<u>PUTTING HEAT IN ITS PLACE</u>

By Steve Knight

(This article about installing a fan to cool the primary mirror on your telescope first appeared in the Feb., March and April, 2002, issues of The FRAC Observer.)

Part One

Most problems with telescopes can be overcome with proper maintenance or equipment modifications. One problem that hasn't been addressed until recently is that of cool-down time.

Unless you leave your telescope outside, you have to deal with tube currents on a regular basis. Even then, though, the air will continue to cool faster than your mirror, giving some degradation in low- to medium power views and possibly even ruining high power images. All this is due to the presence of a large cylinder of glass or Pyrex – the primary mirror – at the bottom of the telescopic tube in a reflecting telescope.

The primary mirror emits heat collected from the Sun (or the heat inside your house), and the dispersion of that heat creates an effect similar to looking across a parking lot on a hot summer day. The shimmering air is simply a boundary layer of heat rising from the pavement to the cooler air directly above it.

Where heat is concerned a primary mirror is, like pavement, a reflective surface. Ten feet above the parking lot, the shimmery, dancing air disappears. One inch above the surface of the mirror in the tube, heat is no longer a factor but the damage has already been done. The starlight we work with must pass through that heat *twice* -- once in getting to the primary mirror, and again on its way back to the secondary mirror and eyepiece.

Various methods exist for cooling mirrors down, but most of them do not actually address the problem; instead, they simply speed up the natural cooling of the mirror.

Probably the most popular cool-down technique (aside from simply waiting 30-45 minutes for the mirror to cool down to match the ambient temperature outside) involves the use of fans blowing on the back of the mirror; while this technique works, it takes time to cool the mirror in such a manner. What if there were a faster way to achieve the desired result without worrying about the actual mirror temperature?

Rather than cooling the mirror, a better method might involve getting rid of the boundary layer of heat. But how do you get rid of something you can't see, much less reach?

The solution is simpler than you might think.

By using basic computer fans to blow air across the mirror's surface, and exhaust holes on the other side of the tube to let the heat out, you can cure the problem instead of addressing the cause. The heat will come out of the mirror regardless of what you do; why not just let it come out rather than cool down the mirror? With proper placement of the fans and exhaust holes, the breeze will scrub the heat layer off the mirror and carry it away before it can do any damage to the image in the eyepiece.

The parts and labor necessary in order to install such a cooling system are as follows (sizes may vary with the size of your 'scope):

(1) two ball bearing, 43 cfm, 12v computer fans;
(2) one cigarette lighter plug with 6' lead;
(3) drilling seven 1.5" exhaust holes on the top of the tube and two 3.625" holes on the bottom for the fans at five and seven o'clock blowing in an **X** pattern across the mirror; and
(4) one 12v battery for power.

I already had a battery pack (from Target for $40) to power my table light. The rest of the materials cost about $30 and took less than an afternoon to install.

Part Two

Last month we looked at the hows and whys of thermal management in Newtonian telescopes. This month we'll describe the installation process I used for my 14" Dob. (While the basic process will be the same for your telescope, there may be small differences.)

The first things you have to decide are, (a) How much airflow do you need?; (b) How do you want to mount the fans?; (c) Do you need to make exhaust holes?; and (d) Will it affect balance and performance?

After deciding how much airflow I wanted, it was time to find some fans. It turned out that CompUSA had exactly what I was looking for in two 43cfm ball bearing 12v fans and a thick mouse pad for insulation from vibration. The total cost of those items was under $25.

A trip to Radio Shack provided a cigarette lighter plug for $10 and Home Depot had the $12 hole saw for the exhaust holes.

From there it was time to do the unthinkable, i.e., start drilling holes in my telescope tube. I put the fans slightly above the primary mirror, with the exhaust holes even with the mirror. This was where the old adage, "Measure twice, cut once," came into play. The last thing I wanted to do was find out I put the holes in the wrong place. Sonotube is hard to come by.

Using an air-powered sawzall, I made two 3-5/8" holes at the five and seven o'clock position (with the top of the tube being twelve o'clock). This was to make the holes the same size as the fan blades. Then I made seven 1-1/2" holes along the top of the tube to allow the air to escape the tube. *(Note: Remove the primary mirror before you drill the holes, and don't leave it close to where you're working or you'll get dust and shavings from the sonotube on it. [Incidentally, you may as well clean your mirror while you have it out of the tube.])*

I attached the fans to the mouse pad with weather stripping adhesive, and used Velcro to attach the fans to the tube. From there I cut the blue wire off the fans, wired the fans in parallel to the cigarette plug, and routed the wires to the altitude bearing of the tube, allowing the wires to pivot with the tube. I considered wiring in a speed control, but since no vibration has been noted even at 640x I may not bother with it. I made a hanger out of wire to hang the battery on the base, and so far the battery runs for hours on a single charge.

The system is light enough that the balance was not affected, and stays out of the way so that it can stay on full time.

To determine what size fan is right for you, go to http://www.sky&telescope.com/resources/software/cool.html and download the simple program that gives a simple graph for deciding what size fan you'll need. The small file takes only a few minutes to download.

If you need any help installing a cooling fan on your telescope, I'll be happy to help you in any way I can (except paying for the parts).

Part Three

After three months of testing – timing cool-down time with and without fans – I have to say that the positive results far outweigh the doubts I might have had initially about drilling ventilation holes in my tube. Being able to split close double stars, see planetary detail and pick out faint galaxies just a few minutes after setup has been fun. No more waiting for the ‘scope to cool down, no more wondering if it’s poor seeing conditions or heat in the tube that’s causing you to miss faint galaxies. Knowing that the difference lies in turning on the fans is very satisfying and rewarding – and knowing that I designed the system and put it to work is even better.

Cool-down times went from upwards of an hour to less than five minutes. Even when the mirror is warm to the touch, the images are clear and unwavering. I thought my ‘scope cooled quickly beforehand, but those former cool-down times seem like an eternity compared with today. I probably gain 2-3 magnitudes during those brief cool-down periods, and the system helps all night long as the ambient temperature cools faster than the primary mirror does.

The fans helped get me off to a flying start in my Messier Marathon at Chiefland last month, since the first objects I went after were galaxies, low in the western sky and two of them face-ons in the twilight. In my estimation, this is the best modification that can be done to visually enhance observing, short of increasing aperture. That’s always nice, too.

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