupler which gives a full-scale reflected-power reading (and automatic transmitter switch-off) at approximately 1.2:1 standing wave ratio. The loss in the line is about 2 watts per linear foot.

observations

Four years of operating produced the following observations:

1. If the cable is sealed at both ends while filled with ordinary air containing some moisture, the swr is excessive. If a tuner is inserted to lower the swr seen by the transmitter, the swr readings become unstable at full power. Each adjustment of the tuner to lower the swr results in another shift in impedance, the condition continuing for several hours, possibly without end. It seems that the power dissipated in the line is moving the moisture around from one place to another.



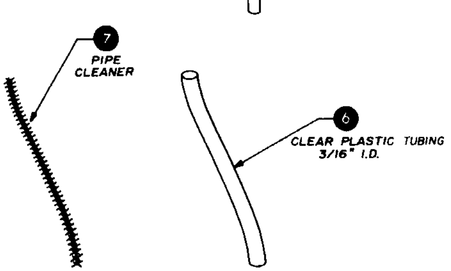


fig. 1. Construction details of the low-cost hard-line dehumidifier. See table 1 for complete list of parts.

2. Under the above conditions, increasing the line pressure by adding air (dry or ordinary) produces a rapid and substantial shift in swr.

3. If the cable is opened to the atmosphere at one end, initial swr readings will be unstable, but in about 30 minutes the readings stabilize. Apparently, the dissipated power has forced the moisture out of the cable. If the cable is left unsealed the whole job must be repeated the next day.

4. Opening the cable at both ends and flushing it with dry air (air from a small compressor pumped through a can of dessicant and into the cable) will result in stable readings. However, this air flushing takes longer than the rf flushing described in **3** above.

5. If one end of the cable is sealed, and the other end is attached by a short length of tubing to a closed can of dessicant, the cable can be flushed by rf in about 30 minutes, as in **3.** Thereafter, the swr will remain low for a week with no further operation of the transmitter.

objectives

The objectives for a home-made drying system would be to keep the line under a slight positive pressure (to insure there is no leakage from outside in), and should include a pressure indicator and an overpressure release. It should also include a drying agent and a humidity indicator.

Maintenance, if required, should be simple and easy. Periodic operation of any of the apparatus should not be needed. Furthermore, the drying system should be safe, and both initial cost and operating expense should be minimized.

My system meets these objectives. One end of the cable is sealed; the other end is connected by tubing to a container of dessicant. Normal changes in temperature cause the cable to "breathe" through the dessicant. Air "exhaled" by the cable passes into an ordinary balloon, which serves as a constant-pressure variable-volume indicator, and safety valve. The dessicant is held in a glass container, through which the humidity indicator can be seen clearly.

construction

All the parts for the dehumidifier are shown in **fig. 1** and described in **table 1.** First, punch, drill or ream two holes in the dome lid to pass the 3/16-inch brass tubing and 1/2-inch copper pipe with a snug fit. Tin the edges of the holes with solder, insert the two pieces of tubing, leaving about a third of the length on the lower side of the lid, and solder them in place. Be careful when soldering not to damage the rubber seal around the edge of the lid.

Now, attach the clear plastic tubing to the 3/16-inch brass tubing, and assemble the lid to the Mason jar with the retaining ring. Submerge the jar in water, and while holding your thumb over the open end of the copper pipe, blow into the free end of the plastic tubing and look for air bubbles. If it leaks, re-solder the joints. If it's airtight, separate all the parts and dry them thoroughly.

table 1. Parts list for the coax dehumidifier.

