PUTTING HEAT BACK IN ITS PLACE

by Steve Knight

(This article about using heat rope to control the dew that might otherwise collect on your mirrors, lenses and eyepieces during observing first appeared in the March, April and May, 2003 issues of The FRAC Observer.)

If the title of this article sounds familiar, it should: it's taken from my earlier article, "Putting Heat In Its Place" *(The Observer,* Feb.-Apr. 2002), that discussed getting rid of heat in the primary mirror.

Hey, I never said that heat is *bad.* When properly applied, heat can defeat one of our worst enemies, **dew.** We already use heat for that purpose in the form of hair dryers – drying off finders, eyepieces, secondary mirrors, corrector plates and anything else that suffers from the effects of dew. Dew shields help, too, but dew forms as much as it falls, and it will form on anything that has a cooler temperature than the air around it. Dew can dramatically shorten an observing session, especially when the temperature drops below freezing. At the November Cox Field observing, even the *inside* of my tube had a layer of ice on it.

When used properly, heat keeps the moisture away. You need only a few degrees of heat to keep things high and dry. There are several commercially available systems that will do the trick, but they're pricey and you can't turn individual heaters on and off for the finderscope, secondary mirror and focuser at will. Rather, you have to unplug them at the controller to turn them off to save power, or else you're unnecessarily heating things that don't need it. (If only the finder is affected, why heat the secondary or focuser?) Even though they draw minimal current, your batteries will last longer by using individual controls, and you won't have heat on the optics until necessary. After seeing a Kendrick system in action, I decided I had to have one, but the $200 price tag was 'way too high for me. You can, for a fraction of that figure, build a system that will permit you to observe until you're ready to leave, not when the dew chases you away.

I did a lot of walking and looking around at the Chiefland Star Party last November, and I eventually found just what I was looking for: a little thing called **Heat Rope.** Heat rope is used in commercial products that heat water, such as coffee makers. When used with 110v, you can boil water in

seconds, but with 12v it produces just enough gentle heat to keep dew away, drawing very little current in the process.

If you can do any basic wiring at all, I can lead you through the process and show you how to use heat rope to make your own dew-zapping system for less than a third of what a commercial system costs – and you can customize your system to fit your needs, too. I installed individual switches to turn each heater on and off independently from the others – but if you don't want to do that you can save even more money. I'll give you the mathematical formulas to get amps of draw and wattages from the length of heat rope you're using. The switch box uses simple DC wiring, and the heaters themselves are easy to install.

The Parts. The basic rundown of parts for the control box includes: 1 medium project enclosure; 4 small 12v, 3-amp. On/Off switches; 1 roll of 18-gauge solid core wire; four 12v red LEDs; one 10k-ohm volume control with knob; 1 tube of fine silver solder; and 5 female RCA jacks. All of the parts are available from Radio Shack and cost under $50 altogether.

The Jacks and Switches. I used the jacks to supply power to the box, the Telrad, the secondary mirror/focuser, the fan heater and the fan power. I used the switches to: turn on the box with one switch; power the Telrad heater; power the secondary/focuser from the volume control; turn on the fan heater; and turn on the fans. I have fan speed and fan heater control, but if you don't have fans they aren't necessary.

Directions. Install the switches in the box, spacing them evenly apart, and install the RCA jacks directly opposite the switches. Use a common bar across the grounds of the jacks with the solid wire stripped of its insulation. Run power to the master switch, and from there run it directly to the Telrad heater, the fan heater, the fans, and to the positive post on the volume control. The center post of the volume control goes to the secondary/focuser, and the last post of the volume control gets a ground wire. Run the wire from the center post to the focuser/secondary switch, and from the output of the switch run a wire to the center of the appropriate RCA jack.

Run wires from the other switches to the proper jacks, and don't forget to attach the power and grounds to your LEDs. They will indicate when each heater is turned on, and they also dim with the heat control indicating how much power is on.

And that's all there is to it. It's really easier than it sounds, just take your time and it will all fall into place.

Next month's installment will cover figuring out how much heat rope you need, and how to install it.

Part Two

Now that you have your control box planned, it's time for the telescope aspect of the project of building yourself a dew zapper.

First, you need to decide just what you want to apply heat to. The first and most obvious location is the Telrad and/or finderscope, hung out in the wind and usually sitting right on top of the tube. When you can't point the telescope with any precision, it may as well be cloudy outside. You can wipe the dew away, but besides being very aggravating it returns quickly.

Next, your eyepieces start to cloud over. You can wipe them off, but the dew comes right back.

The secondary mirror is last – but you can't wipe it off without risk to the coatings – and you can't tell when the secondary dews over, either: the image just dims until you wonder what's wrong.

Once you decide what you want to heat, some planning is necessary. The front lens of the finderscope is really all that needs to be heated since the rear is angled down and usually shielded. On Telrads, when you heat the glass both sides stay clear. The lens sometimes needs help, too, and running the rope along the sides of the lens will keep things nice and clear.

On the focuser, a length around the top of the drawtube will work fine.