1.	1 quart Mason jar
2.	1 Dome lid for Mason jar
3.	1 retaining ring for holding Dome lid on jar
4.	½" copper pipe, 3" long
5.	3/16" OD brass tubing, 3" long
6.	3/16" ID (5/16" OD) clear plastic tubing, length to reach from dehumidifier to coaxial cable
7.	pipe cleaner
8.	3/16" ID (5/16" OD) clear plastic tubing, length to reach bottom of jar
9.	2" square nylon stocking material or fine net
10.	4" string
11.	1 pint silica gel dessicant
12.	Blue-Spot humidity indicator
13.	rubber balloon, size and color optional
14.	8" length plastic insulating tape
15.	5/8" stainless hose clamp
16.	3/16" OD brass tubing, 2" long

Wrap the fine net (an old nylon stocking works fine) over one end of the short section of clear plastic tubing (part 8 in **fig. 1**) and tie it in place with the piece of string. Push the other end of the plastic tubing over the lower end of the 3/16-inch brass tubing which is soldered to the jar lid.

If the silica gel has been exposed to the air, dry it according to the instructions on the container (or spread it on a flat pan and bake it in an oven at 250° F for five hours). When the dessicant is completely dry, place the Blue-Spot humidity indicator inside the Mason jar so the spots are visible from the outside and pour the silica gel into the jar. Reassemble the lid and retainer ring on the jar and work the plastic tubing down through the silica gel until it's near the bottom of the jar.

Place the rubber balloon over the top of the 1/2-inch copper tubing, wrap it tightly with the plastic insulating tape, and secure it with the 5/8-inch hose clamp. Slip one end of the long section of plastic tubing (part 6, **fig. 1**) over the end of the 3/16-inch brass tubing. Place the pipe cleaner (a secondary dirt filter) in the free end of the plastic tubing.

Arrange the air fitting on the coaxial line to receive the free end of the plastic tubing. If necessary, drill or ream the air fitting to accept a 2-inch length of 3/16-inch brass tubing (part 16) and solder the tubing to the coaxial line. The plastic tubing can be attached to this brass tubing.

Now, blow into the free end of the plastic tubing until the rubber balloon is suitably inflated. Quickly push the free end of the plastic tubing over the brass tubing soldered to the coax line. This completes the dehumidifier system.

Obviously, there is nothing magic about the dimensions I used, but a few remarks may be in order. The flexible plastic tubing should be a snug push fit on the brass tubing so that clamps are not needed. The shorter the length of the tubing to the coaxial line, the better the system will work.

If the balloon is a snug fit on the copper tubing, it may be held tight enough just by the tape. In one case I found the balloon fit only loosely, so the hose clamp had to be used.

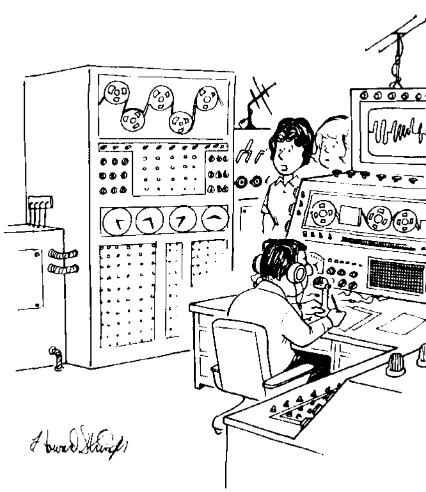
If the system is inflated by lung power, condensed moisture from the breath may be seen inside the plastic tubing, especially in cold weather. However, this will dissipate in a few days. It can be avoided by using a tire pump or football pump to pressurize the system. Initial drying of the air can be accelerated by running the line at full power for an hour or so.

Don't expect the size of the balloon to change dramatically unless you have a long, fat coaxial line. The actual change will depend on the temperature variations. Black-jacketed line exposed to the sun will heat up much more than line buried in the earth.

On a recent trip I described this system to several amateurs and one asked, "What happens when the balloon breaks?" I thought this was a joke until I returned home and found the balloon split and deflated (it was an old one). This is not a crisis because the cable continues to breathe through the dessicant, which traps any moisture which might otherwise enter. My system sat "open" like this for four days without any noticeable change in the dryness of the dessicant or the swr of the cable.

Now that we have gotten rid of that RG-8 – what about the PL-259?

ham radio



"It started out as a simple listening post. But that's how Arnold is. . . When he gets involved in something, he goes all out."