Where you mount the rope will determine its length. For instance, the length needed for a Telrad is almost exactly 12" the way I routed mine. I went inside the case, around the lens and all the way around the glass. Twelve inches works out to 73 ohms, 2.0 watts and draws .16 of an amp. That may not sound like much, but all that's needed is a few degrees of difference in heat to keep things high and dry. I made a complete list of the figures needed to effectively place your heat rope with the proper length necessary to do the job. I even did the math for you. All you have to do is measure the area you want to warm up. (Key: **L**=length of heat rope in inches, not including the wire ends; **O**=ohms of resistance; **W**=watts or amount of heat; and **A**=amps of draw on your battery.)

L	**O**	**W**	**A**
3	20	7.2	.6

6	37	3.9	.32
9	54	2.7	.22
L	**O**	**W**	**A**
12	73	2.0	.16
15	93	1.55	.13
16	100	1.44	.12
19	110	1.31	.11
22	137	1.1	.088
25	149	.97	.081
27	162	.9	.074

Nine to 12 inches is a good all-around length for most telescopes; it fits in most places and provides plenty of gentle heat without draining your battery – and you can do your Telrad, focuser and secondary mirror with only one piece of heat rope. At $2.00 for 27" of heat rope from American Scientific and Surplus, it's a steal.

If you want to put 12" of heat rope in an area that won't accommodate that length, you can put in a 50-ohm resistor in line on a 3" section and wind up with the same as a 12" section as far as wattage is concerned. If you have a one-inch secondary, you're covered.

(Next installment: Armed with all this knowledge, we'll assemble this collection of parts into a living, breathing dew zapper.)

Part Three

Before I get started, I need to backtrack a bit.

Awhile back, I was observing with Doug Maxwell at Cox Field. I had just gotten my telescope set up and the fans turned on to cool things down. I was getting the rest of my gear out when the fans shut off. The variable potentiometer had burned itself out. Was it faulty, or did I overload it? I don't know, but if you were planning to build a control box like mine it may be better for you to put a switch on there and avoid the problem.

Now that you have the control method worked out and you've decided what to heat, I'll tell you how I mounted the system on my telescope and put it to work. I like for my installations to be nice and clean, with as few exterior wires as possible and them out of the way, and functional. And I want to be able to get to everything easily in case anything goes wrong.

Incidentally, I made one mistake that you can avoid: I mounted the control box in the wrong place, and as a result the red LEDs shone right in my eyes when I used the Telrad. A few dabs of nail polish fixed it, though.

Moving on, I fashioned a strip of scrap metal into a holder for the female ends of the RCA jacks that I mounted on the inside of the tube, with the male ends going through the tube for a connection. With the box removed, the connectors are flush and out of the way. Use short sheet metal screws to attach it to the tube.

For the power supply, I used a similar version of the above at the pivot point of the tube, with just one connector to the battery that hangs on the front of the tube. (I'm presently working on a better system, since sometimes the tube becomes unbalanced.)

The secondary was the hardest part as far as getting power supplied to the heater was concerned: you can't just run wires out from the tube since the vanes are already in the way, and the last thing you want to do is make them thicker. What I wound up doing was putting a layer of liquid electrical tape on one of the spider vanes and running two strips of copper tape, cut to size, on top of the tape. The liquid electrical tape is available at Home Depot (and actually says that on the jar), and the tape is available at music supply stores as insulating tape. It goes in electric guitars to help with sound at the controls.

I then soldered the leads to the ends of the tape at each end, with a female RCA jack drilled and installed in the arm of the spider next to the center. It's hidden there by the secondary mirror.

I then removed the secondary mirror from its holder and placed the proper length of heat rope on the backside of the mirror without the insulation so it would be in direct contact with the mirror, securing it with black silicone. I drilled a hole in the top of the holder and ran the wire through to the rope inside, put the wadding back on the mirror, and reinstalled it in the secondary. I then wrapped the correct amount of heat rope inside the focuser drawtube, leaving the insulation on since it is a metal focuser, and secured it with silicone. I used a length of test lead wire to get the power to the rope, since the focuser moves a lot and test lead is very flexible. I mounted it at the bottom of the focuser so the aluminum would wick the heat up to the eyepiece.

It works like a champ.

The last step was to run the wires inside the tube. I put the VCR wire in the tube and made the proper connections at each end. Holding the ends with masking tape, I glued the wire down with silicone and allowed it to dry.

While it was drying, I reinstalled the secondary and primary mirrors and flipped the sytem ON for a dry run. At first I was disappointed, but after I got my thermometer I found that everything was about ten degrees warmer than the ambient temperature. Since all you need is 2-5 degrees difference in temperature, I was doing great.

The system has been out in varying degrees of dew, including Chiefland, and has passed the test with flying colors. Not a drop of dew has bothered me so far: even dewed-over eyepieces dry out quickly when placed in the focuser. It works so well that I'm considering building an eyepiece box with the dew zapper in place to keep things dry.

I love it when a plan comes together, and actually works.

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